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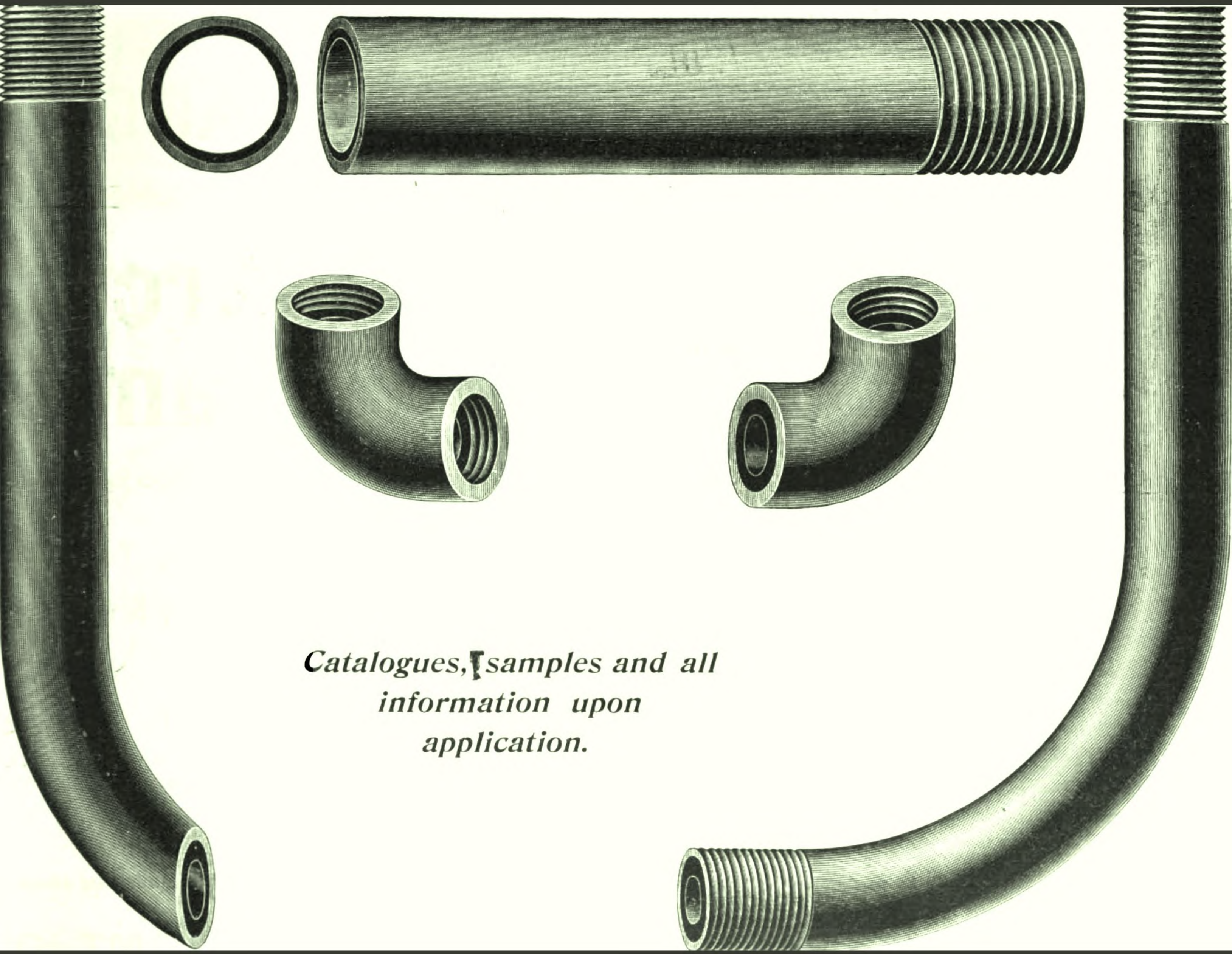

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VOLUME XXIII.—1897.

(January to June.)

NEW YORK:
The Electrical Engineer
120 Liberty Street.

Alphabetical Index of Contents.

An asterisk (*) denotes Illustrations.

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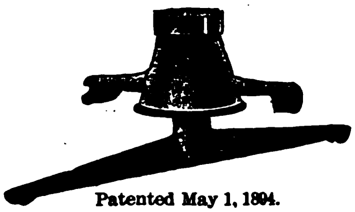

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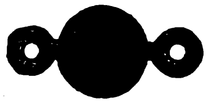

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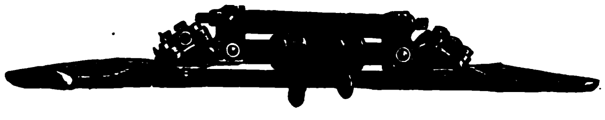

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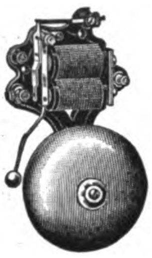

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Westinghouse Elec. & Mfg. Co.

Electrical Specialties.
Electric Appliance Co.

Elevators.
Armitage-Herschell Co.
Link Belt Engineering Co.
Sprague Elec. Elevator Co.

Engineers.
Sargent & Lundy.

Engines, Gas.
Climax Gas Engine Co.
Otto Gas Engine Wks.

Engines, Steam.
American Engine Co.
Armington & Sims Eng. Co.
Ball Engine Co., The.
J. A. Grant & Co.
Kensington Engine Works.
McIntosh, Seymour & Co.
Pierce & Miller Eng. Co.
Racine Hardware Co.
Southwark F'dy & Mach. Co.
Westinghouse, Church, Kerr & Co.
Westinghouse Mach. Co.

Feed Water Heaters.
Goubert Mfg. Co.
Warren Webster & Co.

Fire Alarm Apparatus.
The Universal Fire Alarm Co.

Fixtures.
Petereit-Wehrle Mfg. Co.
White Co., O. C.

Fuse Wire.
Chicago Fuse Wire & Mfg. Co.

Hard Rubber.
Goodyear Vulcanite Co.
Butler Hard Rubber Co.

Induction Coils.
International Elec. Co.
Varley Duplex Magnet Co.

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American Mica Co.
A. & J. M. Anderson.
Empire China Works.
H. L. China Co.
Hemingray Glass Co.
H. W. Johns Mfg. Co,
F. M. Locke.
Peru Elec. Mfg. Co.
A. O. Schoonmaker.
Standard Paint Co.
Stand. Undergr'd Cable Co.

Insurance.
Liverpool & L & G. Ins. Co.

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Berlin Iron Bridge Co.

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John Wennstrom Co.

Kinetoscopes.
Riley Bros.

Lamps.
Beacon Lamp Co.
Bernstein Elec. Co.
Bogue, Chas. J.
Bryan Marsh Co.
Columbia Incan. Damp Co.
Buckeye Electric Co.
Edison Decorative & Miniature Lamp Dept.
Electric Appliance Co.
Electric Arc Light Co.
Excelsior Elec. Co.
Ft. Wayne El. Corp.
General Elec. Co.
Ideal Elec. Corp.
Imperial Electric Co.
Lynn Incan. Lamp Works.
Manhattan General Const. Co.
Orient Elec. Co.
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Sawyer-Man Electric Co.
A. H. Ryder & Co.
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American Mica Co.
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N. Y. Stencil Works.
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E. H. Kellogg & Co.

Ozokerite.
Am. Wax & Paper Mfg Co,

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Peerless Rubber Mfg. Co.

Paint.
Carbolineum Wood Preserving Co.
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H. W. Johns Mfg. Co.
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Heber Wells.

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Piping.
Michigan Pipe Co

Platinum.
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Baillard, E. V.
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Edison Mfg. Co.
G. A. Frei & Co.
Emil Grenier.
Pearson Mfg. Co., F. J.

Roentgen Tubes.
Edison Dec. & Min. Lamp Dept.
G. A. Frei & Co.
Standard Elec. Lamp & Novelty Co.

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New York Stencil Works.
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A. & J. M. Anderson.
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Partrick & Carter Co.
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Switches
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Auto. Circuit Breaker Co.
H. P. Ball Mfg. Co.
Cutter Elecl. & Mfg. Co.
Elec. Eng'g & Supply Co.
General Elec. Co.
Hart & Hegeman. Mfg.
W. S. Hill Elec. Co.
Perkins Elec. Switch Mfg. Co.
Pettingell Andrews Co.
C. S. Van Nuis.
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Zimdars & Hunt.

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J. H. Bunnell & Co.
The E. S. Greeley & Co.

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Am. Elec. Teleph. Co.
E. V. Baillard.
De Veau & Co.
Farr Telph. & Const. Sup. Co.
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Terminal Boxes,
Bossert Elec. Const. Co.

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General Elec. Co.
Stanley Elec. Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

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Chapman Valve Mfg. Co.
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Water Motors.
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Water Wheels.
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Wires and Cables.
American Electrical Works.
W. R. Brixey.
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Crefeld Elecl. Works.
Eastern Elec. Cable Co.
Electric Appliance Co.
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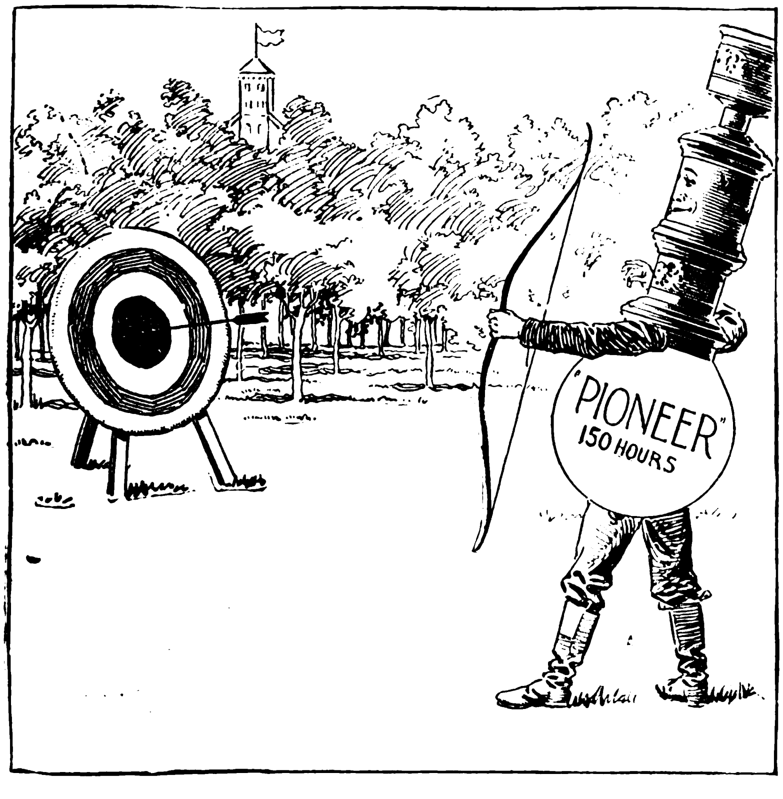
General Elec. Co.
India Rubber and Gutta Percha Ins. Co.
Nat'l India Rubber Co.
N. Y. Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Elecl. Co,
Stand. Underg'd Cable Co.
Washburn & Moen Mfg. Co.

Zinc.
Beattie Zinc Wks. Co.
J. H. Bunnell & Co.
E S. Greeley & Co.



The "Pioneer" Has Hit Perfection.

❧

The best light.

Softest, steadiest and whitest.

The mechanism simplest.

The operation safest and most economical.

PIONEERS IN ENCLOSED ARC LIGHTING
THE PIONEER
TRADE MARK

THE ELECTRIC ARC LIGHT CO.

LOUIS B. MARKS, M.M.E.
CHIEF ELECTRICIAN.

687 & 689 Broadway,
NEW YORK.

150 HOURS

FOR 30 DAYS. INCANDESCENT LAMPS. 10% DISCOUNT.

WHY ENCOURAGE TRUSTS when you can procure from us lamps made from the highest grade stock—**CELLULOSE FILAMENT, HYDRO-CARBON JOINTS**—with **PERFECT VACUUM,** for 10 per cent. less. Our mode of pumping, together with specially prepared sealed joints, enables us to guarantee lamps not to blacken, and to show the best maintenance of candle power and life.

HIGH, MEDIUM OR LOW EFFICIENCY. We guarantee efficiency to be as ordered, and for one month will send with each barrel order our **CURRENT TESTING APPARATUS** free of charge, which will accurately show the consumption of current on any make incandescent lamp (we are glad to show the economy of ours), and solicit a trial order.

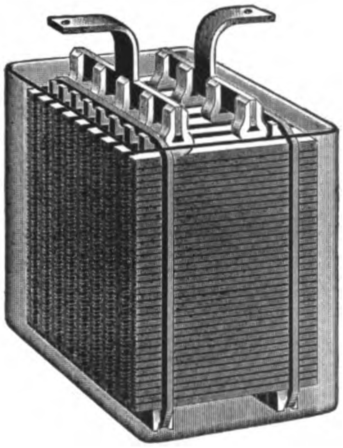
LAMP TESTING APPARATUS, with which 300 lamps can be measured in one hour on direct or alternating current, any voltage, for $1.50, cash with order.

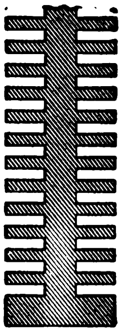
JAS. C. WORMLEY & CO., Marquette Building, Chicago, Ill

..NOTICE..

WE wish to notify the public that the claims and statements made by **THE ELECTRIC STORAGE BATTERY CO.**, of Philadelphia, that our plate infringes their patents, are **UTTERLY FALSE**, and cannot be substantiated.

The "**AMERICAN**" plate is made from a solid sheet of rolled lead, one half inch thick, grooved on both sides as shown in cut. These grooves are 1-16 inch wide, and the projecting ribs are 1-16 inch thick. This is a style of plate which **BRUSH**, in patent No. 266,090, partially described in claim No. 12, and which was afterward disclaimed by the patentee for want of patentable novelty.





The "active material" or peroxide of lead is formed electro-chemically by immersing the plate in a strongly oxidizing solution which attacks the surface of the plate and completely fills the grooves with strongly adherent peroxide of lead.

NO RED LEAD, PASTE OR OTHER MATERIAL IS APPLIED TO THE PLATE. We therefore do not infringe their patent No. 337,299.

The "**CHLORIDE**" plate of the **ELECTRIC STORAGE BATTERY CO.** is about ¼ inch thick and has for its active material pellets of peroxide of lead formed from chloride of zinc and lead. These pellets are about ¾ inch in diameter, and form about one-half the surface of the plate. In the manufacture of the latter, the pellets are arranged in a mould and a lead antimony alloy is poured around their edges.

While a plate constructed on this plan would show considerable capacity per pound weight of cell, it has no durability, as shown by the fact that the pellets disintegrate, the hard grid breaks, and the plate becomes useless after less than a year's service. After trying the "Chloride" cells for a year, the

PULLMAN'S PALACE CAR COMPANY

could not be **COERCED** into buying any more worthless material, and notwithstanding threatened injunction suits, has just placed an order with us amounting to **SEVERAL THOUSANDS OF DOLLARS.** They could not be frightened by empty threats.

Here are the names of a few of our customers most of whom have tried "Chloride" cells:

PULLMAN'S PALACE CAR CO.
PENNSYLVANIA R. R.
WESTERN UNION TELEGRAPH CO.
CHICAGO & NORTHWESTERN R. R.
CHICAGO & NORTHERN PACIFIC R. R.
CHICAGO TELEPHONE CO.
C. B. & Q. R. R.
METROPOLITAN ELEVATED.
CENTRAL UNION TELEPHONE CO.

The "**AMERICAN**" plate, as described above, has been on the market since Nov. 1st, 1895. **CELLS** constructed with these plates are in service all over the country and are giving entire satisfaction.

Not a single complaint has been received.

THE AMERICAN BATTERY COMPANY will furnish, FREE OF CHARGE, any renewals or repairs required for ANY "American" Cells sold since November 1st, 1895, where such are necessary because of deterioration of plates in service. This offer will hold good until February 1st, 1897.

The Electric Storage Battery Company **DARE** not make a similar offer.

In a short time we shall be prepared to construct and install central station batteries of the largest sizes, which will fully meet all requirements. Central Station Managers and intending purchasers of storage cells in general are requested to communicate with us before closing contracts elsewhere.

ESTABLISHED, 1889.
HIGHEST AWARD WORLD'S FAIR,
CHICAGO, 1893.

AMERICAN BATTERY COMPANY,

40 W. Quincy Street, CHICAGO, ILL.

Absolute Protection Guaranteed to Purchasers.

TRADE MARK:

"Chloride Accumulator"

REGISTERED SEPTEMBER 11, 1894.

Information, Caution and Notice!

The Courts of last resort in patent causes have repeatedly and recently sustained **BRUSH PATENTS FOR STORAGE BATTERIES,** Nos. 266,090 and 337,299, dated October 17th, 1882, and March 2d, 1886, covering broadly every practical type of storage battery plate, including not only pasted plates, but also the so-called Plante plates, in the words of **Judge Shipman** (52d Fed. 130): **"A secondary battery plate ribbed, honey-combed, studded or equivalently prepared—in which the Plante process of electrical disintegration or some kindred process of forming was used."**

In the interest of the development of the storage battery business, these fundamental or basic patents have been acquired at great expense by **THE ELECTRIC STORAGE BATTERY COMPANY,** and users, vendors and makers of storage batteries and storage battery plates are cautioned against their infringement.

To guard users, vendors and purchasers against inadvertent and unadvised infringement, notice is hereby given that the types of batteries and plates advertised by the following:

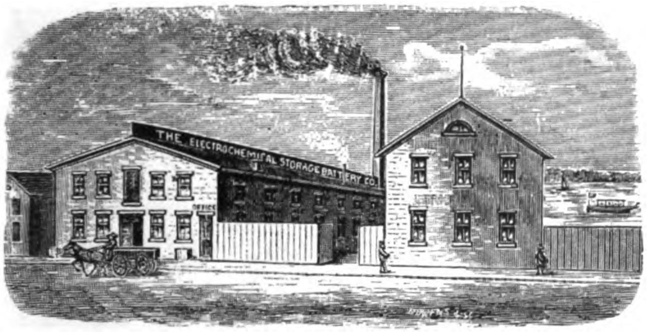
The Electro-Chemical Storage Battery Company,
The Willard Electric & Battery Company,
The Ohio Storage Battery Company,
Norwalk Electric & Battery Company,
The Warwick Electric Manufacturing Company,
Electric Novelty Works,
Momence Electric Ball Storage Battery Company,
Silvey Storage Battery Company (Dayton Manufacturing Company),
The Haschke Storage Battery Company,
Woodward Electrical Company,
Devere Electric Company,
D. J. Hauss,
Eclipse Electric Company,
American Battery Company,
Samuels Dynamic Accumulator Company,
National Electric Car Lighting Company,
New York Accumulator and Electric Company,

are considered flagrant infringements; and further, that vendors, purchasers and users thereof will be prosecuted by injunction and otherwise according to law.

The Electric Storage Battery Company,

Drexel Building, Philadelphia, Pa.

BRANCH OFFICES:
66 Broadway, New York.
92 State St., Boston, Mass.
222 Market St., San Francisco, Cal.
1543 Marquette Bldg., Chicago, Ill.
215 North Calvert St., Baltimore, Md.


THE ELECTROCHEMICAL STORAGE BATTERY CO.

WORKS: BELLEVILLE, N. J.

NON-INFRINGING.

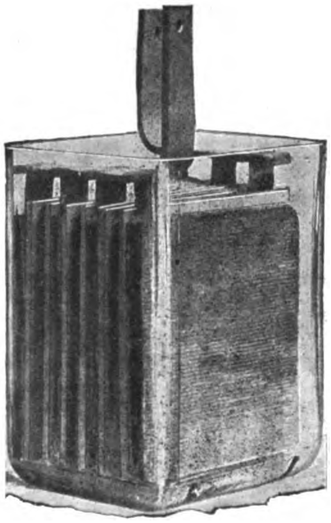
Protection Guaranteed to all Purchasers.

STORAGE BATTERIES FOR

Central Station Lighting,
Trolley Regulation, Telephone,
Telegraph, House Lighting.

SPECIAL STORAGE BATTERIES FOR

Horseless Carriages,
Advertising and Delivery Vans.
Lightest Weight, Highest Efficiency.



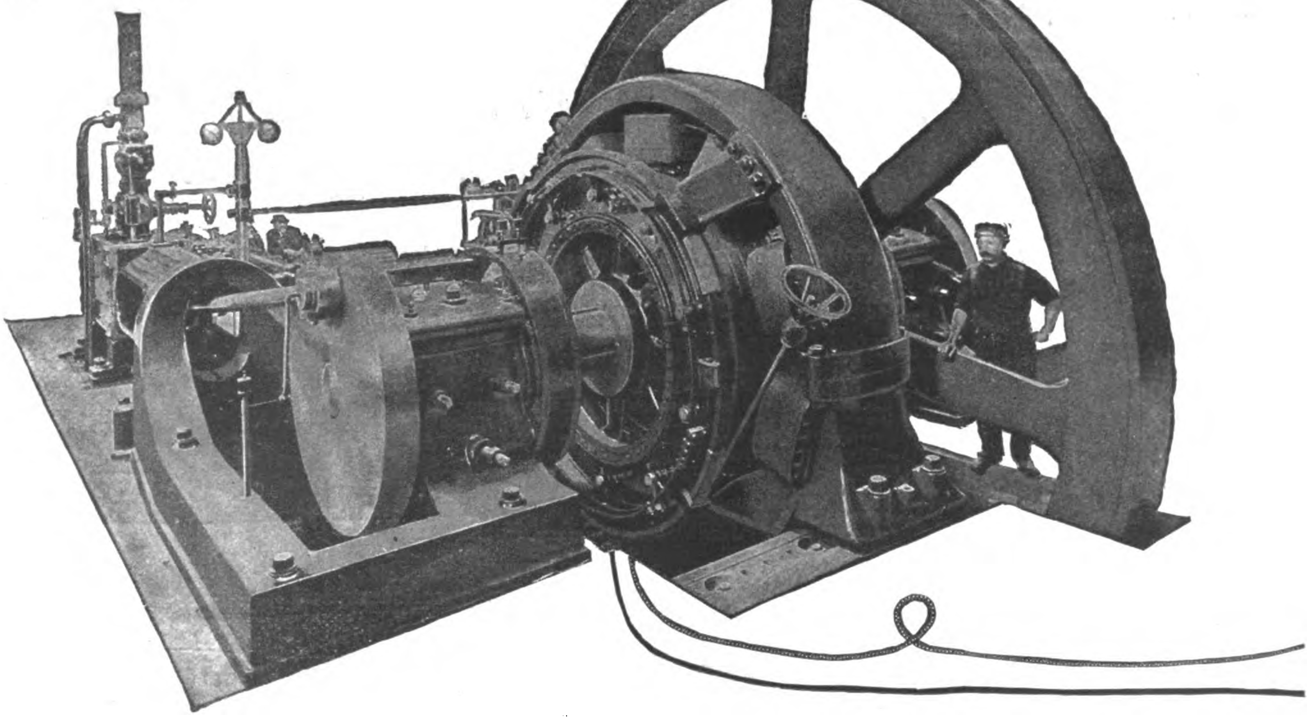
MAIN OFFICES: JOHNSON BLDG

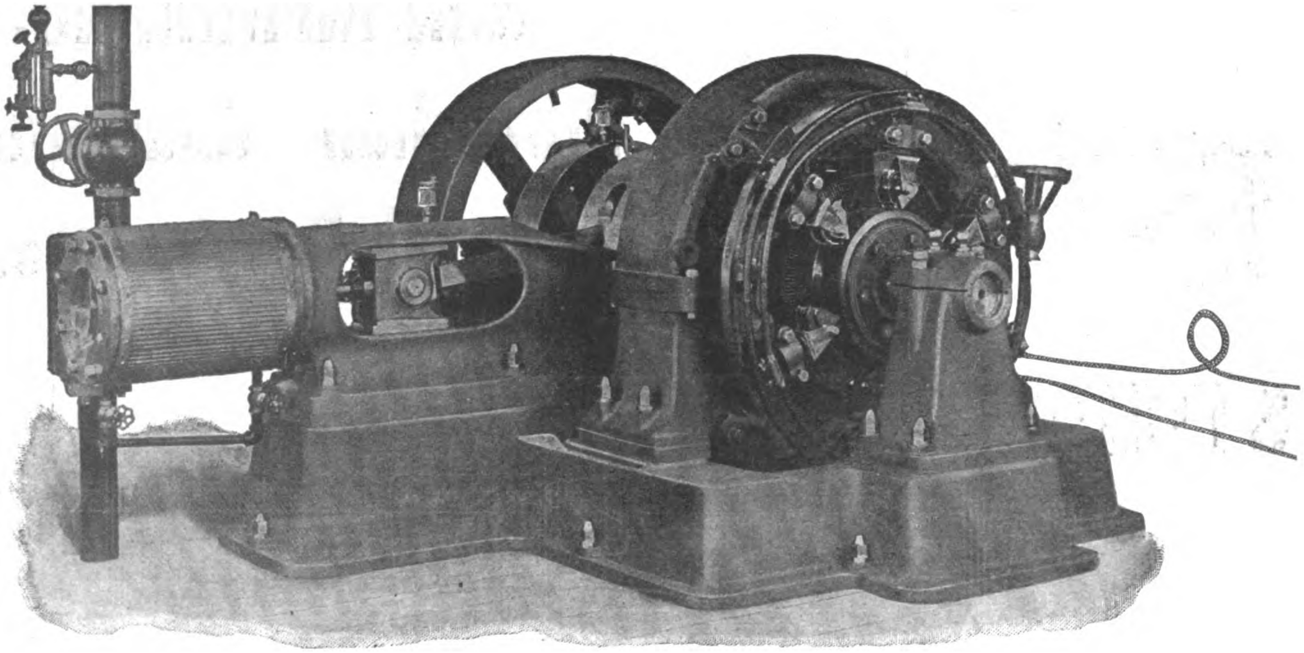
THE ELECTRO-CHEMICAL STORAGE BATTERY CO.,

30-36 BROAD ST. NEW YORK.

At CLEVELAND, OHIO,

and NEW HAVEN, CONN.

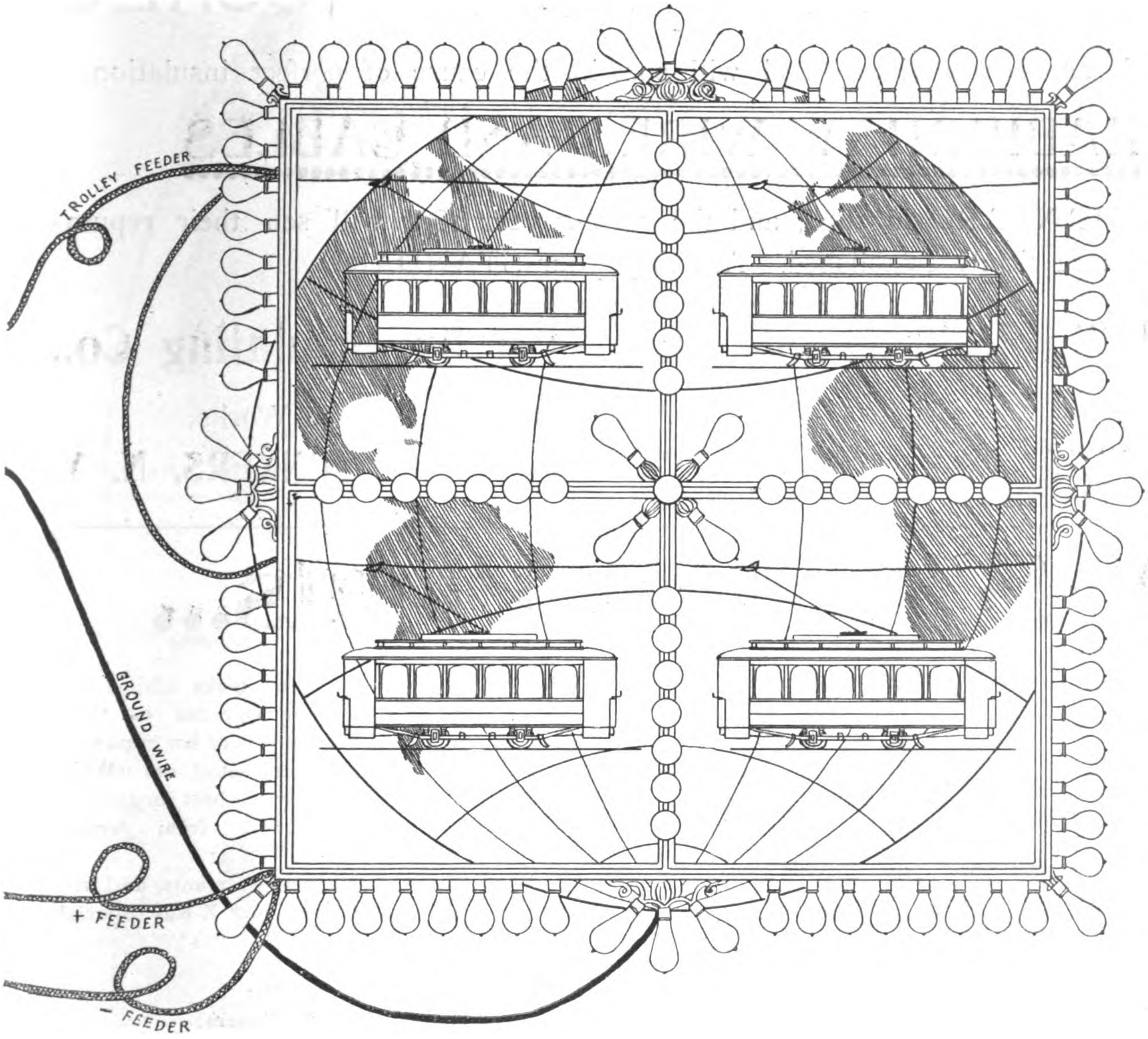




The Walker Company,

Manufactures Dynamos, Motors and Appliances which are sold and used

ALL OVER



THE WORLD.

A PLATFORM FOR 1897.

Plank No. 1, To Maintain Quality.
Plank No. 2, To Maintain Quality.
Plank No. 3, To Maintain Quality.

Our Cardinal Red
Our Imperial White } **CORES**
Our Royal Blue

will march as ever to victory and will sustain the cause of perfect insulation.

HABIRSHAW WIRES AND CABLES

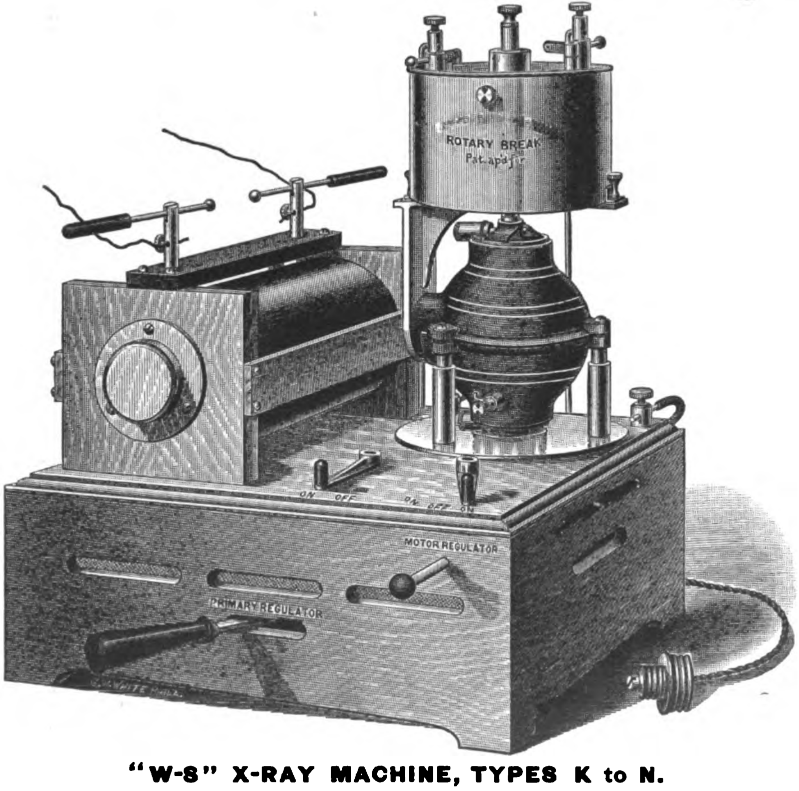
were the STANDARD in 1896, and the current year 1897 will see their reputation even more firmly established. Are they your STANDARD?

The India Rubber and Gutta Percha Insulating Co.,

Main Office, Glenwood Works,
YONKERS, N. Y.

J. W. GODFREY, Manager Sales,
15 Cortlandt St., NEW YORK.

"W-S" X-Ray Plants...



"W-S" X-RAY MACHINE, TYPES K to N.

It don't cost much to make claims—*extravagant* claims—anybody can do that! We want intending buyers of *best* apparatus to *thoroughly examine* in every detail, our ***"W-S" X-Ray Plants,*** endorsed by the best surgeons in Philadelphia and elsewhere, from *personal knowledge.*

As component parts of these plants, and also as independent apparatus our X-Ray Specialties are:—

Willyoung Induction Coils;
Patented Adjustable Condensers;
"W-S" Rotary Breaks, *almost noiseless;*
"Bowdoin" Focus Tubes with Practically constant vacuum;
"W-S" Universal Metal Stands;
Fluoroscopes, *best* quality;
"Chloride Accumulator" Storage Batteries, Etc.

24-page illustrated catalogue mailed free upon receipt of 2-cent stamp.

Special Inducements to the Trade.

JAMES G. BIDDLE, ***906 DREXEL BUILDING,***
....PHILADELPHIA, U. S. A.

We offer hearty congratulations to our friend

The Electrical Engineer

on reaching that age just bordering the period that poets have christened "sweet sixteen." May she live long and prosper and enjoy many happy returns of the crystal day.

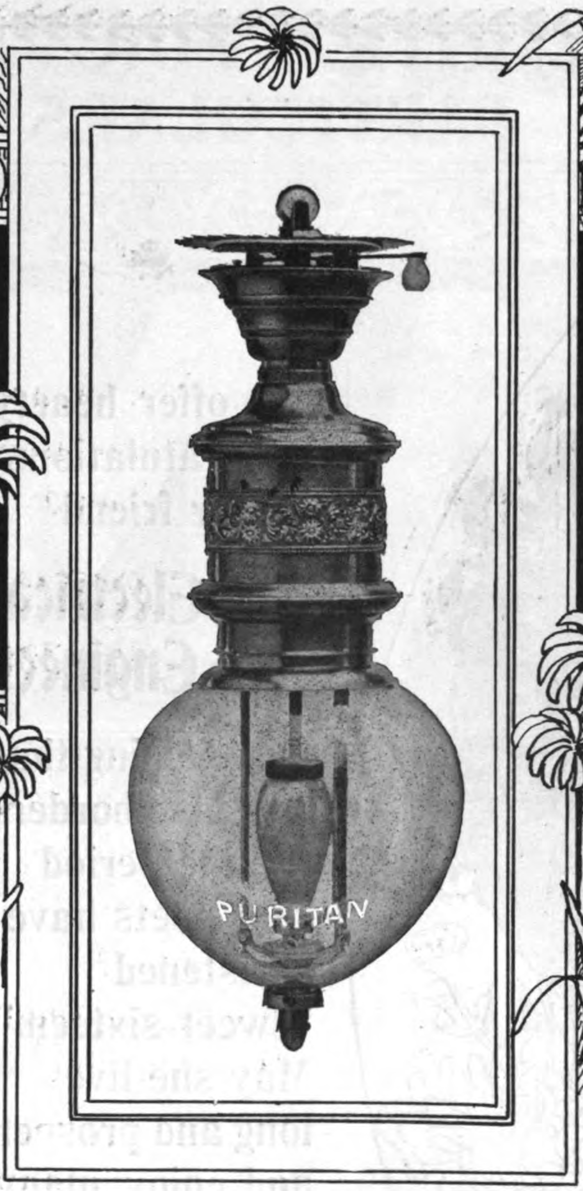
To all other Electrical Engineers we also wish a Happy and Prosperous New Year.

Central Electric Company,

173-175 Adams Street, Chicago.

The

PU



MILTON said:

"They in numbers that compute,
Days, months and years, towards this
all-cheering LAMP
Turn swift their various motions, or are turned
By his magnetic beam."

WRITE FOR PARTICULARS

RITAN

Alternating Current

ARC LAMP

NOISELESS

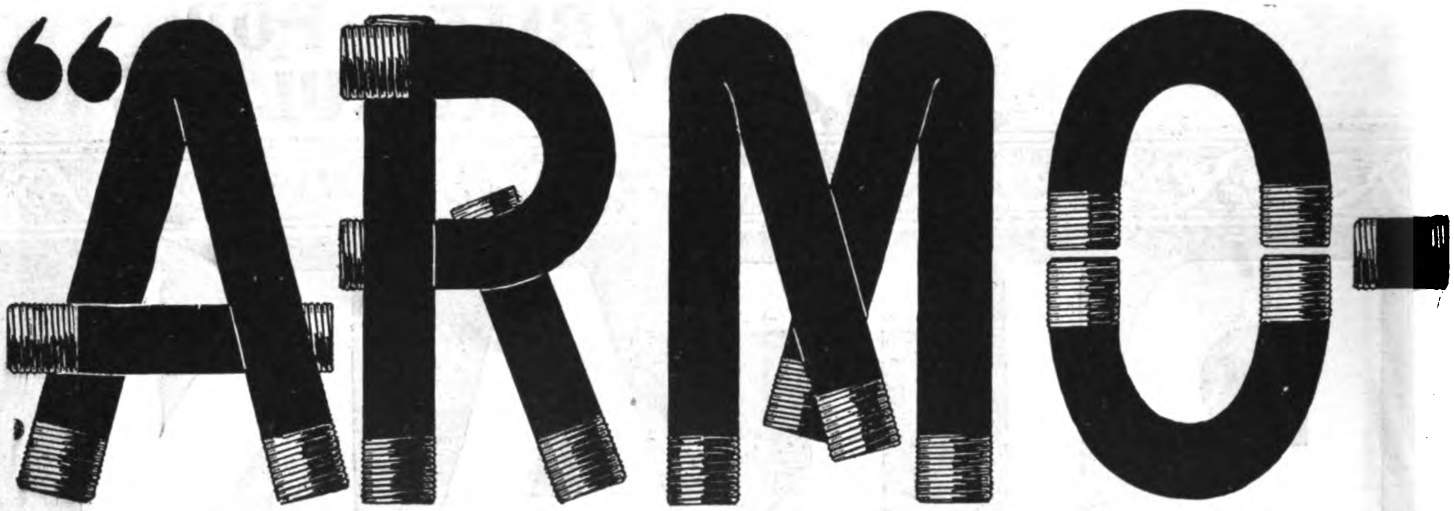
BURNS 100 HOURS.

SHORT AND GRACEFUL

• • ● • •

PURITAN ELECTRIC CO.

150 Nassau St., New York, N. Y.
178 Devonshire St., Boston, Mass.

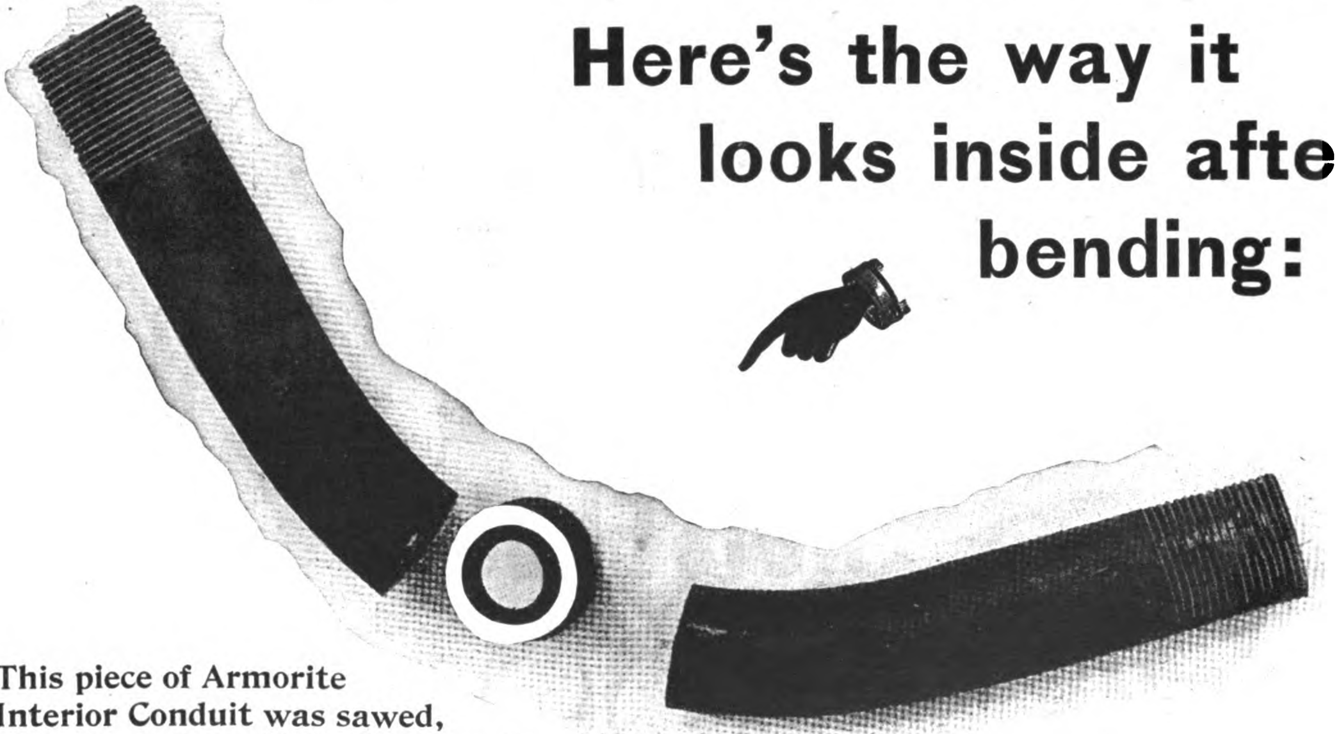


"ARMORITE"
Known all Over the World as the Best Insulated Conduit Manufactured.

INTERIOR

(CUMMING'S

Here's the way it looks inside after bending:



This piece of Armorite Interior Conduit was sawed, as indicated, just after bending in two places, and to show clearly that the bending DID NOT HURT THE WOODEN LINING, the piece cut out was set on end as shown, photographed, and from said photograph the accompanying cut was made.

ARMORITE INTERIOR

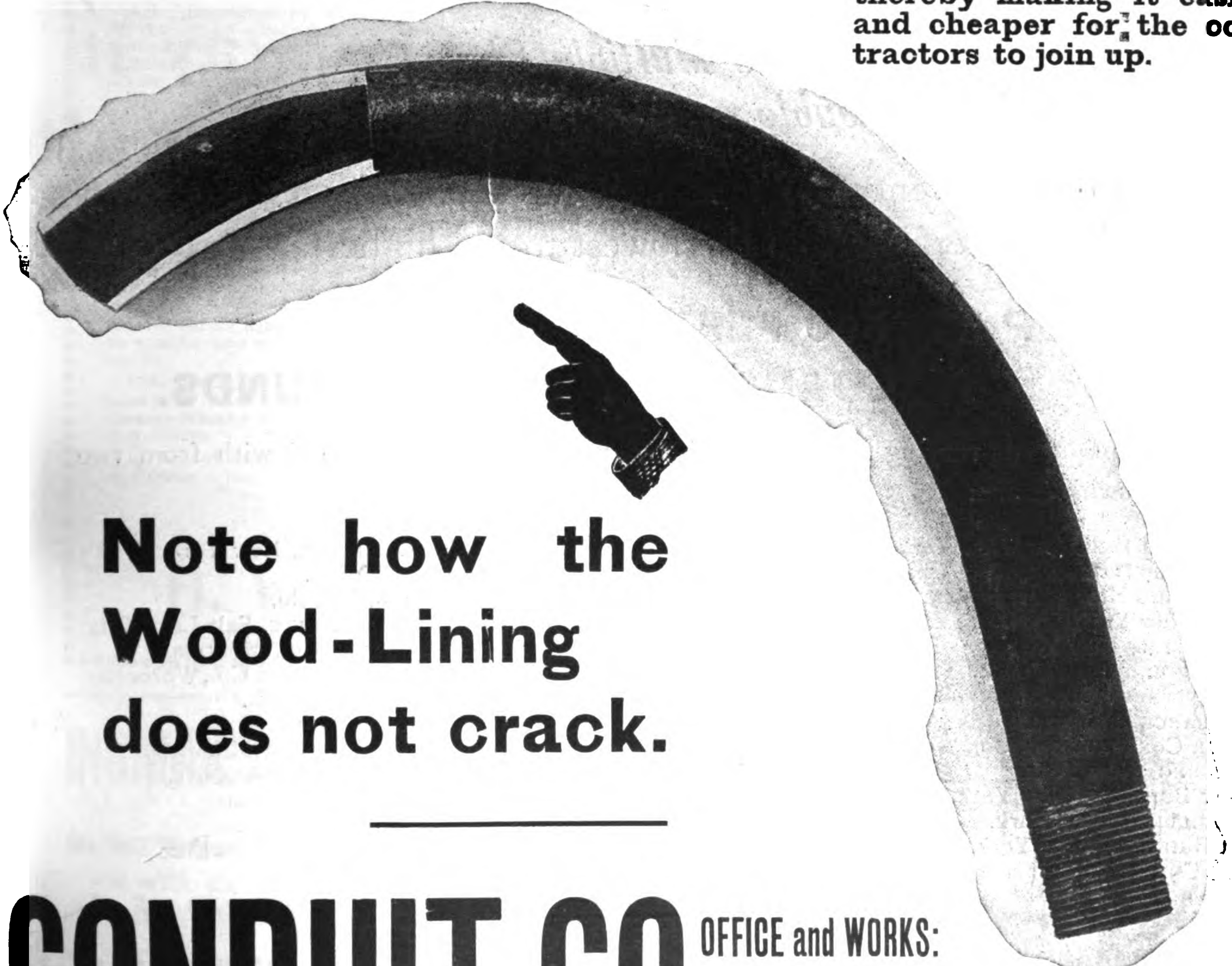
RITE"!

CONDUIT

PATENTS.)

IMPORTANT.

The only practical conduit to install. Standard Pipe, Standard Threads, Standard Couplings. No special tools required, thereby making it easier and cheaper for the contractors to join up.



Note how the Wood-Lining does not crack.

CONDUIT CO., OFFICE and WORKS:

478-480 Fort St., West,
DETROIT, MICH.

SPRAGUE
Electric Elevator Company,
253 Broadway, New York City.

Builders of 12 Sizes and Types of

ELECTRIC ELEVATORS,

Both Drum and Multiple Sheave,
Single, Double and Treble Deck,

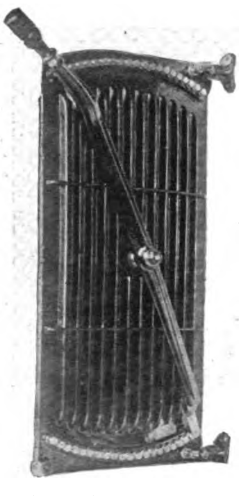
Varying from one to twenty-five tons weight each, and meeting every kind of service from the lowest to the highest.

SPEEDS UP TO 600 FEET.
LOADS UP TO 7,000 POUNDS.

Among the equipments varying from five to thirty-one stories in height, and with from two to twenty-three machines are:

Postal Telegraph Building, New York.
Commercial Cable Building, New York.
John Jacob Astor's New Hotel, New York.
Astor Court, New York.
Manhattan Hotel, New York.
Park Row Building, New York.
New York Telephone Co., New York.
Queen's Insurance Co., New York.
Siegel-Cooper Construction Co., New York.
Gerken Building, New York.
Lord's Court Building, New York.
Syndicate Building, New York.
Wadsworth Building, New York.
Young Men's Christian Association, New York.
W. W. Beebe's Warehouse, New York.
Board of Trade, Chicago.
Guaranty Building, Buffalo.
City Hall and Court House, Salt Lake City.
Canada Life Insurance Co., Montreal.
State Mutual Life Assurance Co., Worcester.
Union Trust Building, Detroit.
Majestic Building, Detroit.
City Hall and Court House, Minneapolis.
Currier Bank Building, Los Angeles.
Parrott Building, San Francisco.
Academy of Music, San Francisco.
Safe Deposit Building, San Francisco.
Hotel Walton, Philadelphia.

THE LARGEST STORE, } **EVER CONSTRUCTED** { **23 MACHINES,**
THE MOST COSTLY HOTEL, } **EVER CONSTRUCTED** { **19 MACHINES,**
THE HIGHEST OFFICE BUILDING, } **EVER CONSTRUCTED** { **17 MACHINES,**



150-Light Dimmer.

Theatre Dimmers

PRICES CUT IN TWO.

150 LIGHT DIMMER (50 steps.)
PRESENT LIST PRICE, $50.00
FORMER " " $105.00

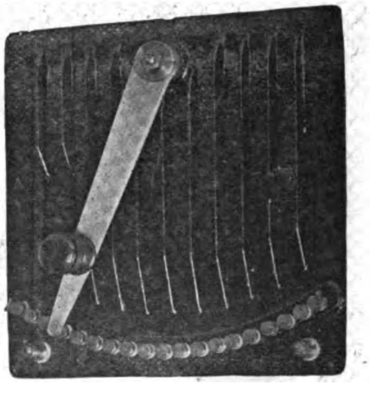
50 LIGHT DIMMER (22 steps.)
PRESENT LIST PRICE, $27.00
FORMER " " $60.00

6 LIGHT DIMMER (9 steps.)
PRESENT LIST PRICE, $9.50

Secure a bid from us before purchasing.

All so called Iron Clad Theatre Dimmers infringe broad controlling patents and application for patents under which this Company and no other is licensed.

Over 1000 Dimmers in Daily Successful Operation.



50-Light Dimmer.

WARD LEONARD ELECTRIC CO., Hoboken, N. J., U.S.A.

BOOSTERS.

All "Boosters" in which the regulating armature is driven by an electric motor, and is in a field whose magnetism can be varied independently of the E. M. F. of the regulating armature, are subject to the claims of Patent No. 572,903, issued to **H. Ward Leonard**, December 8th, 1896.

Also all commercial methods of using a reversible E. M. F. in the circuit leading to lamps, motors, storage batteries, etc., for the purpose of regulating the E. M. F. upon such devices.

All parties desiring to use or to continue using apparatus or methods covered by this patent can do so (except for certain kinds of elevators) without cost to them for past or future use of existing apparatus, by securing license from me under reasonable terms as to future use of additional apparatus which is subject to the claims of the patent, provided that they secure such license before April 1st, 1897.

Parties infringing this patent and who do not secure license before April 1st, 1897, will be held responsible as far as possible and will not be offered license on above favorable terms.

This patent has already been acknowledged as valid by many of the leading companies, among which are the **Crocker-Wheeler Electric Company**, the **Otis Bros. & Company**, and others.

A copy of the patent will be mailed upon application to any party using or contemplating the use of a "Booster."

Typical Claims.

Claim 51.—The combination with a source of electric energy, of a translating device, the armature of a dynamo-electric machine connected between the source and said translating device and running in a variable field whose strength is independent of the electro-motive force of the armature, and a dynamo-electric machine mechanically connected with said armature and electrically connected with the supply-circuit, substantially as set forth.

Claim 33.—The combination of a source of electric energy, a circuit extending therefrom, two dynamo-electric machines connected electrically therewith and mechanically connected together, one of said machines having upon its terminals a practically constant electro-motive force, and the other having a field magnetism independent of its own electro-motive force and producing a variable electro-motive force, said latter machine being connected in series with a translating device, the electro-motive force upon whose terminals is regulated by varying the electro-motive force of said latter machine, substantially as set forth.

Claim 25.—The method of obtaining from a source of electro-motive force a different and controllable electro-motive force at the terminals of a translating device with a minimum waste of energy, consisting in placing in the path of the current leading to the translating device the armature of a dynamo electric machine which is mechanically connected with the armature of a dynamo electric machine having a shunt field-winding and acting sometimes as a motor and sometimes as a generator, and operating the first-named machine as a motor to reduce the electro-motive force at the terminals of the translating device, and as a generator to raise the electro-motive force at the terminals of the translating device, substantially as set forth.

H. WARD LEONARD, — HOBOKEN, N. J.

INCANDESCENT LAMPS, DON'T be buncoed into making a contract for your supply of lamps.

"JUST TELL THEM THAT YOU SAW US."

We will furnish you with our HIGH GRADE **"O.K." LAMPS** any voltage, any base, at a lower price than you can secure by making any contract; and we GUARANTEE EVERY LAMP. We have yet to receive a complaint from a single customer. It will pay you well to write us when in the market.

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THE LEADING SUPPLY HOUSE.
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L. S. MARSH,
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Consulting and Constructing **Electrician.**
Gas Engine Plants for Private Purposes a Specialy.
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STANLEY ELECTRIC MFG. CO.,
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WESTERN OFFICE: 307 Dearborn Street, Chicago, Ill.
THE ROYAL ELECTRIC CO., MONTREAL, CAN., are exclusive licensees for the manufacture of the S. K. C. System in the Dominion of Canada.
See page xlii, this issue.

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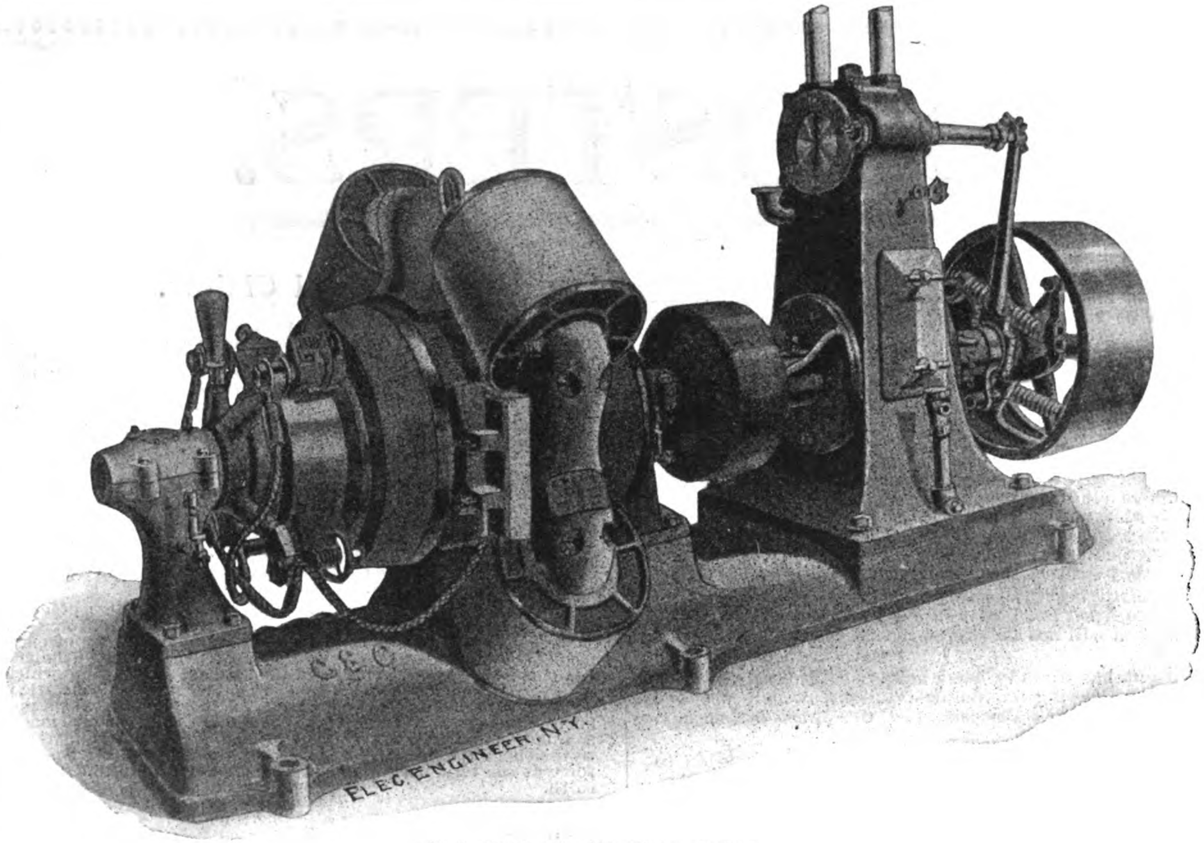
DIRECT CONNECTED UNITS SPECIALLY DESIGNED
FOR CASES WHERE SPACE IS VALUABLE.



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1143 Marquette Building, Chicago, Ill.
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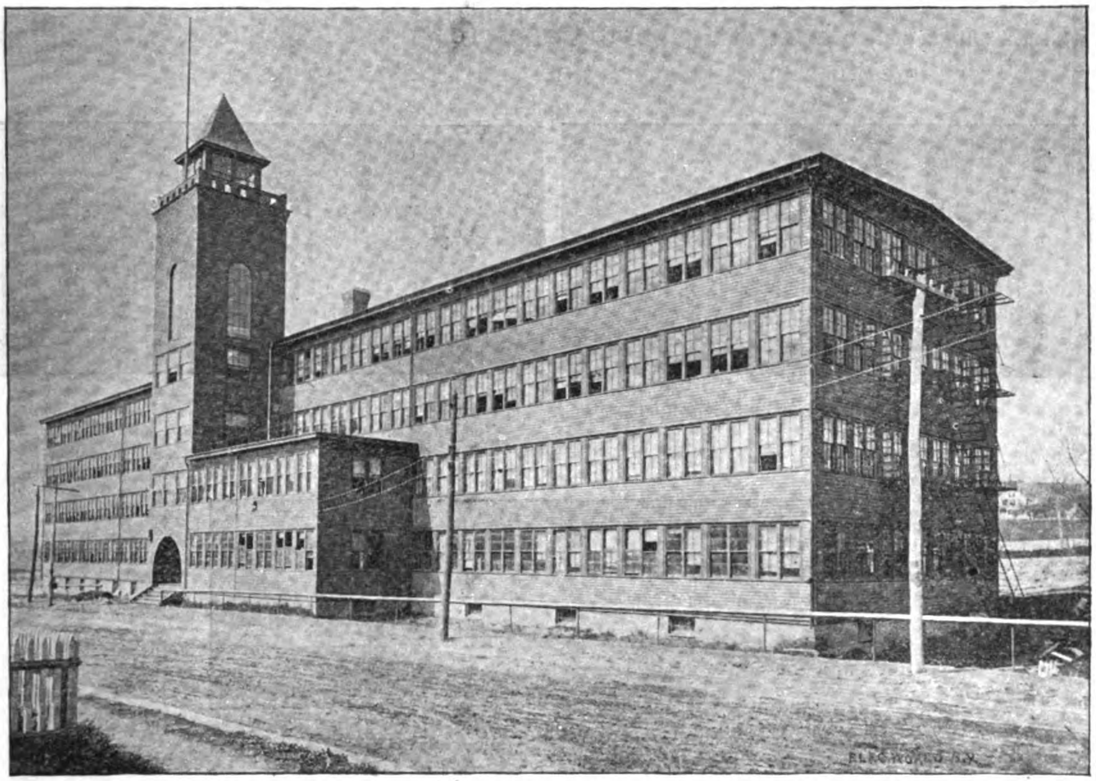


FACTORY, MARLBORO, MASS.

Interesting Statements.

DECLARATION: Every open competitive test of Incandescent Lamps that is made results in the triumph of the IMPERIAL. (Start one yourself.)

DECLARATION: The IMPERIAL is the only independent incandescent lamp used extensively by large Central Stations. (These are the careful buyers, who, having facilities for proper tests, purchase what is cheapest in the end.)

DECLARATION: The two largest Street Railway Systems of the country purchase IMPERIALS exclusively. (40 per cent. longer life than the best competitor on rough railway work—no rigid anchor.)

DECLARATION: There is a reason for all this, for every operation during the manufacture of the IMPERIAL lamp is as surely checked as though it could be gauged. We are specially pleased when our competitors tell how expensive the IMPERIAL is to manufacture.

BRYAN-MARSH COMPANY,

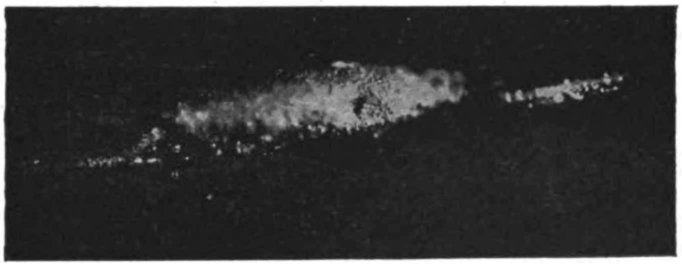
OFFICE:
136 Liberty St., NEW YORK.

CONVERSE D. MARSH, President.

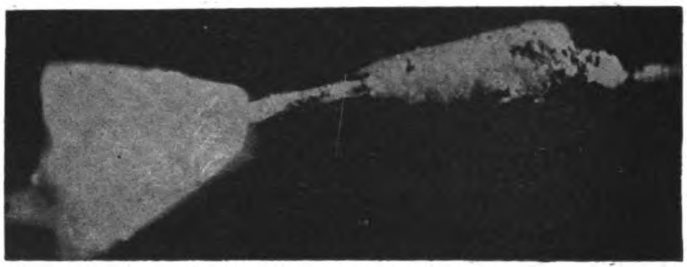
FACTORY:
MARLBORO, MASS.

By the Aid of the Microscope

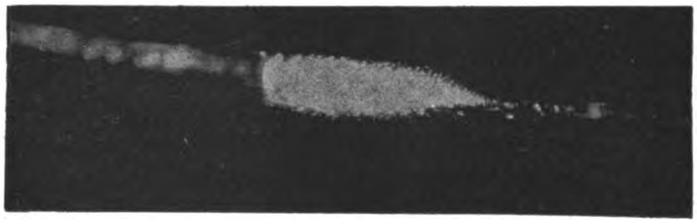
We show on this page some interesting photographs (enlarged 30 diameters) of details of lamp parts, illustrating striking differences between poor and good lamps.



No. 1 illustrates a paste or cement joint (new) connecting the platinum to the filament. Used on the majority of lamps sold. It is the cheapest and easiest to manufacture.



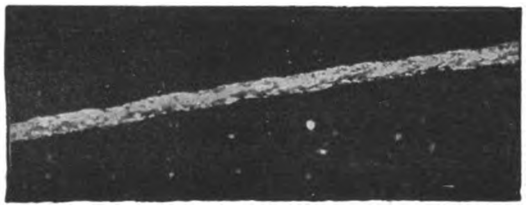
No. 2 is the old paste joint. The volcanic craters show where the gas has escaped, blackening the globe and reducing the c. p. of the lamp.



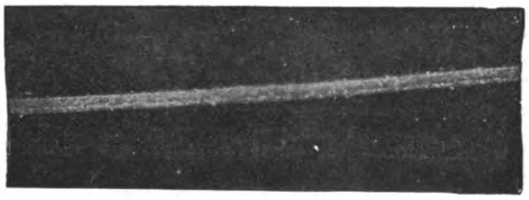
Here is an old Imperial joint—an extremely hard test, as it is a 50 c. p. lamp—the filament first socketed in a platinum sheath, and then covered electrically with pure carbon, remaining unchanged through the life of the lamp.

A Microscopic Lesson on Filaments.

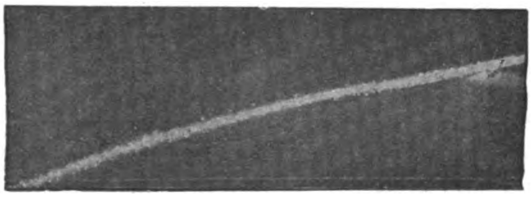
A striking sermon can be preached on filaments by examining actual examples taken from different makers' lamps.



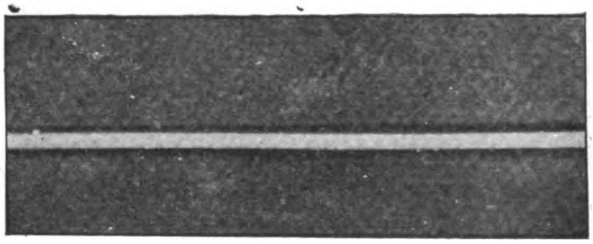
No. 1 shows a very cheap American Lamp.



No. 2, one of a little better quality and price.



No. 3 is from a standard lamp on the market.



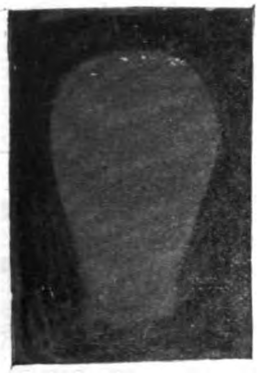
No. 4. From a regular Imperial lamp. A flawless filament, with a polished, silvery surface, gives ideal results in economy, and in connection with the highest vacuum produces greatest sustained brilliancy and life.

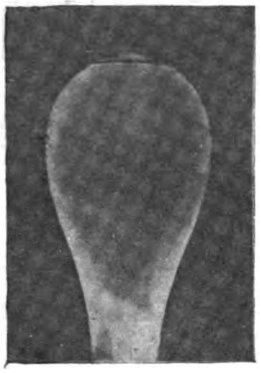
BRYAN-MARSH COMPANY,

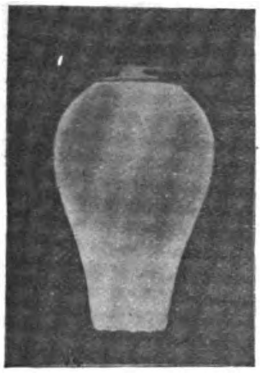
FACTORY:
MARLBORO, MASS.

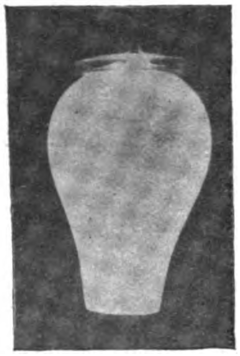
CONVERSE D. MARSH, President.

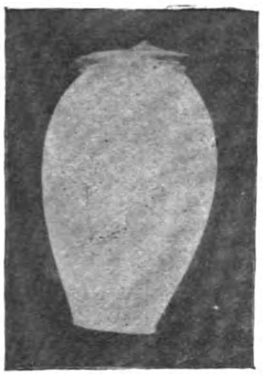
OFFICE:
136 Liberty St., NEW YORK.

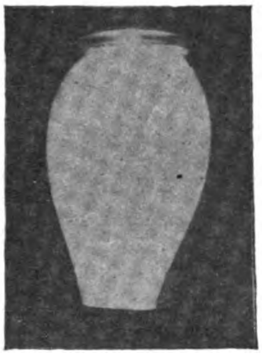

No. 1. Imperial. Background deepened in order to reproduce anything.

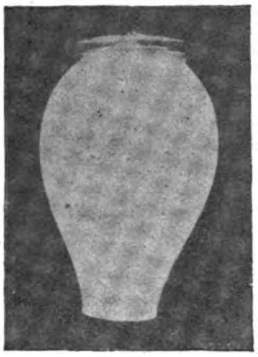

No. 2. Domestic.

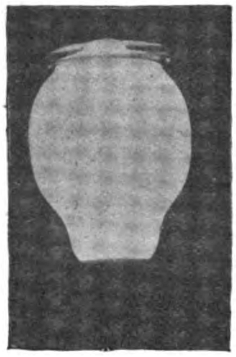

No. 3. Domestic.


No. 4. Domestic.


No. 5. Domestic.


No. 6. Domestic.


No. 7. Domestic.


No. 8. European.

The Vacuum in Lamps.

A poor vacuum appears as a blue fluorescent light when an incandescent lamp is suitably connected to an induction coil for the test.

The better the vacuum the less the glow in the lamp. This means economy—life—brilliancy in an old lamp.

Poor vacuum insures short life--poor economy--blackening and rapid drop in candle power.

No. 1 shows the Bryan-Marsh Imperial Lamp.

Nos. 2 to 8 are the others; some of them contain gas enough to inflate a foot-ball.

No. 1 ***made no record on the photographic plate*** until subjected to more powerful electrical influence than its neighbors, and after twice the length of exposure.

The ***vacuum*** and the ***filament*** form the most important elements in an incandescent lamp. We offer you the best modern results in both particulars for as low a price as such quality can be sold when made in the largest quantities.

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NEW STANDARD IRON ARMORED INSULATING CONDUIT.

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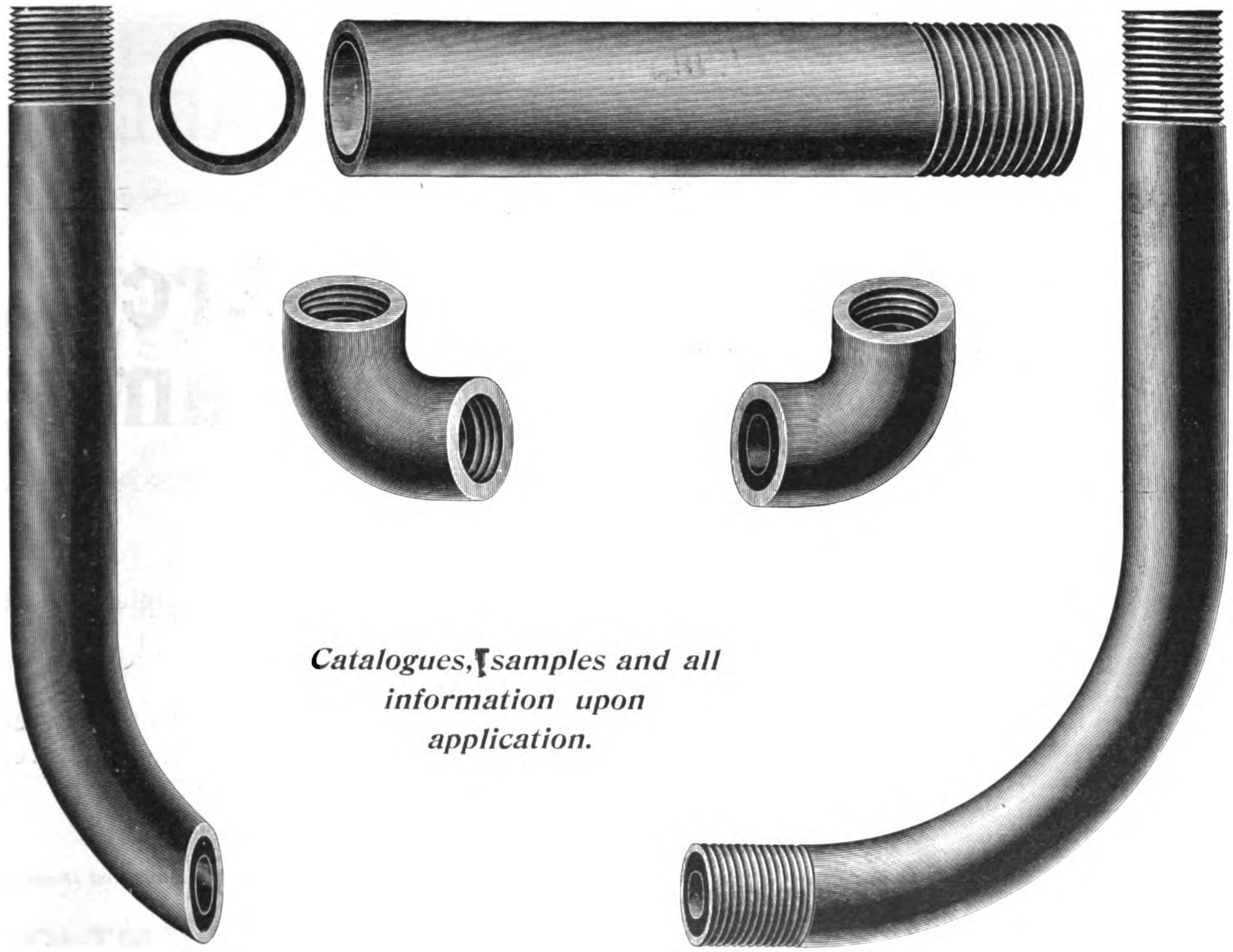

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**Arc....
Lamps**

THEY are unsurpassed for even and perfect combustion.

They produce practically no dust, and are therefore more completely consumed, thus giving a longer life than any other carbon.

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They produce the highest standard candle power in proportion to the current consumed, and are therefore the most economical carbon manufactured.

The leading electric light stations who have tested the "ELECTRA" CARBONS, and have since adopted them exclusively for their arc lighting, admit their superiority over any other high grade carbons.

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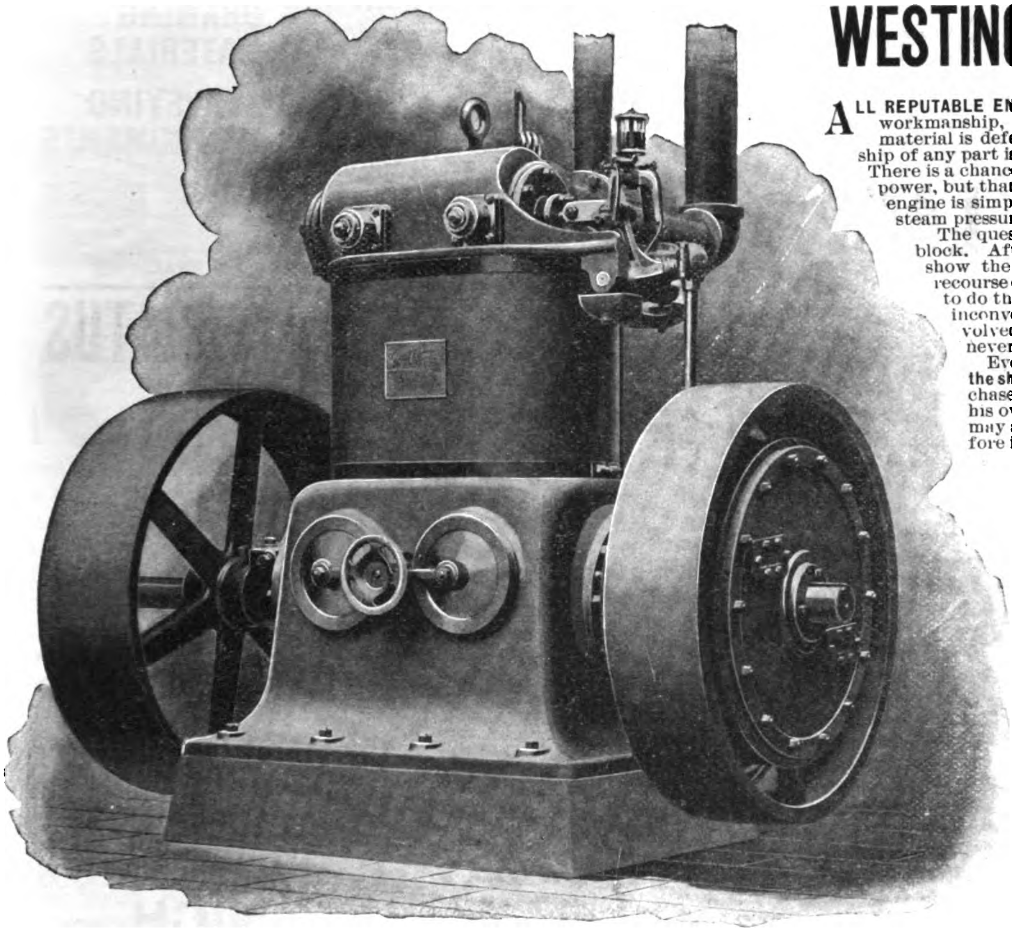

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ALL REPUTABLE ENGINE BUILDERS will guarantee the material workmanship, capacity and economy of their engines. If material is defective, it will be replaced; if the workmanship of any part is not up to standard, it will be made good. There is a chance that the engine may not develop its rated power, but that is not so probable, since the capacity of an engine is simply a measure of cylinders, piston speed and steam pressure.

The question of economy, however, is the stumbling-block. After an engine has been installed and fails to show the **guaranteed economy** the purchaser has no recourse except to take the engine out. If he decides to do this, it means interrupted business and serious inconvenience, aside from the direct expense involved. The consequence is, that it is seldom or never done.

Every engne we build has a record **before leaving the shop**, based on a rigid economy test. Any purchaser so desiring may have his engine tested by his own expert at our shops before shipment, and may accept or reject the engine on that test, before incurring the expense of installation.

THE WESTINGHOUSE MACHINE COMPANY,
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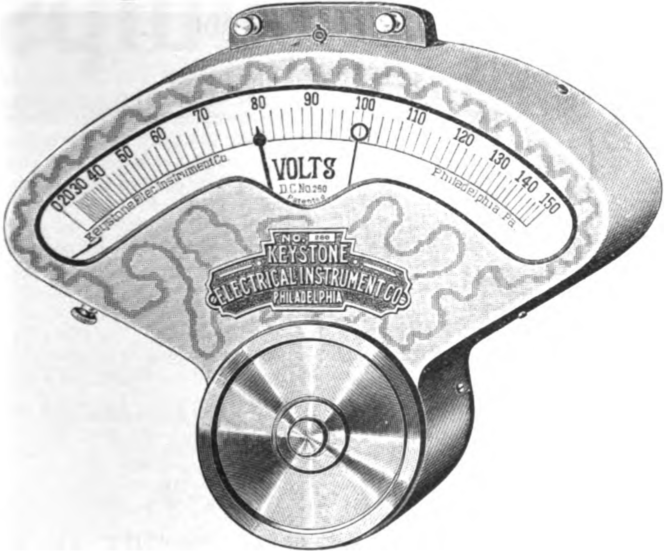
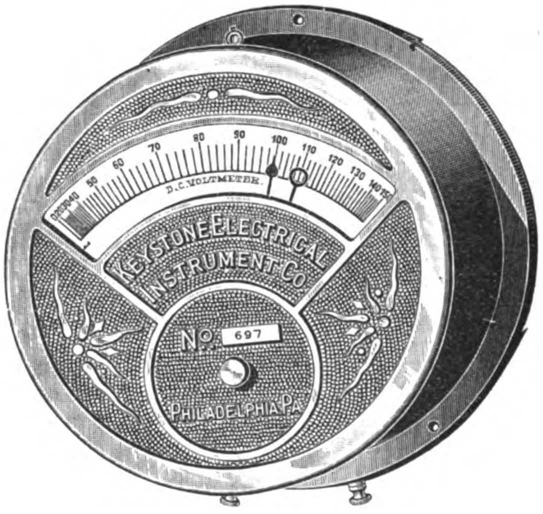


TYPE "K."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of the wise men, or at least, of the wise men o to-day who operate central stations is the

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It leads to . . .

PERFECT LIGHT,
CUSTOMERS SATISFIED,
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Our Fluoroscopes and Fluorescence Screens are of acknowledged superiority and are used by the more prominent X-Ray investigators.

Our Photographing Screens are coming into general use in X-Ray surgery.

OUR FLUOROSCOPES are tasteful in design; they are provided with flexible and close-fitting eye-pieces, which makes it possible to use them in a lighted room, and are as light in weight as is consistent with the strength of frame necessary to protect the screen. The screen is the result of careful experimenting with crystals of different sizes and applied in varying quantities. The method of supporting the crystals has received special attention; after thorough tests of paper of different kinds, card boards, woven cloths, aluminum foil, etc., as mounts for the crystals, we have adopted that which proved best for the purpose.

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A NECESSITY!

Is the only article that will PREVENT SPARKING. Will keep the Commutator in good condition, and PREVENT CUTTING.

ABSOLUTELY WILL NOT GUM THE BRUSHES.
A single stick of Compound will save you anywhere from five to several hundred dollars in the increased life of your commutators.

ENDORSED BY ALL USERS.

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THIS SPACE FOR RESULTS OF TRIALS.—Send for free sample stick and let us have the results. Your experience will be of value to your neighbor.

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"I am in receipt of your sample of Gale's Compound, and have tested it with remarkable results. We want more."
NIAGARA FALLS ELEC. LIGHT & POWER CO.
Niagara Falls, Ont. GEO. E. FOSTER, Supt.

"We have been using your Compound for our Commutator and it works very well, giving a smooth surface and preventing cutting. It seems to do all that you claim for it, and we will continue to use it."
C. L. HEALY, Supt.
New York City, N. Y. NEW YORK QUOTATION CO.

"The sample of Gale's Commutator Compound which you sent us some days ago we have given a careful trial and we are much pleased with the results. It does absolutely all that you claim for it, entirely doing away with sparks and giving the Commutator a clean, hard, polished appearance. We shall certainly continue the use of this 'dynamo-necessity.'" Very truly yours, THE O. C. WHITE CO.
Worcester, Mass. Per O. C. WHITE, JR.

The Electrical Engineer.

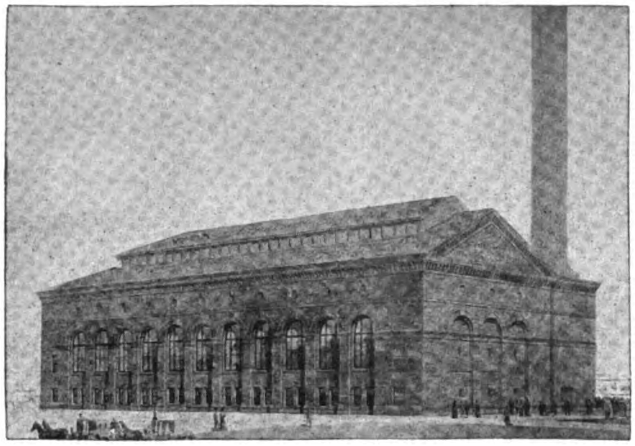
Vol. XXIII. JANUARY 6, 1897. No. 453.

ELECTRIC TRANSPORTATION

THE COMBINATION LIGHTING AND RAILWAY PLANT OF THE TOLEDO, O., TRACTION CO.

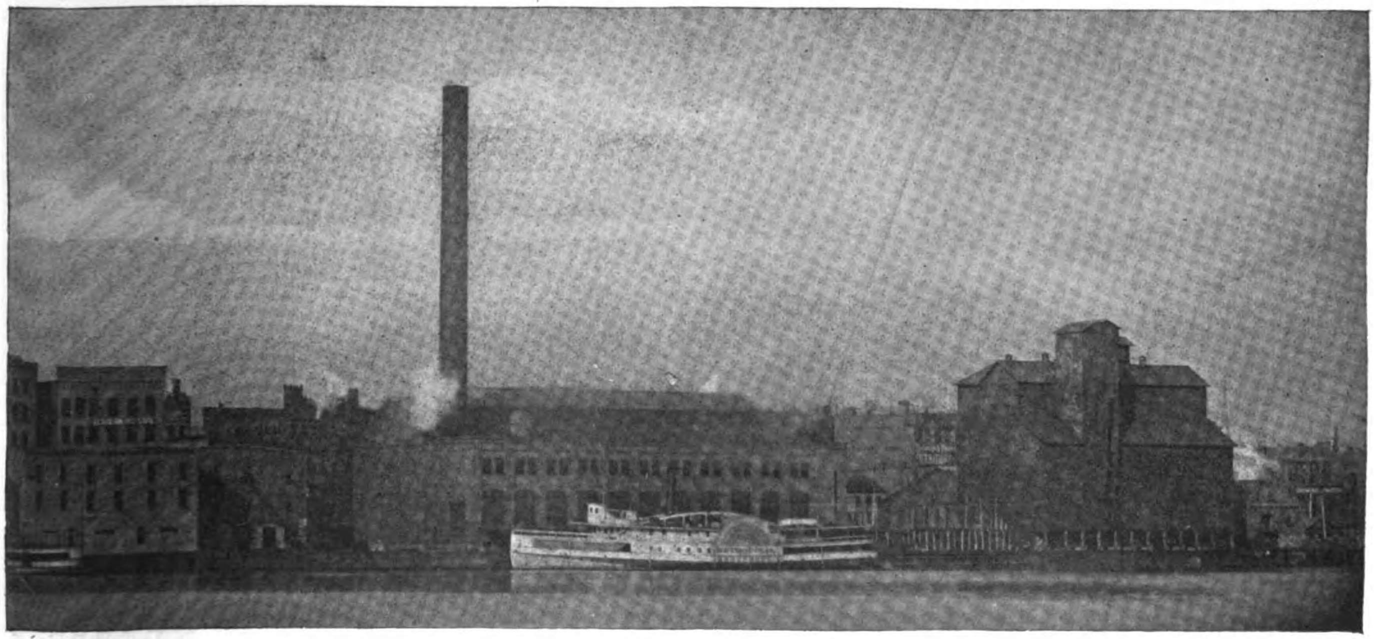
FEW, if any, cities in the Central States have had a more rapid growth than Toledo, O. The census of 1890 credited the city with a population of 81,000. At the present time it is about 120,000, and gives every indication of large and steady gains. A visit to the city reveals advance and activity on every hand, and the enterprise of the people creates daily new opportunities for expansion or investment. Under such circumstances, it is natural, one might even say inevitable, that the lighting and street railway systems should have undergone rapid changes and that the original plants should have proven inadequate to the needs of the present hour. It was difficult, however, to secure new capital in any bulk unless it could be in some degree protected from undue competition, and this state of affairs led to the formation of the Toledo Traction Company, which by consolidation and merger represents the various interests formerly owned and operated by the Toledo Consolidated Street Railway Company; the Metropolitan Street Railway Company of Toledo; the Central Street Railway Company; the Ironville Street Railway Company; the Toledo Electric Railway Compauy, and the Toledo Electric Street Railway Co. This imposing aggregation of properties is capitalized to-day for $2,000,000 in preferred stock, $4,000,000 in common stock and $5,000,000 bonds, the latter a first-mortgage 5 per cent. issue, now being made, which retires all other bonds except $2,000,000 which are met by these new bonds to an equal amount held in the hands of the trustees. More interesting, however, from the strictly engineering point of view are the details of the plant and system, which to-day has to earn the fixed charges of $254,000, and promises to earn this year nearly twice that amount in addition, net, for the stock. Mr. N. B. Ream, the well-known Chicago capitalist, is president of the company, and furnishes the data given above.

The company owns and operates all the street railways in the city of Toledo, comprising about 120 miles of single track, completely covering the entire city and in some cases extending beyond the city limits into suburban localities. The entire system is operated by trolley, having been completely equipped during the past few years. The equipment consists of 119 closed cars, 100 open cars, 29 trailers, 284 motors, 5 snow ploughs and about 147 trucks, all of modern construction and in good order.

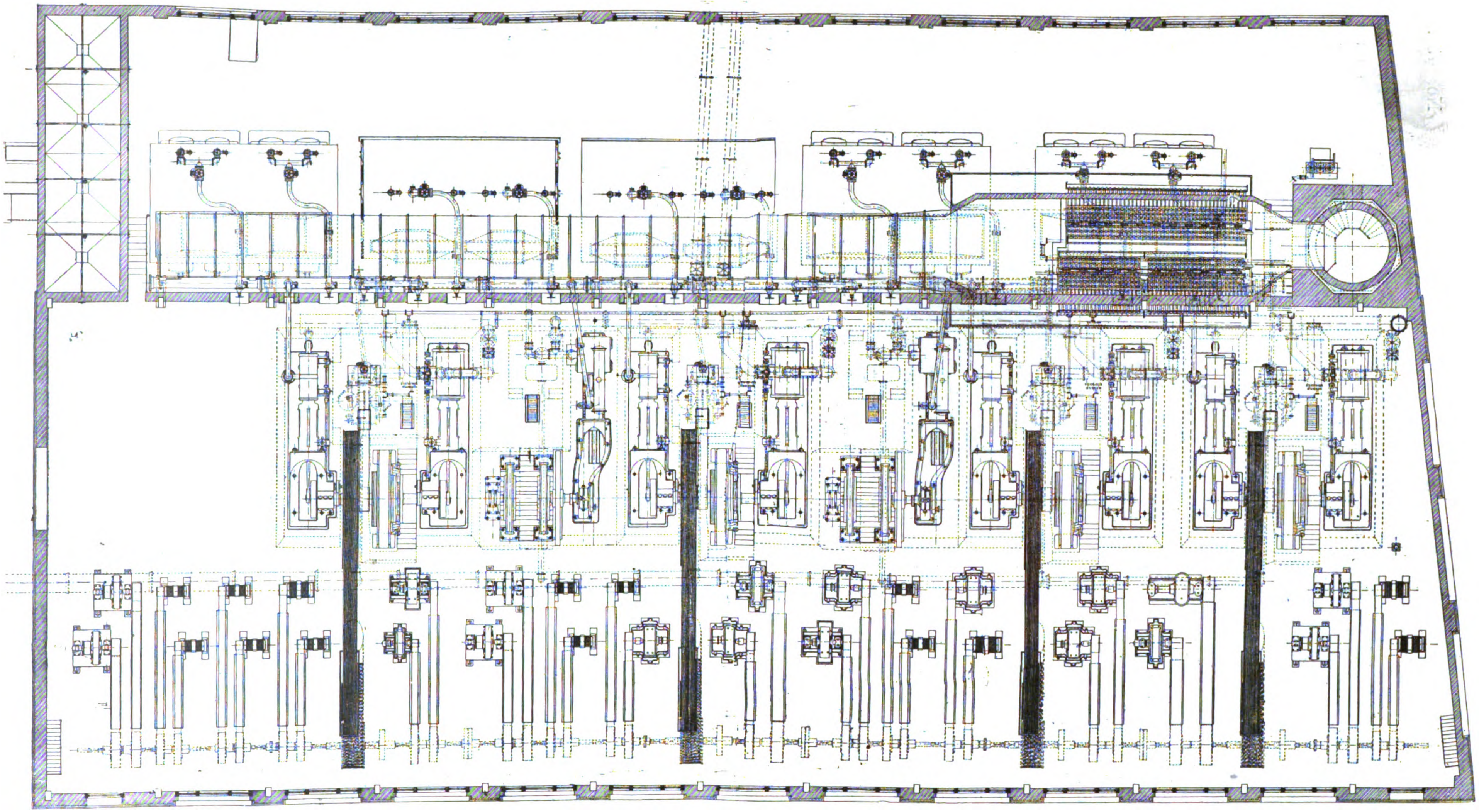


NEW POWER HOUSE, TOLEDO TRACTION CO.

All of the track has been rebuilt within the past five years with heavy girder and "T" rails and the best quality of oak ties, averaging about 2,600 to the mile. The streets on which the tracks are located are for the most part substantially paved with stone, brick, asphalt, and wood pavement. The overhead construction is well built and in good order and condition, and the entire plant is properly equipped with the most improved type of machinery and apparatus.



NEW POWER HOUSE, TOLEDO TRACTION CO. FROM THE MAUMEE RIVER.



Plan of Generating Plant, New Power House,

Toledo Traction Co.

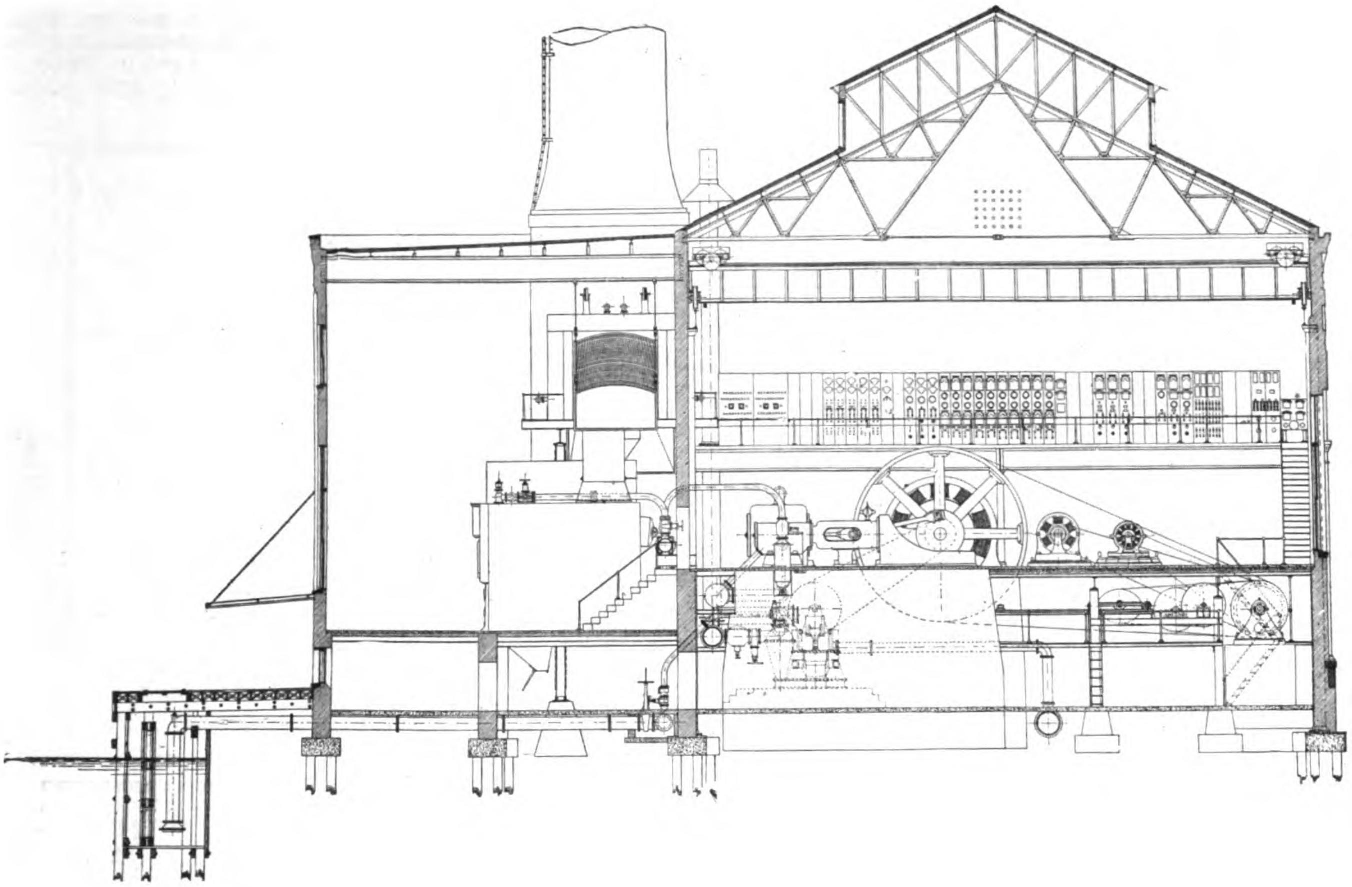
The company has just completed a new fireproof power station, located on the Maumee River, in the center of the city, its size being 212 feet on Water street and 115 feet on Monroe street, extending to the river bank, from which water is taken for condensation purposes. It has more than as much additional land adjacent to this station, available for any extensions which may be desirable in the future. This station is equipped with American Wheelock-Greene engines, General Electric direct connected generators for railway and power service, Fort Wayne generators for arc lighting, Westinghouse generators for alternating lighting, and the Edison generators for the three-wire system for its underground circuits for power and lighting.

The companies have a contract with the city of Toledo for lighting the streets which does not expire until January, 1900.

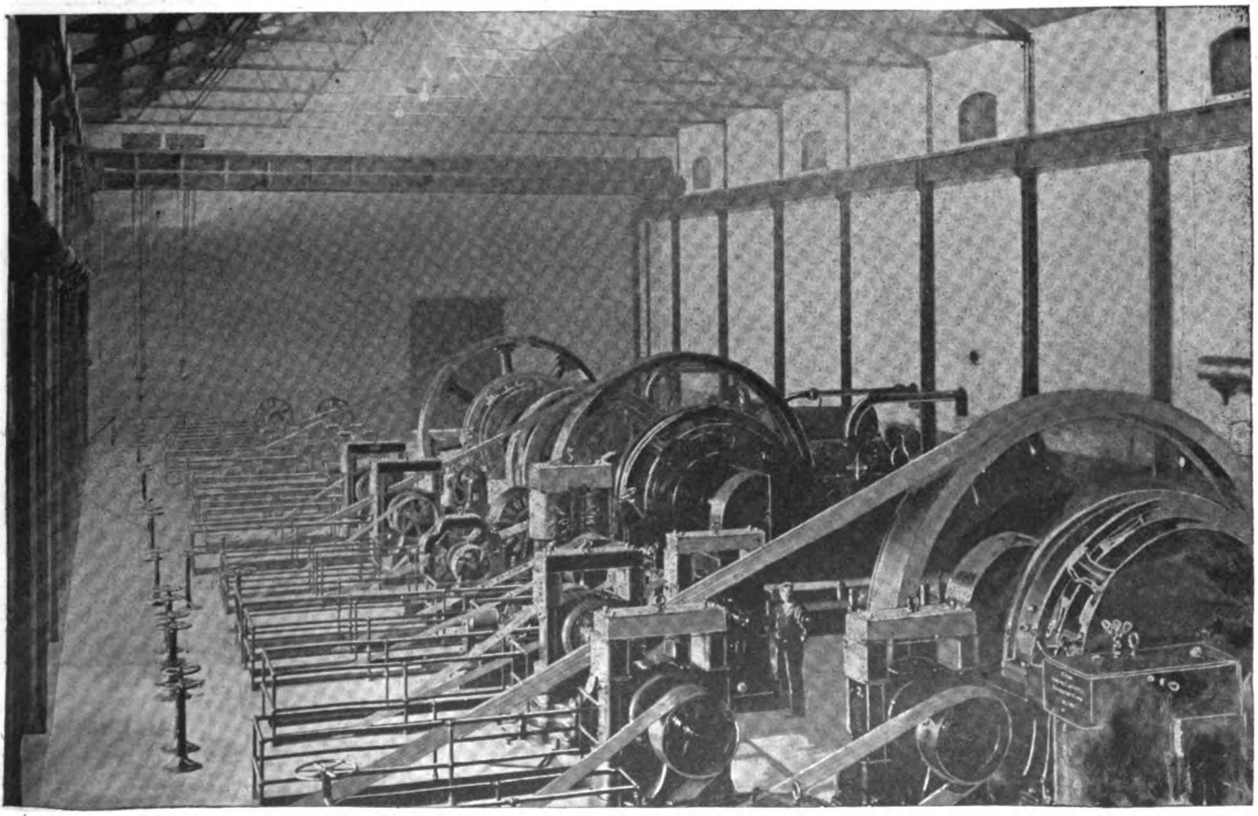
The business of the company is as follows: City arc lights, 719; commercial arc lights, 304; incandescent lights, 30,578; motors, horse-power, 923.

The entire system, railway, incandescent and arc lighting, and power, is operated from this new central station, and the variety of the service enables a good load to be maintained and utilized during the entire twenty-four hours, thereby giving the highest efficiency with the greatest economy.

In addition to this station the company has two smaller ones, which are held in reserve, located on the Maumee River and equipped with modern apparatus for the economical production of electric current.

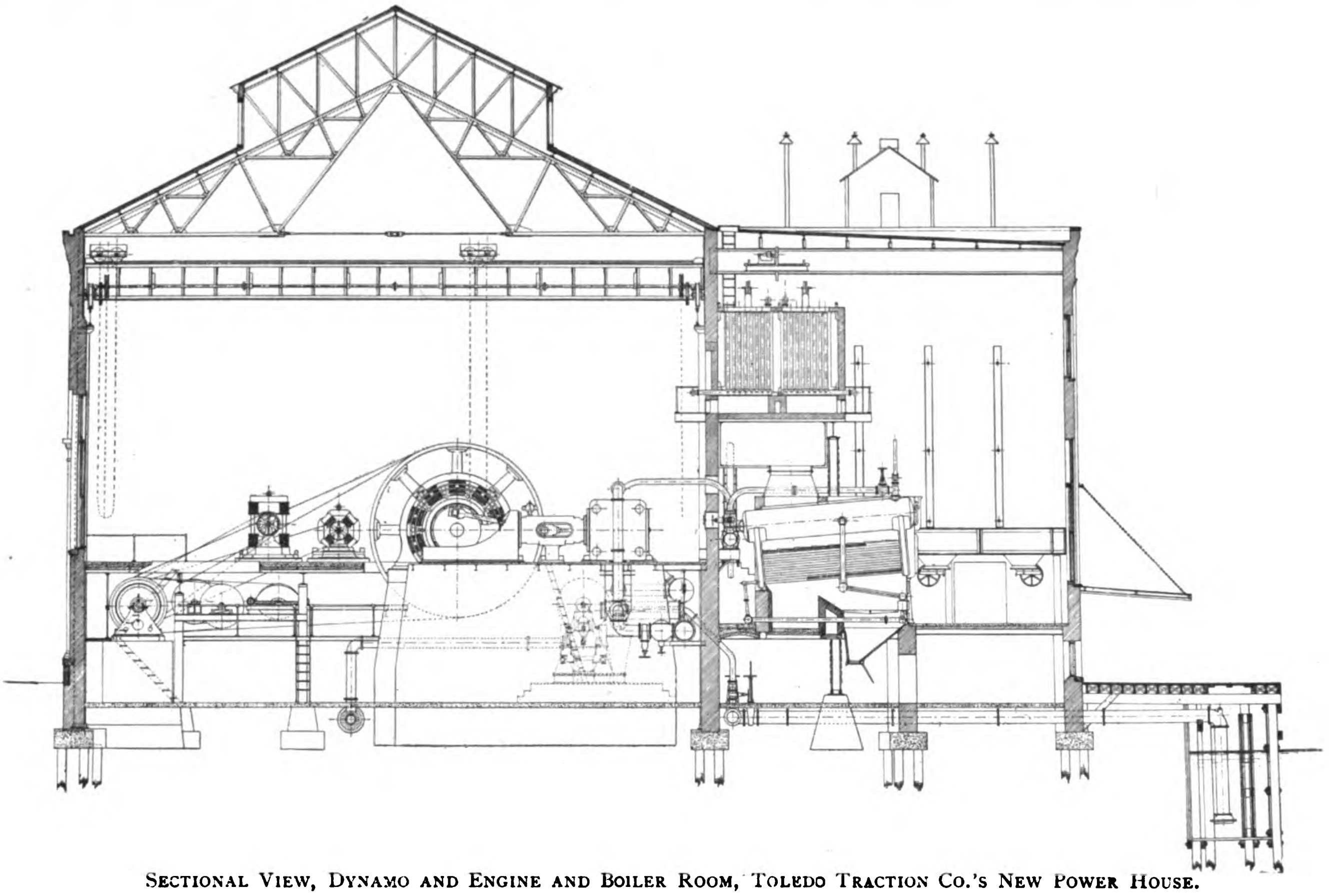


SECTIONAL VIEW, TOLEDO TRACTION CO.'S POWER HOUSE.

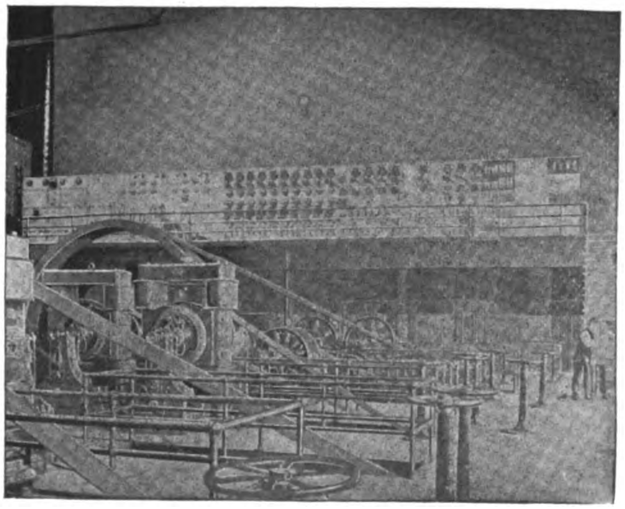


LIGHTING AND RAILWAY PLANT, TOLEDO TRACTION CO.'S NEW POWER HOUSE.

The Toledo Traction Company, through the Toledo Consolidated Electric Company and the Western Electric Light and Power Company, controls, with the exception of the business of one small company, all the electric lighting, public and private, and power business in the city of Toledo. The franchises are perpetual and the Toledo Consolidated Electric Company has also a perpetual franchise for subways and conduits extending over the entire city which it has installed throughout the business district. Into these conduits are placed the feeders for the railway and lighting circuits, and with them are connected the entire underground system for the lighting of the central portion of the city and for the distribution of power. During the present year all the poles in the business district now used for supporting wires for the transmission of power for lighting and otherwise, except for the support of the trolley wires, will be removed.

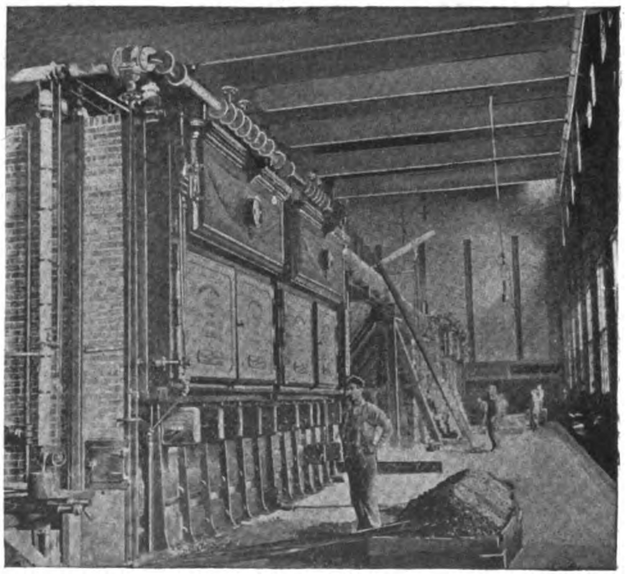


Sectional View, Dynamo and Engine and Boiler Room, Toledo Traction Co.'s New Power House.



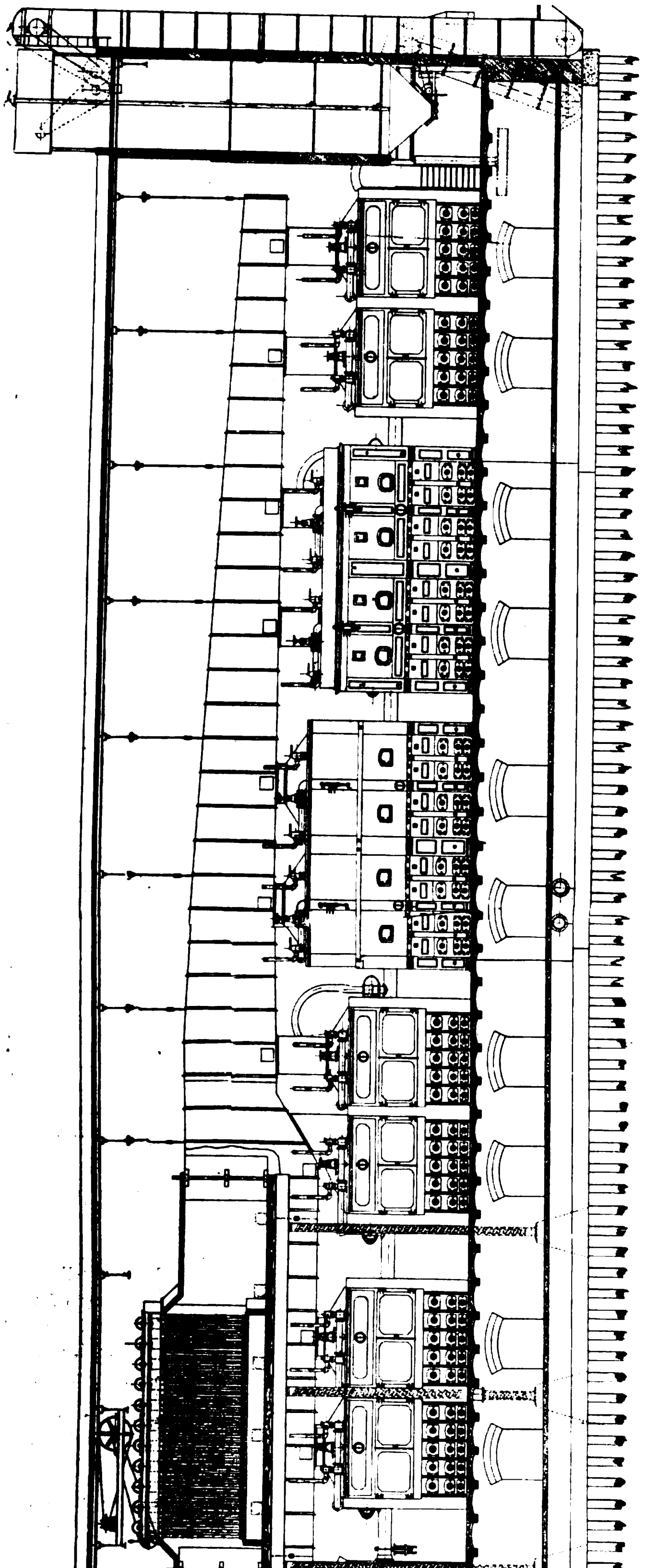
Switchboard and Lighting Generators, Toledo Traction Co.'s Plant.

The new power plant, to which reference has already been made, and of which several perspective and diagrammatic views are shown in these pages, is a fine building, 212 feet by 116, the engine room being 208 feet by 70 and the boiler room 208 by 38. The building is steel frame, with brick walls and slate and tile roof. The foundation is of spiling in the river bank, with concrete and brick. The smoke stack is of steel, 213 feet high, 13 feet inside diameter, lined with fire brick and tile. The building was designed by D. H. Burnham & Co., of Chicago, and the Ohio and Toledo Bridge Company were the contractors for the steel work. Mr. Frederick Sargent, of Sargent & Lundy, Chicago, was the consulting engineer for the electrical and steam engineering work.



View in Boiler Room, Toledo Power House.

The steam plant consists of four American Wheelock en-



Plan of Boiler Room, Showing Economizer. Smokestack, Coal Hoisting Apparatus, Etc.

gines, cross-compound, and two Porter-Allen tandem compound. Owing to the peculiarly miscellaneous nature of the work, resort has freely been made to shafting, the lighting generators on the engine room floor, for example, being belted to the line shaft in the basement. There is 172 feet of Hammond turned wrought iron shafting, with three friction clutch couplings, and Hill Clutch Company's clutches on all pulleys and quills. The boiler plant comprises four 500 horse-power Heine boilers, four 300 horse-power Stirling, two Hawley down draft furnaces, six McKenzie furnaces, and the Green fuel economizer. The coal handling machinery was furnished by Borden & Sillick Co., the crane 20-ton hand power, by the Brown Hoisting Company, of Cleveland. The piping is covered with sectional magnesia. The gate valves are the Chapman make, and the injectors are the Penberthy, while the jet condensers are of Blake and American-Wheelock make. There are four direct belted pumps of Cramp make and two Blake steam pumps.

In the dynamo room the switchboard is of General Electric Company's construction, and a large number of the Weston instruments are used on it. It is of Italian marble, handsomely finished. The wires and conductors in the house are rubber covered, and carried on porcelain insulators.

Special interest attaches to the newer engines in this plant. There are four 1,200 horse-power Greene-Wheelock engines furnished by the American Wheelock Engine Company, of Worcester, Mass., where the valve gears are built; the other parts of the machinery, including the pumping mechanisms, were built by the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa.

These engines were guaranteed while running 90 r. p. m. and developing 675 horse-power each with 150 lbs. pressure to show an economy of 13 lbs. of steam per horse-power hour, regulation to be within 2 per cent. from minimum to maximum load. The dimensions of cylinders are 24 x 48 x 48, cross-compound. The fly wheels to each engine are 20 feet in diameter, grooved for fourteen 1¼-inch ropes and weigh 60,000 lbs.

The Greene-Wheelock valve gear employed in these engines has the two valves inserted in the plug, which is removable from the cylinder. The governor has full control of the cut-off from zero to ⅞ inch. In the low pressure cylinder there are eight valves employed on each end and two outlet and two inlet valves. Each valve has its own eccentric and independent adjustments in each case. The Greene segmental piston packing is used in the pistons. The frames and waists of each engine are specially designed for this plant, and are of the heavy rolling mill type. The crank shafts are 20 inches in the bearing, 36 inches long and 22 inches in the armature hub. Each engine has its own independent jet condenser, driven by a 12-inch belt from crank shaft to engine. The condenser shaft not only drives the circulating pumps, but also the boiler feed in each case. It will be noted that the dimensions of these cylinders are designed under the Rockwood Compound System, and show, as stated, triple expansion results with the use of the compound cylinders.

The electric light machinery is driven by a line shaft with friction clutches running the entire length of the building. Power is transmitted to the line shaft from each engine.

Each engine has an 800 horse-power Hoadley compound wind system transmission connected to line shaft. The Bichette manila rope is used for transmission purposes in this station, 1¼ inches in diameter. Each drive requires 3,100 feet of rope. The American system of steam distribution, patented by F. Sargent is used throughout this plant, and it is authoritatively stated that the entire cost of piping is less than one-half of any other system employed. It will be remembered by the readers of The Electrical Engineer that this steam piping system is also in use in the Chicago Edison station on Harrison street and the Chicago River.

We are indebted for many of the details given above, to Mr. Winfield S. Jewell, the general manager of the plant, and Mr. F. Sargent. Our half-tones are from photographs taken specially by Mr. G. A. Cooke, assistant to the general manager.

"WHITE FLYER" bicycles will probably be built at Niagara Falls, the company requiring about 100 electrical horse-power to run their factory of 150 men.

MATHIESON ALKALI COMPANY.—The new plant of the Mathieson Alkali Company, to be erected at Niagara Falls, will consist of several buildings covering two acres. The first section is to be completed by January 15, 1897. The company, which, as is well known, manufactures caustic soda by the Castner process, will employ 150 men and use 2,000 estimated horse-power at its new works. It already has large plants in England and at Saltville, in Virginia. At the latter plant no water power is available. A very complete electric plant for the chemical process and for lighting is installed, Westinghouse apparatus being used.

SOME PRACTICAL SUGGESTIONS FOR THE OPERATION OF LONG ELECTRIC RAILWAY LINES.

BY PROF. S. H. SHORT.

(*Electrical Engineer, Walker Mfg. Company.*)

THE saving of time effected by the rapid trolley roads in cities, suggested to railway men the convenience as well as profit, to be secured by connecting neighboring centers of population with one another in the same manner. These roads were consequently equipped and have been operated with a measure of success by apparatus designed and constructed for the slower speed and more frequent stops necessary in city traffic.

The limited experience in inter-urban traffic has already created a demand for heavier equipment and higher speed, and the public is now familiar with double truck passenger coaches equipped with motors ranging from 50 to 100 horsepower, and a complete system of air brakes similar to those used on steam railways. Several roads in this country from 40 to 50 miles in length are using trains consisting of two or three of these passenger coaches. These roads use the overhead trolley system and the cars or trains are brought into the center of the cities over the lines of the local street railway companies.

The greatest difficulty in this combination service is that apparatus required in this suburban work must be constructed to develop much greater speed than is permitted within city limits. In existing practice two motors of large size are used and regulated by an ordinary series multiple controller. If these motors are geared to run 40 miles an hour at full speed on the parallel position of the controller, their minimum speed would be 20 miles per hour, on the series position, unless considerable rheostat resistance be included in circuit, which is both wasteful of energy and destructive to the resistances themselves.

I would therefore suggest a method which I consider preferable, that is, the using of four smaller motors, one on each axle of the motor car. With these a controller should be provided which, when grouping the motors in parallel will develop a speed of 40 miles an hour, in series parallel a speed of 20 miles an hour, and in series, a speed of 10 miles an hour. The latter is the maximum speed permitted in city streets at present.

One distinct advantage obtained by the use of four motors is the increased tractive effort due to the adhesion of double the number of wheels to the rails. All practical street railway men are familiar with the difficulty of producing sufficient tractive effort with large double truck cars, even without a train attached. It is useless to attach to the axle of the car a motor which will have a greater horizontal effort than one-fifth the weight supported by that axle, and its pair of wheels.

With the increased speed and weight of trains there is a proportional increase in the amount of power used, which means the consumption of large quantities of current drawn from the trolley wires overhead.

There being but a small point of contact between the wheel and its overhead wire, the trolley now in use has reached its limit in current carrying capacity, therefore it is necessary to improve upon the present method of taking current from the supply conductor. This may be done in several ways. Two or more trolleys may be arranged, one behind the other, and connected in parallel, each taking its portion of current from the trolley wire; or perhaps better, a single trolley with a cylinder of some length attached to the upper end of the trolley pole, making contact with two or three current carrying trolley wires. These trolley wires would be connected in parallel and would reduce the size of the feeders of the line. Over switches and sidings these wires could be separated, as one wire would carry sufficient current for any short distance.

For long distance roads which pass beyond the class of interurban street railway and become in reality cross-country roads on which the equipment must be as heavy and durable as that of steam railways, and on which several hundred will be required to operate trains, the overhead trolley system is, in my opinion, impracticable. A feasible and entirely practical method would bring into use again a third rail. This rail might be supported at one side of the track and protected by a sufficiently complete conduit, current being passed to the moving train through contact shoes, attached to the front and rear trucks of the motor car. This rail should receive its current from a main extending the full length of the road. As has been said before, it would be necessary to provide these fast trains with a very complete air brake system operated by independent motors. It is generally conceded to be unwise to use a current of more than 600 volts for street railway purposes.

Because of the fact that the starting torque or effort of the direct current motor is so great, a direct current has been used almost exclusively up to the present time. The increased mileage of several important lines of railway already planned will prohibit the use of the direct current system because of the initial cost of the copper conductors. The alternating current has already replaced the direct where water power within reasonable distance is available, and is undoubtedly a solution at least in part of the difficulties which have been outlined. It is true that at present the use of the alternating current forces upon electricians all the difficulties of an original adaptation. The necessity for step-down static transformers and rotary converters with their indispensable care-takers at frequent intervals along the line, to convert the currents of 10,000 or 20,000 volts into direct currents of the ordinary pressure still exists, and forms a serious but not insuperable objection to its use. I consider the use of alternate current motors imperative, as by receiving the current directly from the static step-down transformers, they render the use of the rotary converters unnecessary.

While alternating motors work with entire satisfaction after they have attained their normal speed and synchronize perfectly, they cannot as yet be depended upon to furnish the necessary starting torque. This defect has, however, been in part overcome by recent efforts and the subject is having close and intelligent attention from practical electricians. The speed of the alternating motor can be accurately regulated, since on the various sections of the road the supply conductor can be fed with exactly the number of alternations per minute necessary, to produce the speed required there, and the ascent and descent of grades will be accomplished with equal facility.

It is probable that we are in the end to discard both these practical and financially successful methods or operating railways for a third, which, according to recent public announcements of experiments carried on through several years past, seems to be almost within our reach. The conversion of the potential energy of carbon into electrical energy is already an accomplished fact and its application to the problems of street railway service is but a question of time. When the special apparatus has been devised and we are able, in the comparatively small space of a motor car to convert coke directly into electrical energy without heat or smoke and transmit that energy to motors attached to the car axles, it would seem that engines and dynamos, supply conductors, and even trolleys themselves, will no longer be necessary.

Little will be left in fact of the present equipment, but the fine roadbed, which it is now regarded as the best economy to construct. Laboratory experiments in direct conversion of coal into energy emphasize the fact that our practical mechanics, in being satisfied to obtain from a pound of coal but one-fifth of its value in force, have exacted too little.

The possibility of approaching theoretical efficiency, which the adaptation of direct conversion to our street railway service would seem to bring within our reach, already makes the boasted economy of our Niagara systems little less than wasteful expenditure.

THE TROLLEY IN INDIA.—THE MADRAS ELECTRIC RAILWAY.

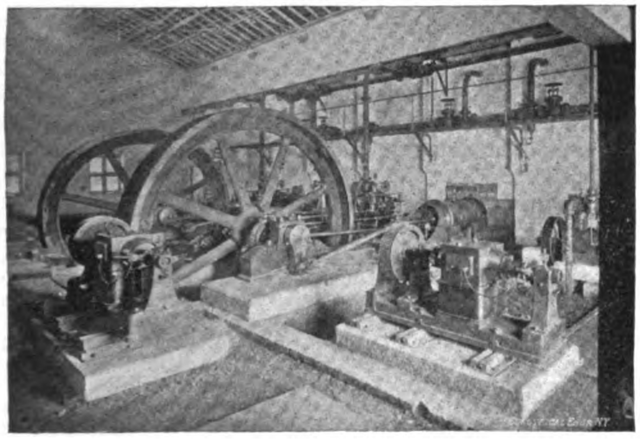
BY GEORGE HELI GUY.

IT would seem one of the anomalies of modern civilization that Madras, the capital of the Indian Presidency of that name, of whose 452,000 inhabitants, 411,000 are Hindoos and Mohammedans, should have its electric road, while New York, the metropolis of the Western Hemisphere, is still running horse cars in its streets.

Two years ago, Madras, whose local passenger transit facilities had been limited to ramshackle cabs, sedan chairs, and bobtail horse cars, was invaded by the operations of the Madras Electric Tramways Company, who laid a conduit to connect important sections of the city. The line was laid down the center of one of the main business arteries, and thus resulted in two collateral advantages much appreciated by the 13,000 Christians of the city. It necessitated the regular repairing of the road, which before then had been almost entirely neglected, and it compelled the street traffic, which consisted mainly of ox-carts, sedan chairs, and mules, to follow the "rule of the road," instead of being perpetually in a state of noisy confusion from the collision of its up and down streams. But the monsoons and the jutkawallahs were too much for the electric conduit in its new sphere. When the heavy tropical rains came down, the conduit would be flooded, sometimes with over a foot of water, and no drainage provisions were adequate to altogether overcome this difficulty. The jutkawallah, the native driver of the indigenous shandrydan, a picturesque vehicle drawn at a snail's pace by a misanthropic looking steed, had bitterness in his heart for the swiftly moving car that swept away his living, and endless short circuits vexed the soul of the road superintendent, who would occasionally discover bars of iron and other such trifles jammed viciously into the conduit.

The consequence was that the trolley was brought into requisition on the second and third sections of the line, which, when completed, were nearly ten miles long. There was, of course, trouble and delay in the changing of passengers from one system to the other at the junction of the first and second sections, and it was finally decided that the natural way to smooth and uninterrupted operation and peace of mind was to make the system uniform; and steps are now being taken to supersede the conduit by the trolley on the first section. It is expected that this change will add considerably to the receipts of the road, as the native East Indian is averse to exertion, and blind to the charms of the transfer system, and many a fare was lost from the fact that the passenger could not make the whole trip of the line without the necessity of leaving his seat.

In fact, for a while, the task of breaking in the natives to ride in cars at all baffled the ingenuity of the management. The Hindoos blankly refused to ride with the Mohammedans, and the deadlock threatened to be serious. By a happy thought a lottery system was started. The passenger had a ticket handed to him in exchange for his fare, and the ticket bearing a certain number took a prize. The temptation to make a few annas was too much even for blood prejudices, and now Hindoos, Mohammedans, Parsees, Portuguese, and Europeans throng the cars indiscriminately.



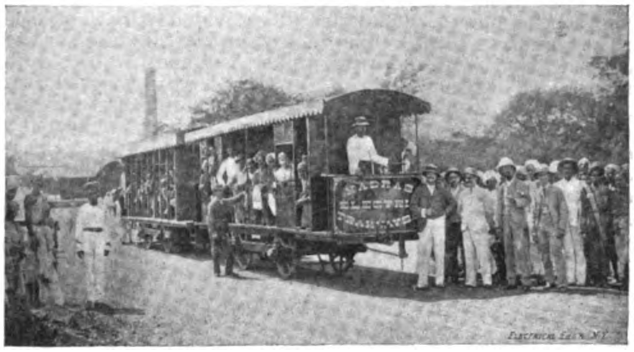
Power House, Madras Electric Railway.

The resources of the Madras line are to be further increased by the establishment of a service to dispose of the city garbage. Under the concessional order of the company provision was made for the construction of a rubbish line, for conveying the refuse of Madras to an outlying district, which the company, if called upon, had to complete by a given time. The municipality has at length availed itself of this option, and arrangements have been made for the early construction of the supplementary line. It is not unlikely that the growing passenger traffic may soon necessitate further extensions. The popularity of the tramway is shown by the fact that although only a limited number of cars are in use, a considerable revenue, over 400 rupees (about $150) a day, is being earned. The large number of passengers that are daily unable to ride for want of sufficient accommodation warrants the assumption that when the full earning capacity of the line is available, the returns will, in all probability, be doubled.

The capital of the company is £100,000, of which about £70,000 has been issued. Very low rates of fare are charged. The fare is fixed by concessional order at one half-anna per mile. Sixteen annas equal one rupee, and the present value of the rupee is about 28 cents.

The line was equipped by the Electric Construction Company, of London. The station contains two coupled compound non-condensing engines of the Burnley Iron Works Company's make, capable of developing 180 to 225 horse-power, at about 90 revolutions per minute, fitted with grooved fly wheels for rope driving. There is also a vertical Belliss high-speed engine for lighting, capable of working up to 20 horse-power. at 320 revolutions per minute, fitted with rope-driving flywheel. The power generators are two shunt wound Electric Construction Company dynamos, each capable of giving an output of 120 kilowatt (240 amperes, 500 volts), rope driven. The lighting generators are two 12 kilowatt E. C. C. dynamos, of the same make, equal to 200 16-candle-power lamps, and rope driven.

The car motors are of the two-pole type, wound for 500 volts.



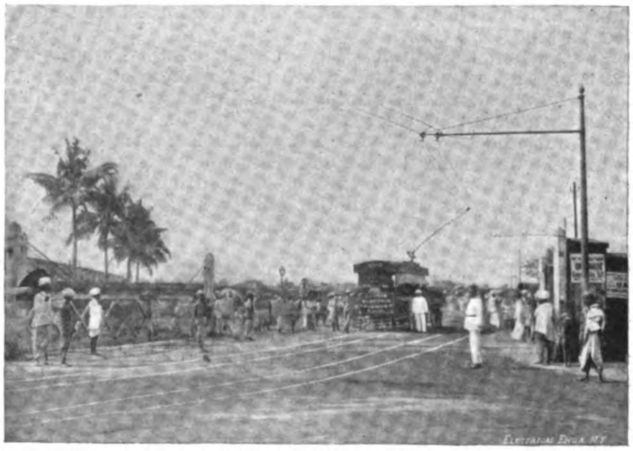
Motor Car and Trailer, Madras Electric Railway.

Each motor will develop 10 horse-power at 400 revolutions per minute approximately. Single reduction gear is used; ratio of gearing $4.83 = 1$. The cars are fitted with a single motor equipment. The gauge of the lines is 3 feet 6 inches.

The Madras Electric Tramways Company is an English corporation. Its chairman, Mr. William Digby, C. I. E., is well known throughout India, in connection with a memorable piece of practical philanthropy. During the terrible Indian famine of 1877, Mr. Digby, who then lived in Madras, wrote a letter to the London "Times" appealing for help for the sufferers. Contributions to the famine fund that was forthwith organized poured in, and in four months $4,000,000 was subscribed. The distribution of this money, under Mr. Digby's superintendence, was made through voluntary committees, missionaries and others, at a cost of less than three-fourths of one per cent. In recognition of his labors, the British Government created Mr. Digby a companion of the Most Eminent Order of the Indian Empire. The Madras Electric road owes its inception almost entirely to Mr. Digby, who has thus in addition to his many public services, the credit of having promoted the first electric railroad in India. In London the interests of the company are watched over by Mr. A. C. Colebrook Codd.

On the directorate is Mr. M. M. Bhownaggree, a member of Parliament for Northeast Bethnal Green, and the only Indian Member of Parliament in the House. It will interest many Americans to know that one of the directors of the Company is Mr. W. A. Gibson, the managing director of the Otis Elevator Company in England.

The success of the Madras line is already stimulating a movement in favor of electric roads in other cities of India. Deputations have been sent from many places to inspect the working of the pioneer line. Negotiations are pending for the construction of an electric railway in Bangalore, and in both Calcutta and Bombay, the traction companies are understood to be about to operate the whole of their lines by electricity. In India, more even than in most other countries, does this



Steam Railway Crossing, Madras Electric Railway.

mean cheaper operating expenses, as well as better service. The abnormally high rate of mortality among draught horses, on account of the climate, can easily be realized by recalling the experience of the New York horse roads during the tropical spell of last August. The Bombay Tramway Company, which is an American enterprise, and which has been phenomenally successful, has the most elaborate arrangements for caring for its horses. They are all provided with topees, or sun hats, and when they come in from work they are sponged down with cold water, and put under a punkah to cool down gradually. A large number of the horses are imported from America, as an animal of special stamina is required for such exacting service. It has doubtless been already suggested to the Bombay Traction Company that American electric installations may not be a whit inferior in actual efficiency to American horses.

SOME RESULTS WITH ELECTRIC POWER ON THE B. & O.

BY T. FITZGERALD.

(Genl. Supt. B. & O. Railroad.)

It is with some little hesitancy that I write even a short sketch on a subject which has been so exhaustively dealt with from its several aspects; however, if public interest still remains active in following the results of this great enterprise and undertaking on the part of the B. & O. R. R., it is with pleasure that I review its growth.

It was in the pioneer days of electric lighting, that the B. & O. R. R. installed its first electric light plant for the purpose of furnishing, in a small way, arc lights at several of its points in Baltimore, as noted already in The Electrical Engineer. Since that time the railroad has found it advisable and to its interest, to take up the use of electricity both as a means of light, as well as motive power, probably more extensively than any other steam railway corporation, and the results have been both successful and gratifying.

The adaptibility of the various applications of electrical energy as viewed from the point of economy is shown by making a comparison of its equipment of but a few years ago, with that of the present, which has grown to the extent that this railroad is now operating thirteen plants, with two additional ones now under consideration, representing in all some 1,500 2,000 candle-power arc lights, 9,500 16 candle-power incandescent lights, and 3,300 horse-power in the shape of power.

Among this list of stations, one of recent and greatest interest, is the one located in Baltimore, commonly known as the "Belt Tunnel Plant," which has a rated capacity of 4,500 horse-power. Due to the difficulty and uncertainty of a ferry transfer, particularly in the winter time, on account of navigation being closed and the railroad being dependent upon this connecting link at Baltimore, coupled with the desire to lower the schedule time of its trains running between Washington, Baltimore, Philadelphia and New York, the question arose as to how this might best be accomplished. After careful consideration, it was finally decided to construct underneath the city of Baltimore, a suitable underground tunnel. At the instigation of this great undertaking, no definite plan had yet matured as to the exact manner in which trains should be operated through this tunnel.

In 1892, when the tunnel was nearing completion, it was found necessary at once to take up the question of determining quickly and definitely how these trains should be handled, because on account of the great length of this tunnel (which is about one and one-half miles) it was decided, from experience in this direction, that some different means of motive power than steam or some means of ventilation, would be required, not only as a matter of safety and convenience in operation, but considered from a point of comfort to passengers, and employés of the road.

After considering all points in favor of and against the several plans submitted for accomplishing the results desired, it was in May, 1892, that the contract was formally closed for installing a suitable electric plant together with specially constructed electric locomotives for the purpose of hauling freight and passenger trains through this tunnel. From the above date, progress in the way of perfecting plans and arrangements was rapid, and in May, 1893, ground was broken for the power house, which was to furnish power for the operation of these electric locomotives.

This work, together with the overhead construction, progressed uninterruptedly until its completion in June, 1894. On June 27, 1894, the first trial trip over the Belt Line with the electric locomotives was made. The entire length, including the tunnel proper and its approaches from either end, at that time, was about three miles. This trial trip was satisfactory, and on August 4, the electric locomotives went into regular service, and have been in use up to the present time, pulling all freight trains.

While those who had examined into the operation and pulling power of these electric locomotives, were confident of their ability to perform the work required, it was not until October of the same year that all doubts as to this were dispelled. It was on the fourth day of that month, due to some misunderstanding on the part of the operator, that two trains numbering in all forty-four loaded cars, together with three dead steam locomotives all coupled together, were stopped in the tunnel and started again by the electric locomotive, which did its work apparently as easily as with any ordinary train.

It was on a five-tenths grade that this performance was made, the total weight of the train being nearly 2,000 tons. The electric locomotive with this load, developed a speed of about eight miles per hour, exerting at times over an eight-tenths grade at the extreme end, a drawbar pull of about 62,000 pounds.

In the way of speed, with an ordinary passenger train, fifty miles per hour has been attained up this grade.

For some time after these locomotives were put in service, a great many railroad men, myself included, were skeptical as to the results they would ultimately produce, but from a practical standpoint, I am free to say that the electric locomotives operated by the Baltimore & Ohio Railroad on its Baltimore Belt Line, are without question, a perfect success.

This latter statement confirms itself by the fact that we are now making additional extensions, which when completed, will give a total length over which these electric locomotives will operate, of about four and one-half miles.

ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

BY JOHN C. HENRY.

Some ten years ago, the writer, in the columns of The Electrical Engineer, claimed the distinction of being the first to design and construct an electric locomotive that was used to haul standard gauge freight cars. Since that time the problem of "Electric Traction Under Steam Railway Conditions," which has been recently discussed by the American Institute of Electrical Engineers, has faced us. The record will show we have patented quite a lot of different forms of electric locomotives, the majority of which have been tested. My convictions as to what the most desirable mechanical and electrical constructions are, being so radically different from those proposed, I thought they might be of interest to some of the readers of The Electrical Engineer.

In the present state of the art, I am of the opinion that Mr. Baxter, Dr. Emery, or any one else who figures on the use of direct current machinery for long distance transmission, are wasting time. High potentials and the induction motor are here. Notwithstanding doubts to the contrary, the latter lends itself quite as well to regulation, if not better, than any direct current motor. By using a simple switch to change the number of poles of the field magnets, high efficiency is readily maintained under great changes of speed.

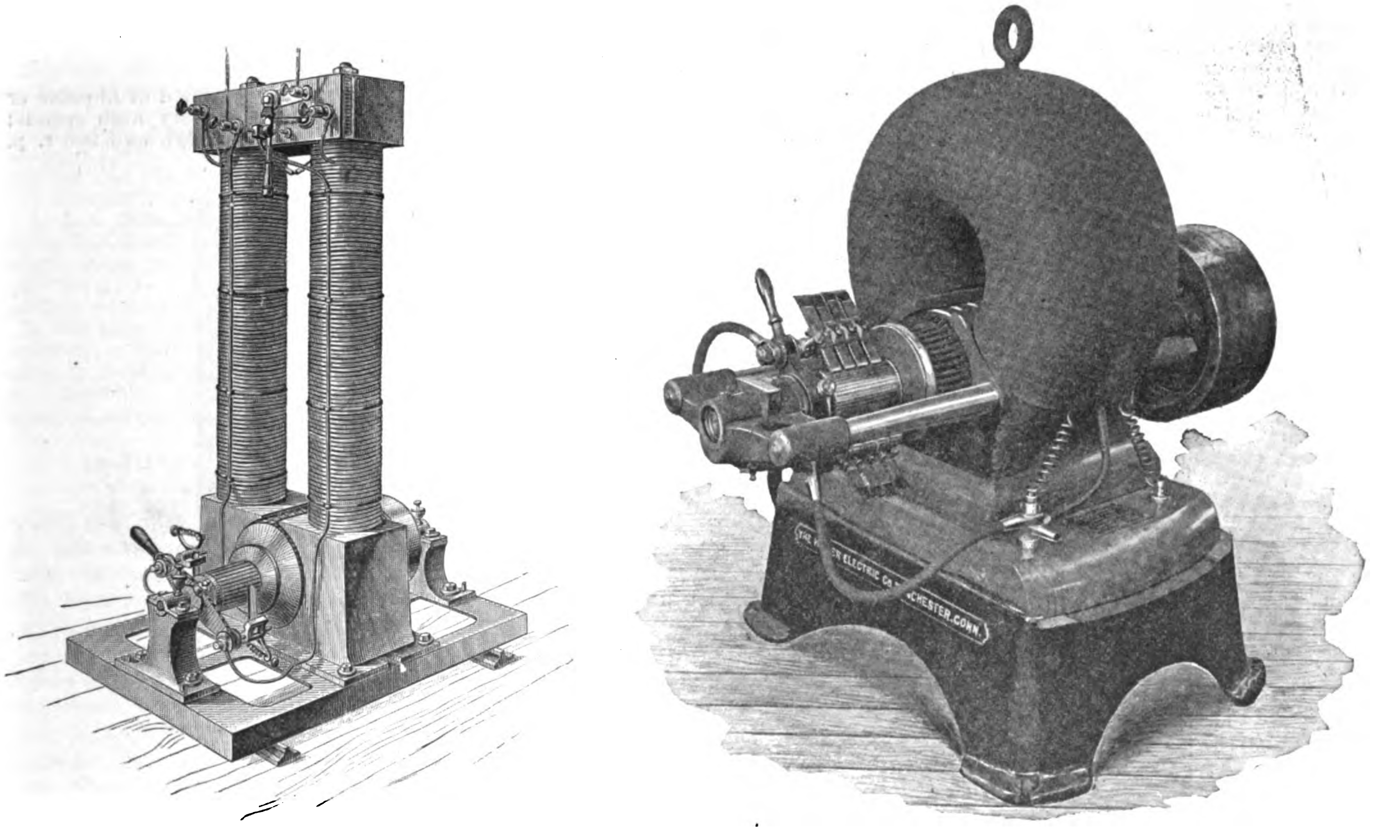
I disagree with Dr. Emery as to the desirable mechanical construction of the electric locomotive. He, I understand, proposes to follow the lines of the American steam locomotive, with all of its mechanical monstrosities, which have been necessitated by reciprocating movements and rough track. Although it is a wonderful piece of machinery and particularly suited to wiggle along over a rough and sinuous course, I think it would be a very difficult problem for a mechanical engineer to design anything (were it desired) as effective for the purpose of throwing the track out of line and knocking down the joints, as is the American locomotive, or even the ordinary electric car. To ensure that each wheel shall strike hard blows at every low joint, powerful springs are placed behind them. My judgment is—and it is based upon experience with both kinds—that where you have good track to start with, the axles may be supported in rigid frames as is the practice on English locomotives, and that they may be held in a position corresponding to what the track should be, so that when the latter is smooth all of the wheels roll on it; but where low joints, crossing, frogs, etc., are encountered, the wheels pass over without touching the depressions.

I appreciate the advantages of connecting rods, but they should be driven from the center and not from their ends, as is the common custom. In brief, I would propose to use a six-wheel rigid frame truck, with one pair of flangeless tyres, securing the armature of an induction motor to the center axle (either directly or through internal gear) and connecting the other axles thereto by rigid connecting rods, which link the three wheels together; such a construction having very few loose or wearing parts, could be constructed much cheaper than the common forms, and would be less liable to derangement.

I am aware of the stock objections that have been used against mounting railway motors on rigid supports. While they demanded attention in the early days before we learned how to make motors solid, they have but little force to-day. I think, were it desired to place electric motors within steam hammers, they would be forthcoming. With the passing of the brushes on dynamos and motor, we will be able to perform mechanical gymnastics that would make the direct current machinery dizzy. The old objections as to the evil effects of shock do not apply with much force to the best forms of induction motors. They have no commutators or brushes to be injured or disarranged. The armature on some of the best forms contains no wire, only a few heavy copper rods, which do not even require insulation. So that all that seems to be necessary is to cushion the field magnet wires, and this can readily be done by adding to their insulation.

In power plants, I think the present much admired, massive, cumbersome, direct connected dynamos are short lived standards, and that they must yield to the more scientific apparatus. That mechanical abortion, the sluggish acting centrifugal governor and the immense fly wheel, both of which have proved such elements of waste and destruction, are destined to the scrap heap. An electric governor which acts instantaneously is within the reach of any good electro-mechanical engineer. The dynamo of the future, whether needed for long distance transmission with converters, or for extensive city work and rotary transformers, will probably be of the induction type, the output of which can readily be doubled by substituting the field magnets for the fly wheel and driving it and the armature in opposite directions with a compound engine. This very desirable construction would be unobjectionable where the dynamos require no brushes, as is the case with inductors.

In conductors and trolleys there seems to be no occasion for improvements except to make the overhead work as trim appearing as possible. Such constructions as that at Baltimore are not liable to be duplicated. Whatever influenced the engineers there to use iron, with its low current conductivity, for conductors, and bridge work to support it, is a mystery to me.


OLD STYLE DYNAMOS.

The third rail, which was tried and abandoned by such celebrated engineers as Siemens, Edison, Field, Daft, Van Depoele and Fisher, appears to be again coming to the front. It, however, has too many objections to compete with the buried feeder and overhead span wire system, which I had the pleasure of introducing less than a dozen years ago. Although many hundreds of thousands of dollars have since been spent, and the genius of the world's best engineers has been devoted to schemes to avoid the overhead trolley wires, none of these so far developed are liable to be duplicated except under special conditions and in a very limited way. They are usually fascinating under favorable conditions, but lack the advantages of the high order of insulation that may be maintained with the exposed overhead wires. The flexibility and smoothness of the trolley's track, the exposed position enabling faults to be readily seen and easily repaired; these are almost essential features, and it is my opinion that any designer who ignores them will fail.

ELECTRIC LIGHTING

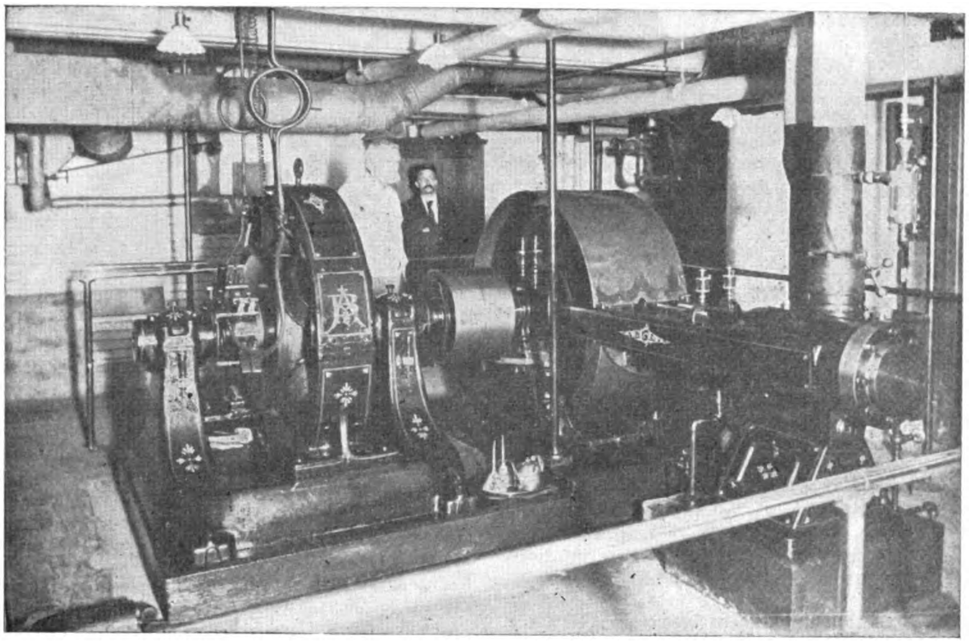
THE EVOLUTION OF THE ISOLATED ELECTRICAL PLANT DURING THE LAST FIFTEEN YEARS.—I.

BY CHARLES HENRY DAVIS, C. E.

IN the United States, the lighting of buildings by means of an electric current generated within the walls was in its infancy in the year 1880; the success or failure of an isolated electrical plant was a matter of conjecture; most of those installed up to that time have since been replaced, not only so far as generators are concerned, but also the wiring, fixtures, etc., in fact, in many cases, the entire system. Such plants when erected to-day are as certain of producing results desired as in any other branch of engineering; the evolution of this art in its various branches is of interest to history and as indicating the lines of development for the future.

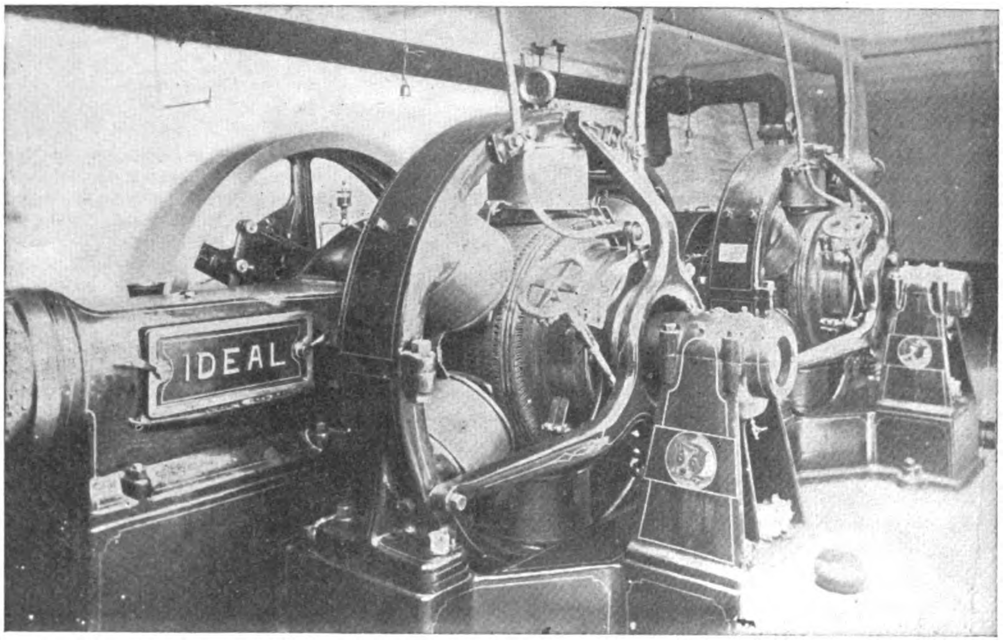
The first installations were designed for lighting purposes alone, while the modern plant operates lights, motors for elevators, fans and pumps, heating apparatus, arc lamps arranged for incandescent circuits, charging storage batteries,

etc., enabling the owner to utilize electricity in every part of the building and to dispense with hydraulic power and the use of gas where conditions show a saving. In the old days a plant involving the cost of ten or fifteen thousand dollars was considered large even with the then high cost of apparatus as compared with to-day, while now we have installations that exceed one hundred thousand dollars in cost; this, more than any one fact, presents most forcibly the enormous development of this branch of the electrical industry.



Modern Dynamo.

An isolated electrical plant is best defined as "a plant where current is not sold as the primary object of such installation," so that under this definition plants furnishing current for large works covering many acres would come within this class, although in their design and operation they approach the central station. In like manner private installations for mines or power must be included. While the broad definition seems necessary for the future, yet, now the term is more generally used as defining a plant located in the building which it serves; it is with the more general and present signification that the isolated electrical plant is treated of in this article. The term, isolated electrical plant, is usually shortened by omitting the word electrical, but strictly speaking isolated plant would include steam and electrical work; in making this distinction the writer will not consider the steam work of such installations. The subject will be divided into the following headings: Generating Plant; Switchboards; Wiring; Fixtures; Lamps; Motors; Contracts; Labor; Cost, and The Future.



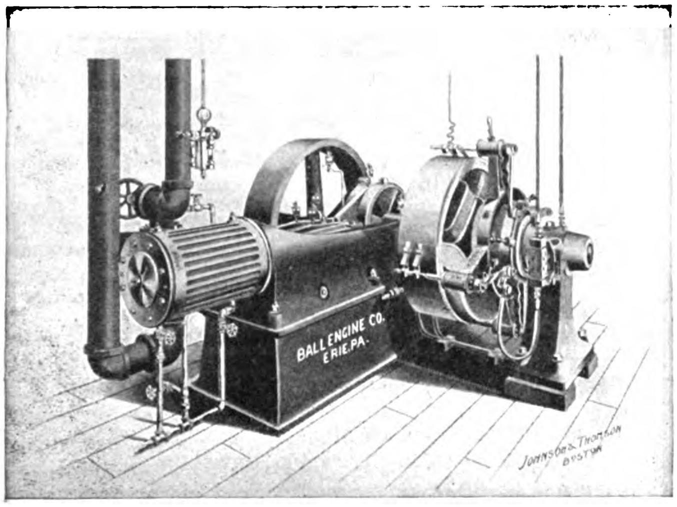
Modern Dynamo.

GENERATING PLANT.

The old time generating plant mostly consisted of bi-polar or consequent pole shunt wound dynamos of very high speeds; in some cases the speed developed was as high as 3,900 r. p. m. These machines had wooden bases, light shafts, small bearings with oil cups; were usually weak in mechanical design and sold at high ratings, causing hot and unsatisfactory operation; furthermore they were usually sold with the purchaser fully convinced that they needed "no attention" and were "automatic"; at first machines of different size were not run

in multiple. When compound wound generators were first put on the market the writer remembers the interest in the experiments and solution of operating them in multiple and the opposition to their use by manufacturers of shunt wound apparatus. The accompanying engravings show types used in the early days, in which is plainly shown the lightness of mechanical construction; these machines were not so inferior in their electrical efficiency compared to those of to-day as they were weak in their mechanical make-up and their inability to regulate closely made it impossible to maintain a constant potential at the lamps; compounding has become universal for the purpose of producing this result.

The development of better mechanical details led at once towards lower speeds to reduce wear and tear and this, combined with the necessity of saving space, has produced the slow speed, multi-polar, direct-connected generators of to-day, which are compounded, have bars of copper in place of wires on the armature, self-oiling bearings, steel castings, and laminated, toothed and ventilated armatures, gauze or carbon brushes and the best of mechanical design and workmanship. The illustrations show types made by several manufacturers of to-day. The belted machines run from 500 to 1,200 r. p. m., while the direct-connected are as low as 200 r. p. m. for the larger sizes, considerably below the older dynamos making 1,000 to 3,900 r. p. m. The improvement in commutation is marked, resulting in less sparking due to variations in load.



Modern Dynamo.

In the generating plant can be included the use of storage batteries, coming about the years 1884-85, and rapidly developing in their use only to lose the ground they gained by poor workmanship and unwarranted guaranties, but which are again an advancing factor in installations of this character.

15 YEARS' PROGRESS IN ARC LIGHTING.

BY PROF. ELIHU THOMSON.

THE past fifteen years is the period covering nearly all of the commercial development of arc lighting on the large scale. It is the period during which many great advances have been made and improvements introduced tending to the perfection of arc lighting technically and industrially.

At the close of the year 1881, there were but few central station enterprises based on electric supply, and practically all that enormous extension of such enterprises which has taken place began in 1881 by the establishment of a few stations for series arc lighting based mainly on the use of the Brush system. These stations were of very moderate capacity and sixteen to eighteen arc lights upon each circuit was considered a goodly number. The copper wire used for the line was entirely bare and generally without soldered joints. The writer well remembers that even in 1883 the lines in Cincinnati were of bare wire. It was there, in fact, that on the first production by the Brush Electric Company of machines of forty arc lights capacity, the foolhardy experiment of coupling up seven of these machines in series on bare copper was tried. But nature thus outraged rebelled and burned out several of the machines. This I think was in 1882.

Those were the days when an occasional Jablochkoff candle plant was to be found. But the electric candle soon burned out its life, though only burning at "one end." Those were the days of bad carbons; carbons bent like a bow, carbons soft, carbons hard, carbons from which the copper dripped when they were heated, or carbons which heated red hot throughout their length by their resistance. Those were the days of the "short arc" systems with twenty-five to thirty volts at the arc and twenty amperes for a (very) "nominal" 2,000 candle-power light. Those systems died; it was even evident then that they must eventually, and gave place to the "long-arc" or 40 to 50-volt arc, the true electric arc.

It was upon the use of the long arc that the Brush and Thomson-Houston systems were built and their commercial success and permanence was of course in a measure due to that fact. Curiously, we now see coming into vogue, extra long arcs, namely, the 80-volt enclosed arc on constant potential circuits, to which phase of arc lighting we will refer later on.

More might be said of the difficulties in the way of the first introduction of arc lights, but some of the obstacles which confronted the pioneer in the art have been alluded to above. In spite of the difficulties, the art grew and arc lighting became a recognized industry, while the economy and adaptability of the lights to streets and large spaces soon caused stations to be established in all the large cities and towns. The arc lights in use to-day in the United States are probably between one-quarter and one-half a milion. The color of the light of electric arcs was at first objected to as ghastly, but this prejudice, for it was only that, gradually wore away as the habit of seeing by the light became formed.

The design and appearance to the eye of the earlier lamps was certainly not pleasing, and in some of them decidedly the reverse of pleasing. For ungainliness there were examples which had not even the excuse of utility. Nowadays much more attention in response to demand is being given to the production of lamps of neat, convenient, ornamental design, and at times it would seem as if there might be danger of going to the other extreme, as when a man buys a watch for its case and gives little heed to the works. It should neither be necessary to "tight lace" the works and cut down the size of parts in an arc lamp to get it into a small case, nor should it be necessary to allow the "vitals" to spread out laterally to an inordinate degree so as to require what looks like a section of the largest size stovepipe to cover them.

The days of glycerine dash pots and glycerine carbon rods are past and gone. Such devices in clutch lamps were replaced by air dash pots and specially constructed, slow-feeding clutches. In geared lamps we still have those feeding by the removal of a detent from the feeding train and those working by an escapement oscillating from tooth to tooth. We still have series lamps in which the control is by a differential system of magnets, a winding in the main circuit acting magnetically to separate the carbons and opposed by a derived circuit around the arc. A great many lamps in use on series circuits are provided with derived circuit control only, as in the Thomson-Rice M & K lamps.

The improvements made in arc dynamos in late years have been such as are conducive to ease of handling and repairs. The capacity of the machines has, of course, been greatly increased during the past ten years. The regulation is now almost entirely some form of automatic brush moving mechanism, on the general plan of that introduced into the Thomson-Houston machines in 1880. It is sometimes combined with "field regulation," as in the later 125-light Brush machine. This plan of combined brush and field regulation was worked out by the writer with Mr. Rice about thirteen years ago.

A series arc dynamo is in some respects a peculiar machine. Dynamos to be used for running incandescent lamps may be very poor in design, but will work in a way. Not so with arc machines. Unless they have the proper form of characteristic curve they will give an unstable current, or a current which is only stable when largely in excess of that wanted for the circuit. In fact, the writer has found machines which were stable enough when working on differential lamps become unstable or "surge" badly when the load is of non-differential lamps, like the "M & K" lamps referred to above. The characteristic curve of the dynamo used for arc lighting must then be such as not only to imply a stability of current with arc lamps in series, but the curve may be required to be different with different lamps used as a load. For these reasons also arc dynamos cannot be designed to work with such high efficiencies as machines for constant potential work.

In regard to the running of arc light circuits, it is of course to be noted that a large amount of underground wire is now in use in cities and the result obtained while involving expense is in general satisfactory. Properly cared for, the cables maintain a high insulation and are of course out of the way of injury or leakage by crossing of other wires or by accidents due to storms. Naturally, it is a prime object to keep the potential between wire and earth as low as possible, especially when circuits of 75 to 150 lights are used.

In the recently constructed large Brush arc machines of 125 lights capacity, the full potential may be about 7,000 volts. But as the machine has three commutators and is therefore virtually three generators in series, a material saving of stress on insulation is obtained by connecting the lighting loops or circuits between the commutators in such a way that the circuits of light and generating armature coils in series alternate in position on the circuit. Thus the current leaving the positive brush of one commutator passes through a circuit of, say, 42 lamps, then in at the negative brush of the second commutator and out at its positive brush, through a second circuit of lamps, and so on, through the machine and lamp circuits in series. In such an arrangement the difference of potential between earth and line at any point is much below the total potential and in no case can it rise to be more than a moderate fraction of the whole. Within the past few years a certain amount of lighting has been done by alternating current arc lamps fed from secondary lines of alternating current plants. In some cases these lamps are a great convenience, but the lamps themselves are more sensitive to changes of voltage, require soft carbons, specially made for the work, and, for a given energy expended, the output in light is far below that of the direct current arc. The noise of the arc is also an objection except out of doors. The writer, in 1879, made attempts to enclose arc lights in globes so as to exclude the air. But it was found that owing to the great amount of impurities then existing in the carbons the glass was soon coated with a brownish deposit.

More recently similar attempts have been made from time to time and circuits of arc lamps have been run in series, each arc enclosed by a fairly gastight glass receptacle. It had long been known that if air was kept away from the carbons they would burn blunt or nearly square at the ends. This with ordinary lengths of arc would, of course, prevent the light from escaping except at angles not far from the horizontal plane. To overcome this the voltage and separation of carbons underwent an increase until now lamps are run at an arc voltage of eighty and a corresponding separation. An enclosed arc can naturally be an extra long arc without danger of being wafted aside by air currents.

Such lamps are now run with great success upon circuits of constant potential, such as the incandescent lamp circuits at 110 volts. With 30 volts taken up in dead resistance the arc at 80 volts has a sufficiently stable current. Lamps for three amperes, and particularly those for five amperes, are now standard.

Their chief merit is their long burning quality without frequent renewal of carbons. They can continue to be effective sources of light for 100 hours or even 150 hours with one set of carbons. While it is true that the actual light-giving power of such a lamp for a given amount of energy consumed at the arc is not as great as that of the naked arc, it is still, in view of the saving of carbons and attention, satisfactory.

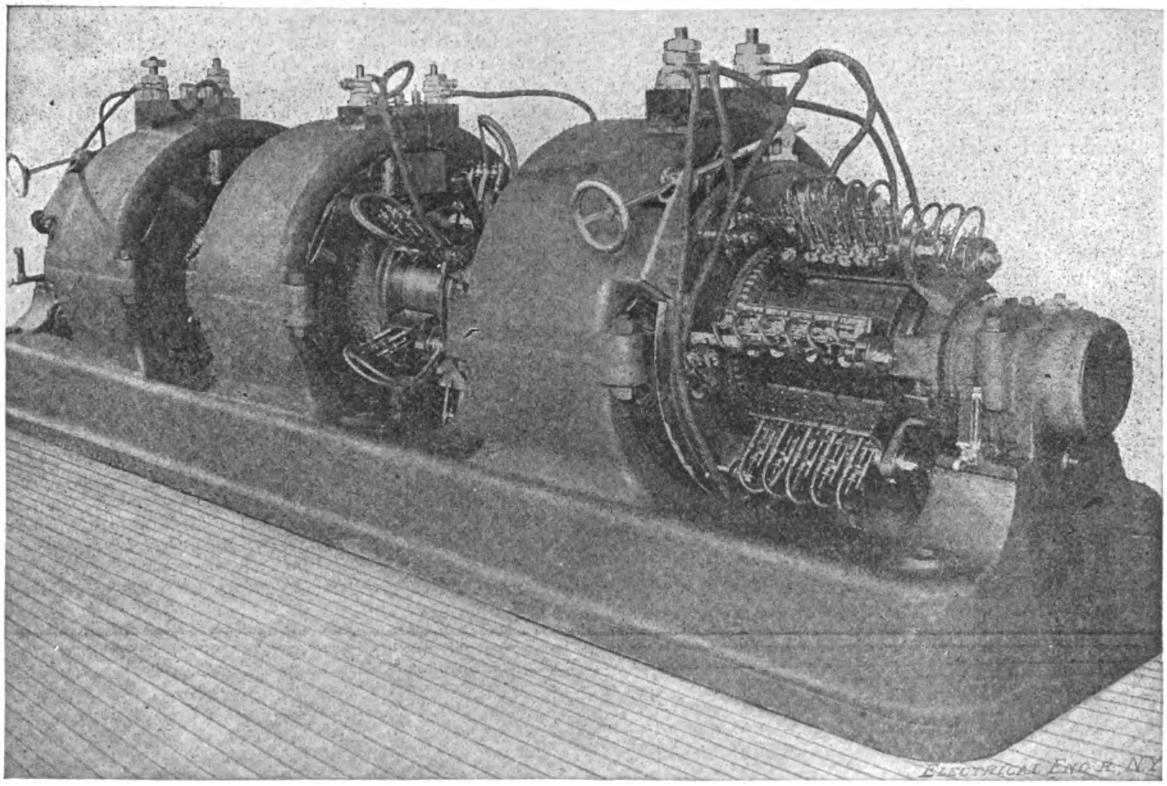
The success of such lamps depends upon purity of carbons and specially pure makes of them have to be used. Otherwise too great an obscuration of the sides of the globe will be the result. It is only in recent years that carbons fine enough for this use could be obtained. The "enclosed arc" undoubtedly fills a need, and its use will grow to considerable proportions in the near future. The lamps are even being used to replace groups of incandescent lamps in stores, etc.

In this brief reference to progress in arc lighting there is little more to say. It is to be hoped, however, that conditions may in the future be such as to permit the introduction of better means of hanging arc lamps in our streets. They do these things better abroad. Most of our arc lamp posts and hanging arrangements are as works of art described by the word "execrable." Let the cities furnish artistic, substantial poles and fixtures for the lamps and the electric station manager will take a pride in giving a light to match.

THE CHURCHWARD MULTIPOLAR BOOSTER.

THE Excelsior Electric Company has lately installed in the Second District station of the Brooklyn Edison Illuminating Company a booster of the latest Churchward multipolar type, for the Barstow booster system employed by that company. The machine is illustrated in the accompanying engraving.

The two end machines are dynamos having a capacity of 1,000 amperes at 50 volts. The middle machine is the motor, so constructed and connected as to run on either 125 or 250 volts; 250 volts when dynamos are required to give their current output at a high pressure and 125 volts when dynamos are required to give their current output at a low e. m. f. The advantage of this is that the dynamos will always have a comparatively strong field.



CHURCHWARD BOOSTER IN EDISON ELECTRIC ILLUMINATING CO.'S STATION, BROOKLYN, N. Y.

The dynamos are fitted with carbon brushes and the commutators are built up with drop forged bars, with sufficient surface so that the carbon brushes have bearing enough to carry the current at the low density of 20 amperes per square inch.

The advantages of carbon brushes for this type of machine are very evident. In cases where the load fluctuates severely as in motor service, or where the machine has to work on a constant current and variable pressure or again with constant pressure and variable current, if copper brushes were used they would require constant attention and adjustment, while with carbon brushes the severest changes of load can be taken care of without sparking and without adjustment of brushes. The machine illustrated was able to carry its full current at a pressure of 1 volt at full speed, showing that the armature reaction is very slight.

The fields of this type of booster are separately excited from the station bus bars. The rheostats are especially constructed with a great number of points, so that the voltage of the dynamo can be varied from 1 volt on open circuit up to 50 volts at 1,000 amperes.

The floor space occupied by this machine is 12 feet 2 inches by 34 inches wide by 37½ inches high; its weight is 14,153 lbs.

This is the second machine of the same capacity that Mr. Churchward has designed for the Edison Illuminating Company, of Brooklyn, the first one being in the First District station in Pearl street, and has been running a little over two years.

FIFTEEN YEARS IN CENTRAL STATION OPERATION.

BY SAMUEL INSULL.

(President Chicago Edison Co.)

As late as the winter of 1880-1 some of the best electrical experts of Europe, to say nothing of this country, were questioning the possibility of the success of the incandescent electric lighting system, the development of which is now universally conceded to Mr. Thomas A. Edison. At that time, a small distribution system was in operation at Menlo Park, N. J., and I well remember paying a visit there one evening immediately after my arrival in this country in March, 1881. I was naturally carried away by the enthusiasm of the moment, seeing for the first time an incandescent lighting system in operation. The pleasure of the occasion was greatly enhanced by having as my guide the illustrious inventor himself, and after spending the evening with him I hurried to the cable office to apprise my friends in London that Edison's electric lighting system was an accomplished fact.

Immediately after this Mr. Edison took up the engineering problem of designing and installing the first incandescent central station plant, so well known as the old Pearl street plant and system. I have often wondered whether Mr. Edison actually realized at the time the stupendous task before him. He had worked for several years in the laboratory, on his electric lighting system. Its success as a laboratory experiment was complete, but as a matter of fact in the year 1881, when he was probably more talked about than any other living American, his work had hardly begun. To launch successfully his great inventions in electric lighting, it was necessary not only to design the plant, the system of distribution, and the one hundred and one devices in connection with interior wiring, but also to equip one factory for the manufacture of incandescent lamps, another for the manufacture of generators, a third for the production of underground conductors, and yet a fourth for the construction of house wiring devices and fixtures. Whilst the money for the central station plant and distributing system was mainly provided by some of his banking friends, it should be remembered to his credit that Mr. Edison risked what money he had made as the result of his telegraphic and telephonic inventions, in equipping the four factories above refered to. Whilst he was loyally and ably assisted by a devoted corps of assistants, his was the master mind that carried through this great undertaking which was to a very large extent a leap in the dark; and when it is remembered that this first plant proved a great success and paid dividends on the original investment of $1,000,000, one cannot but admire Mr. Edison as an inventor and electrical engineer, to say nothing of his business sagacity which the success of this investment in an entirely new branch of industrial work demonstrated.

To one connected with the electric lighting industry at its inception, only fourteen years ago, it seems almost impossible to realize that in a decade and a half the business should have grown from nothing to such enormous proportions, as is shown by the fact that up to this time about $350,000,000 has been invested in 2,750 central station undertakings in the United States, and that probably $250,000,000 has, during the same period, been embarked in some 8,000 plants for isolated lighting.

The financial interest involved in so vast an investment is sufficient evidence of the absolute seriousness of the central station industry, but if this is not sufficient we have but to contrast the character of the construction adopted in connection with the large central station undertakings of to-day with the method of ten years ago. True, Edison's original scheme of direct connected units as shown by the "Jumbo" machines used in the Pearl street station has been revived, after the use for some years of belted generating apparatus, with the advantage that the great strides made in dynamo designing have rendered it possible to run at much lower speeds, enabling the central station manager to use vastly more economical steam generating machinery. Some writers make the mistake of assuming that because the early central stations were usually located in that portion of a city where real estate is generally the most expensive, the custom has become a necessity. Those engaged in the early exploiting of the central station industry are familiar with the fact that it was comparatively easy to induce the pioneer investors to expend a large amount of money on a valuable piece of real estate while it was a difficult task to induce the same people to make the outlay for a distribution system; hence the necessity for locating a station in the very heart of the business district—dispensing, as far as possible, with expensive feeders and foregoing the advantages of location near a railroad for cheap fuel or on the banks of a river or lake for condensing water—was made absolutely necessary by the demand for low initial investment.

To-day this situation has changed. The large modern stations with the most costly class of steam and electrical machinery in New York, Boston, Chicago and other large cities, are of themselves the best evidence of the confidence alike of the capitalist and the central station manager, and must be accepted as an answer to those writers who theorize as to whether central stations are doomed.

I know of several central stations in large cities which generate power, deliver it to the consumers, clear the business off the company's books, and, in short, pay all expenses excepting interest, at a cost not exceeding the cost of the gas companies in the same locality. If this can be done, surely it is only a question of obtaining the volume of business in order to produce relatively the same results as those obtained by the gas companies, as the investment necessary in both classes of business is not very far apart. It must be borne in mind, however, that the results referred to are obtained only through the agency of the most modern central station plants.

A central station manager is confronted with the necessity of finding some means of obtaining better results, so far as cost of generating is concerned, in the outlying territory, say, in the residential districts where the central station load is not heavy enough to justify the investment in expensive generating plant and where it is impossible to obtain the advantages of cheap water for condensing and adjacent railroad connections for cheap fuel. My experience has been confined mainly to the Edison low tension system, though I handle arc systems also, but it would seem to me that small central stations in outlying territory will be largely dispensed with in the next few years and their places taken by sub-stations, in which will be installed rotary transformers (and possibly a small storage battery equipment), operated by alternating feeders, the current for these being generated at the point where the main output of the company is produced under the most economical conditions.

This method has been decided on as the best one to be used in Chicago. Two small generating stations on the north and south sides will be abandoned within the next few years. All current will be generated from two large stations on the river where fuel can be delivered to the boiler room at the lowest possible price and water be obtained for condensing purposes at a trifling cost. The large low tension load required downtown will be generated by direct current generators, as at present, the load for the outlying territory being taken care of by means of generators of special design, and high pressure alternating transmission and low tension three-wire distribution from substations. By this means the same low cost possible in the district where great quantities of current are in constant demand will, except for the losses in transmission and conversion, be available as a basis for figuring the selling price in the outlying territory.

It is not the purpose of this article to go into the details of central station management and the possibilities of the central stations competing with isolated plants and with so-called block plants. The figures of cost to the central station plants given by some recent writers may have been correct, but if so, they simply bear evidence of the fact that the stations showing such results are ill equipped and poorly managed. The fault is not with the central station industry as a business, but with the design and management of the plant. On the other hand the figures given by the same writers as to the cost of operating isolated or block plants are theoretical and are not the results of practical experience. After operating both large and small plants from 10,000 horse-power down to a few hundred horse-power, I believe that the vast investment made in central station lighting is fully justified by the results, and the same principles properly followed out in every branch of industrial enterprise—showing that the wholesale manufacturer, although apparently having large expense, can compete with the small producer and occupy his field with profit—are equally applicable to the central station industry, as opposed to small producing enterprises such as block and isolated plants.

The success of the central station industry, however, does not depend alone on economical production. The judicious selling of his product is equally essential to the success of the central station manager. It often occurs that a customer who is willing to pay 20 cents per kilowatt hour for electric energy is not so desirable as one whose business can only be obtained at 5 or 6 cents per kilowatt hour. The central station manager who thinks that he cannot compete with an isolated plant where there are long hours of burning, assuming that he has a reasonably economical central station equipment, is usually led astray by a lack of knowledge of the elements that go to make up his cost of energy.

The more the central station manager elaborates the detail of his cost sheet, the more easy will it be for him to find means of competing for business, which will broaden his curve, lower his cost and increase the number of hours of each day that his plant is earning money for its owners. The selling price of 6 cents per kilowatt hour to large consumers having a steady load all day is no theoretical figure. It is a price very generally quoted. To my mind the obtaining of what might be termed the wholesale business, is a settled fact, and is much easier to deal with than in enlarging the business with small retail customers. The difficulty with the latter is in the way of wiring and fittings, few houses being at present equipped. But time will cure this, and with the tendency to centralization of plant, made possible by the great improvements in systems of distribution and the consequent low cost of production which will necessarily follow, it does seem to me quite within the realm of possibility that the small customers of central stations will within a few years, be able to purchase current at prices not much higher than those now charged in large cities for illuminating gas.

BROOKLYN, N. Y., has been talking municipal light plant, but she has already reached her debt limit, and not less than $2,000,000 would be required as a starter.

MECHANICAL

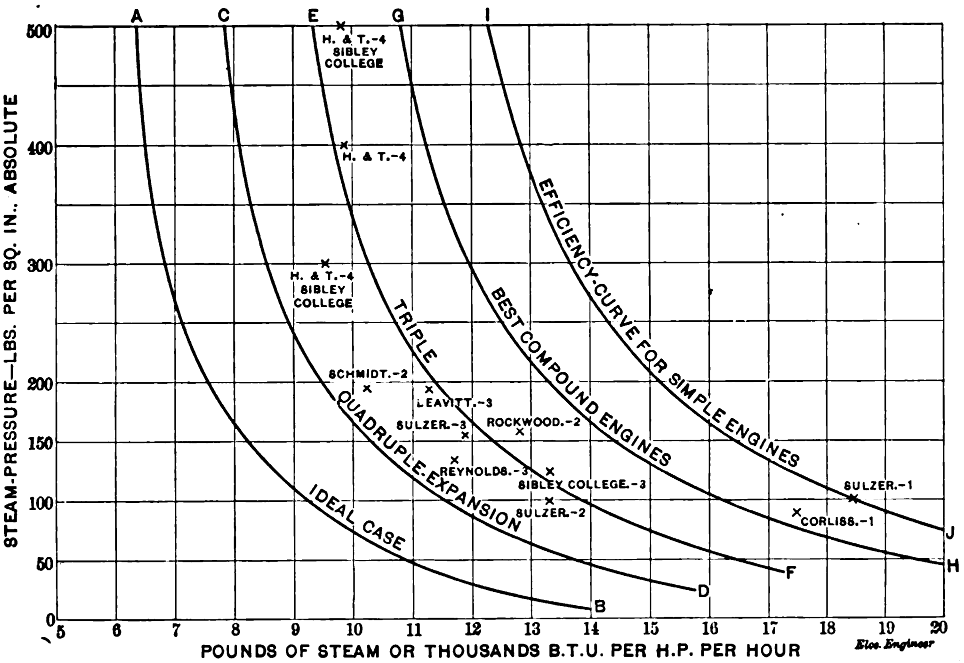
THE STEAM-ENGINEERING OF TO-DAY AND OF TO-MORROW.

BY PROF. R. H. THURSTON.

(Director Sibley College, Cornell University.)

IN the early days of electrical distribution of power and light, and, in fact, before the introduction of electric railways and of power distribution had fairly passed the experimental stage, the writer was asked by the editor of this journal to prepare a series of articles for publication on the subject of "The SteamEngine for Electric Lighting." These were published, later, by Messrs. Wiley, in book form, from plates kindly furnnshed the writer by the publishers of the original articles, and have now for many years been a reference book of the engineer and of the layman as well upon that subject[1].

In this series of papers was presented, as fully as space permitted, accounts of the then standard forms of the steam engine as adapted to the use stated, and a brief statement of the special and characteristic features of the machines described and of the design and construction of their principal details. As time went on and further progress was made, the book was revised, and, as happens, is now under revision once more, with the intention, on the part of publishers and author, of bringing it up to date by the introduction of the rather interesting and sometimes remarkable changes of later years.



EFFICIENCY CURVES OF BEST ENGINES, 1896.

At that date, the standard forms of engine in use for such work were the older Corliss type of engine, the Greene engine, the then still novel Porter-Allen engine, the earlier forms of "automatic," and all the beginnings of a now familiar practice. Since then, the drop cut-off engines have been improved by the addition of safety devices to meet the emergency of sudden loss of load or the slipping or breaking of the governor connections; their speeds have been increased from the old figure, forty-five to sixty, up to ninety and, in some cases, a hundred revolutions a minute, or more, bringing up their piston speeds to about six hundred feet a minute ordinarily. The steam pressures have risen from about eighty, as an average maximum, to one hundred and twenty-five pounds, in standard practice; while the consumption of fuel has dropped ten or fifteen per cent. Condensing is more common than formerly, and compounding and steam-jacketing are becoming familiar expedients for raising the efficiency of the machine.

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[1] "Stationary Engines for Electric Lighting." By R. H. Thurston. New York: J. Wiley & Sons; 5th Ed., 1892. Reprinted with revision and additions descriptive of recent practice from "The Electrician," now "The Electrical Engineer." New edition in preparation.

"Automatics" have become formidable rivals of the engines with detachable valve-gear, in economy as well as through their special features of marvelously close governing, of a positive motion valve-gear, their consequently higher speed, and their special security against accident due to loss of load or injury to the governor and its connections. The contracted quarters often assigned this class of machinery, as a consequence of the often very high cost of real estate in the cities, has resulted in the introduction of the marine type of engine, with its vertical cylinders and peculiar forms of framing and accessory parts, and, under such conditions, the triple-expansion machine has often been found desirable.

At the boiler, the progress observed in increasing steam pressures, from the time of Watt, has continued, and, where economy of fuel is an important item, the water-tube boiler, built for 150 pounds and upward, is coming into use. In other fields of stationary engine and in marine practice, as in locomotive construction, 180 pounds is now not unusual and 200 and upward are figures beginning to be observed. There seems no reason why, as a matter of engineering construction, to-day, the now long familiar figures, of the practice of Messrs. Perkins, 350, 400 and 450 pounds, or more, even, should not be adopted. Mr. Leavitt has been long employing 185 pounds in stationary engine operation. Gain is observed with rising pressures, within the now actual range of maxima of leading practitioners, roughly speaking, as the square roots of the pressures—more accurately, probably, as the logarithms of the pressures. Superheating is employed to a very moderate extent in this country, and on rare occasions, while, in Europe it is now, as always, much more common and more radically used[2].

Where it is difficult to furnish ample floor space for the older type of boiler, the water-tube boilers are set, irrespective of relative costs; and when the head-room is ample and the ground area restricted, the vertical tubular boiler finds its peculiar place. Of the two classes, the water-tube and the fire-tube boiler, the former excels in capacity, as measured per square foot of heating surface; the latter is built and sold more cheaply. The one usually demands, for good work, about ten square feet of heating surface per conventional horse-power—34½ pounds of water evaporated "from and at" 212 degs.—and the latter requires twelve to fifteen; the last-named figure being that adopted by the older and more experienced builders. Isherwood's experiments, a generation ago, showed an advantage in capacity and in economy, other things equal, on the side of the former, of about 10 per cent., and later practice confirms his deduction. Either kind of boiler, set, and in operation at its rated power, should be capable of delivering, when forced, at least one-third more power, for use in case of emergency. Some boilers may be forced to double their rating, especially with the soft coals. The best designers give excess of about forty or fifty per cent. to meet such cases.

The unanticipated reduced cost of recent years in the production of the compound engine, and its large gain, as compared with the simple machine, giving at once an engine of moderate cost, and of greatly reduced magnitude and cost of the boiler supplying it with steam, has now, in many, if not in most cases, made the first cost of the plant less than that of the simple engine and its boiler, so that we have, in such instances, the curious fact observed that both first cost and economy of operation dictate the use of the compound engine. As a rule, also, as shown long ago by Mr. Emery, the compound is the most desirable form of engine, on the score of total running costs, whether compared with the less economical simple engine on the one side or with the more efficient triple and quadruple expansion engines on the other side. The latter, nevertheless, where exceptional economy is rendered essential by high price of fuel and of boilers, find their place and may pay handsomely.

In detail, the engine of to-day excels in its admirable proportions of running parts, in the solidity and symmetry of its frame, and in the extraordinary efficiency of its governing mechanism and of its valve-gear and steam-distribution[3]. That now well-recognized aid to improved efficiency of thermodynamic action of the machine, the steam jacket, is more generally used in this country than formerly, though not nearly as generally as in Europe, except on steam pumping engines and other slow-moving machines. Its value is coming to be well-established, and at its true rating, however, and the conditions under which it may be safely and economically employed are now well understood by intelligent and well-informed engineers engaged in steam-engine design and construction[4].

The steam engine of to-day has, through the intelligent application of the now familiar principles and methods of modern construction, assumed a fairly standard and probably nearly permanent form and proportion, and the anticipated improvement of the coming years seems likely to be the result of gradual increase in the pressure of steam employed and of the introduction of more and more superheating. The best usual figures for our practice of to-day, may be taken as substantially as follows, for saturated steam at 125 pounds and for large jacketed condensing engines:

Simple "drop cut-off" engines, lbs. steam per I. H. P., per hr.	20
Compound engines, lbs. per I. H. P., per hour	16
Triple-expansion engines, lbs. per I. H. P., per hour	14

Two pounds less may be reached under especially advantageous conditions, and superheating may still further add to economy ten per cent. and upward. The unjacketed engine should be expected to consume at least ten per cent. more steam than the above, and throwing out the condenser may reduce the economy something like twenty per cent. in ordinary and representative average cases. Gains and losses are, however, in actual practice, very variable and depend greatly, for their magnitude, upon every variable condition of design, construction and operation.

The outlook, in respect to engine efficiency and economy in the use of heat, steam and fuel, may perhaps be fairly well indicated by the data exhibited in the accompanying diagram, which represents the variation of efficiency and economy in the expenditure of heat, steam and fuel, in the ideal, purely thermodynamic, case, under the most favorable conditions of actual practice, as seen on the curve A B; in the case of an engine in which the total of all wastes is taken at about one-fourth the supply, as on the line C D; and in cases in which larger proportions of heat fail of useful thermodynamic transformation, as on lines E F, G H, and I J. Condensation and a good vacuum are assumed, and a feed-water supply at such a temperature as will store about one thousand heat-units in each pound of steam passing through the engine and boiler cycle, where jacket-water is included.

The forms of these curves are substantially exact, their location being representative of good practice, and the area bounded by them being taken as inclusive of the whole field of best recent practice. The limiting curves are those for good modern practice with the simple engine and the case of the perfect thermodynamic machine; while the intermediate curves may be taken as approximately illustrating past and prospective experience with the multiple-cylinder engines. The data obtained from recent records are illustrated by the points inscribed in this field, the number of cylinders in series, in each representative case, being indicated by the attached figure.

It is seen that the best simple engines recorded are the Sulzer, which gives a point on the curve I J, and the Corliss, a simple engine which excels the former somewhat and gives a point nearly attaining the first line, within the curve G H. The best compounds are the Rockwell, which nearly reach over to the line assigned good triple-expansion engines, and the Sulzer which excels that standard and approximates that of the triple-expansion engines of contemporary practice. The best triple-expansion engine results, judged from this standpoint, are those of the small experimental triple expansion of Sibley College, designed by Reynolds, working at 113 horse-power, and which comes close up to the standard curve assigned this class, the Leavitt and the Sulzer, which approximate the standard but somewhat excel it, and the Allis, another design by Reynolds, which considerably excels the standard. The Schmidt engine is a small compound machine, brought over into this part of the field by its effective system of superheating.

The only quadruple-expansion engine in the set is that of Hall and Treat, built as an experimental engine and the property of Sibley College. This falls into one or another of our standard curves accordingly as its system of drying and reheating steam is made more or less effective. Were either of the experimental engines here referred to reproduced on the scale of the larger engines with which they are here brought into comparison, the resultant diminution of internal heat-wastes would carry them over near the standard line next the ideal, and they would then demand less steam, heat and fuel by presumably twenty-five per cent. at least. The line adjacent to the ideal, here marked quadruple-expansion, is that which experience seems, in the judgment of the writer, to indicate may be hoped and fairly anticipated to become that of best actual practice when the design, the construction and the operation of the engine is made in all respects as satisfactory as present knowledge and our improving skill should permit.

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[2] "On Superheated Steam." By R. H. Thurston. Trans. A. S. M. E., May, 1896; Vol. XVII., No. DCXC.

[3] "On Superheated Steam." By R. H. Thurston. Trans. A. S. M. E.; May, 1896; Vol. XVII.

[4] "Authorities on the Steam-Jacket; Theory of the Steam-Jacket." Trans. A. S. M. E. By R. H. Thurston. 1890; Vol. XII.; 1894, Vol. XV. Nos. CCCCXXXV., DLXXXIII.

The general trend of the curves indicates the gain to be anticipated from increasing pressures when we shall have become as competent to avail ourselves of them as we are today in the use of the familiar pressures of our own time. The thermodynamic value of either engine is obviously measured by its economy in the use of steam and, especially, by its approximation to the ideal curve. The line C D is the estimated position of the quadruple-expansion engine of Sibley College, reproduced on the scale of the large engines with which it comes into competition on the diagram. In the comparison of types and of performances of engines, it is now clearly seen that the simple statement of their relative demand for steam or for heat is not a true gauge; the figure must be compared with the curve of efficiencies in the manner here illustrated to determine the real position of the engine, thermodynamically, and the merit of the design.

The success of the steam-engine designer and constructor is not, however, entirely dependent upon his own efforts, or even upon the intrinsic merit of the machine, or on the location of its representative datum upon our diagram; it depends, in very large and often controlling degree, upon the conditions of the case outside the engine room. It is only when the load upon the engine is held constant, and at that amount for which the machine is best proportioned that the maximum efficiency of the engine can be secured. Every variation from its best load, and especially in the direction of reduced demand for power, causes loss of economy of power-supply. The disposition of the plant in such manner as to insure the most uniform possible load upon the engine, and the assignment to each machine of its proper proportion, securing so far as practicable its best load, is a primary requisite of economical operation. In the design of large stations this problem is less difficult of solution than with smaller loads; but it is usually the principal obstacle to the attainment of highest duty. As the storage battery becomes more satisfactory in first cost, in endurance, and in operating expense, this problem will become less and less difficult of solution and the perfection of a steam power system in the distribution of electrical energy will come, when this or some other method of giving the engine its best and a constant load can be secured.

THERMO ELECTRICITY

ELECTRICITY FROM COAL, WITH AND WITHOUT HEAT.

BY WILLARD E. CASE.

All great discoveries necessarily pass through a process of evolution. Since the discovery of the arc by Davy and its more successful operation through the demonstrations of Faraday, the science of electricity has made great strides. The century's advance has been so rapid that no one dares predict what is possible. The feeling has existed for several years that an immense amount of energy is being wasted in generating electrical energy by steam. It is an inexorable law of nature that under the conditions in which we live, a great waste must accompany the transformation of heat into any other form of energy. To condense steam in the condensing engine it requires four or five pounds of water to every pound of steam. Three-fourths the heat used goes to warm the water and is wasted. In hot air engines, or gas engines, a cold water jacket must be used and to it goes the larger share of the heat employed. In the thermopile one set of junctions must be kept cool by circulation of air or water. In Edison's pyromagnetic generator the iron tubes must be cooled by a blast of cold air.

By the second law of thermo-dynamics the minimum amount of heat that goes to this cooling agent is the fraction, $\frac{t}{T}$ of the total amount employed, where t is the temperature of the cooler reckoned from the absolute zero, and T the higher temperature of the working substance; t cannot be less than 500 degs. so the numerator of the fraction is always large and the heat wasted is the larger portion. Let it be understood that this is a law of nature, it is inevitable under the conditions in which we live. No cunningly devised furnace, or feed water heater, or cut-off, or triple expansion apparatus, or pyrogenerator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted over and above the proportion $\frac{t}{T}$.

But are we to go on wasting all this energy of fuel? Cannot some means be employed to utilize it? We know that the voltaic battery is not a case of the transformation of heat into electrical energy, it produces electrical energy directly. The second law of thermo-dynamics does not apply, as no heat appears. If we could convert the chemical energy of coal and oxygen into electric energy direct, and cheaply, we would do away with our steam motors in time. There is no known reason why a cheap substance may not be found which will act on coal and develop electric currents in place of heat. This electric energy would be the equivalent of the heat energy that would be developed by the combustion of the same coal in the ordinary way, and could be transferred into mechanical power, heat, light, etc., with small loss.

In a paper read by the author in 1888 before the American Institute of Electrical Engineers, this principle was advanced, and a carbon consuming battery shown which operated in the cold, demonstrating its success theoretically, but not commercially, as the oxidizing agent was too expensive. The cell consisted of platinum opposed to carbon in an electrolyte of water saturated with chlorine peroxide. The carbon was attacked and oxidized to carbonic acid, as proved by analysis. The e. m. f. equals over one volt.

A résumé of some of the efforts to solve this problem, which have fallen under the author's notice, put in chronological order, may be of interest. They may be grouped as follows: 1. Cells which were devised to utilize the oxygen of the air. 2. Carbon consuming cells. 3. Cells combining both principles. And it is surprising to find they were all co-existent some years ago.

1. Of the cells which develop electricity by atmospheric-oxidation Gladstone and Tribe[1] in 1873 described a cell which consisted of a tray full of silver crystals as one electrode, opposed to a copper plate immersed in a solution of 6 per cent. copper nitrate; cuprous oxide is formed and deposited on the silver; the oxygen of the air being the active oxidizer; e. m. f. about $^1/_{10}$ volt. They also described in the same paper a cell formed by opposing zinc to copper in a 20 per cent. solution of zinc chloride. Oxygen of the air is absorbed, giving an e. m. f. of $^7/_{10}$ volt. In 1887 Wright and Thompson[2] showed a cell in which copper is opposed to platinum in a solution of ammonia; oxygen of the air is absorbed and cupric oxide formed which goes into solution, e. m. f. equals $^8/_{10}$ volt.

Andreas[3] also described another form which comes in this class, as oxygen of the air plays a part; he uses two carbon tubes immersed in dilute sulphuric acid, and supplied respectively with sulphur dioxide and chlorine under pressure; e. m. f. $^5/_{10}$ volt. The products of the action are sulphuric acid and hydrochloric acid.

2. Cells in which carbon is oxidized to produce electrical energy. Jablochkoff's "heat cell" brought out in 1877, consists of a vessel, the positive electrode of cast iron, containing a fused bath of nitrate of soda which supplies the oxygen that attacks the negative carbon electrode; e. m. f. equals one volt.

Bard "Brick," so called, was brought out in 1882. The electrodes, tablets of carbon and nitrate of potash, were separated by sheets of asbestos. When placed in the fire it gave about one volt.

About the same time we had the Crum heat cell. This consists of carbon, iron, black oxide of iron fused. in which the carbon is attacked. Also Edison's carbon consuming cell in which a fused oxide is reduced by carbon. the bath being regenerated by oxidation.

Andreas' cell[4] consists of two carbon electrodes separated by a porous partition, the one immersed in a solution of cuprous chloride, the other in one of cupric chloride; carbon monoxide was led into the first compartment and chlorine into the other, the combination gave 10 ampere hours with an e. m. f. of $^6/_{10}$ volt.

Dr. Bucherer[5] has described this form of cell, in which he attempts to oxidize carbon monoxide. The apparatus consists of a wrought iron vessel containing a fused bath of potassium and sodium carbonate; the electrodes are hollow, supplied with carbon monoxide and oxygen under pressure.

3. Cells combining both principles in which the oxygen of the air is made to attack the carbon:

(a) Without the aid of external heat. Wright and Thompson[6] in 1889 described an attempt to produce a current by oxidizing coal gas or hydrogen with the oxygen of the air, in a solution of alkaline permanganate; or sulphuric acid, and potassium dichromate. Many other cells of this class have been described by others, but no great advance seems to have been made.

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[1] Proc. Roy. Soc., Vol. 21, p. 247.
[2] Jour. Chem. Soc. 1887, part 2, p. 672.
[3] "Electrician" (London) Nov. 20, 1896.
[4] "Electrician" (London) Nov. 20, 1896.
[5] "Electrician" (London) Nov. 29, 1896.
[6] Proc. Roy. Soc. 44, 182-200.

(b) With the aid of external heat. The first cell of this class, which came under the author's notice, was during the discussion of his paper above referred to, on "Electric Energy from Carbon Without Heat," in 1888, when Mr. C. S. Bradley[7] described experiments he had performed in 1882 with fused salts and their action on coal. He said oxygen of the air is absolutely necessary. His cell as described "consisted of of fused sodium manganate, and putting a blast of air through it, and by that means supplying it with oxygen and allowing it to act on the coal, which is put in another part of the vessel. A little over one volt was obtained."

A cell described by W. W. Jacques in Harper's "New Monthly Magazine," for December, 1896, is another illustration of this same principle with a few practical modifications. It is said to produce electric energy at a very economical rate and to consist of an iron vessel which is the negative electrode containing the fused salt, caustic soda, into which is plunged the positive coal or carbon. Oxygen is supplied by putting a blast of air through the fused bath. An e. m. f. of about one volt is obtained.

The electrolyte conveying the oxygen of the air can be heated as Bradley, Jacques and others do without infringing the second law of thermodynamics, as the law does not apply so long as the oxydation of the carbon itself does not produce heat, but electricity. There is heat in all electrolytes down to absolute zero. The electrolyte is simply heated to permit the chemical affinities to act. Of course this heat is wasted if it is above he normal temperature under which we live, unless it is a reaction which absorbs heat.

MARRIED

HOPKINS-DORSEY.

The marriage is announced of Mr. Nevil Monroe Hopkins to Miss Katherine Guy, niece of Miss Anna J. Dorsey. Mr. Hopkins is well known in electrical circles. He was at one time connected with the General Electric Company, and is now practicing as an electrical engineer in Baltimore and Washington, representing also The Electrical Engineer, which begs to tender its congratulations to the happy pair.

OBITUARY

WALTER B. CHILDS.

Mr. Walter B. Childs, a young electrical engineer, died on December 21 from pneumonia, at the Homeopathic Hospital, Pittsburg. He was 29 years of age. He was employed by the Electric Construction and Supply Company.

JOHN OWEN RICHARDSON.

The death is announced of John Owen Richardson, superintendent of the Wissahickon Electric Light Company's plant, Philadelphia. Mr. Richardson was born in that city, November 25, 1851, and after acquiring an education, learned mechanical engineering. He subsequently removed to the South, where he had charge, as chief engineer, of a number of steamboats that ran from Tampa, Fla., along the gulf and Atlantic coasts. After his return to Philadelphia he had charge of the Lincoln Park boats on the Delaware. Mr. Richardson died of heart disease, after a week's illness.

EMIL DU BOIS-REYMOND.

Prof. Emil Du Bois-Reymond, the distinguished physiologist, died in Berlin on December 26. He was born in Berlin in 1818. He began studying theology, but abandoned this for natural science. After a sojourn at Bonn he returned to Berlin, and studied anatomy and physiology under Jean Muller, and on his advice undertook his researches in animal electricity, on which subject he published several works. In 1868 he replaced his master as professor of physiology at the University of Berlin, and was named, in 1867, perpetual Secretary of the Berlin Academy of Sciences.

ROENTGEN RAYS

FLUORESCING SALTS.

BY THOMAS A. EDISON.

FURTHER experiments, beyond those already recorded by me in The Electrical Engineer, have been made with crystals sensitive to the X-ray of Röntgen. The following are selected from a large number of chemicals made at my laboratory, all the chemicals in commerce having already been tested and reported: Borate of Sodium and Uranium; Cyanide of Copper and Zinc; Cyanide of Copper and Silver; Cyanide of Silver and Calcium; Cyanide of Silver and Tin; Cyanide of Silver and Strontium; Cyanide of Silver and Barium; Cyanide of Copper and Lithium; Phosphate of Uranium and Ammonium; Phosphate of Uranium and Silver; Nitrate of Uranium and Lead; Cyanide of Uranium and Silver; Nitrate of Uranium and Strontium; Nitrate of Uranium and Potassium; Benzoate of Uranium and Copper; Benzoate of Uranium and Cadmium; Dicalcium Tungstoborate; Dimanganeese Tungstoborate; Cyanide of Mercury and Chromic Chloride; Cyanide of Mercury and Fluoride of Calcium; Cyanide of Cadmium and Silver Phosphate of Uranium and Calcium; Phosphate of Uranium and Zinc; Phosphate of Uranium and Sodium; Phosphate of Uranium and Magnesium; Phosphate of Uranium and Aluminum Phosphate of Uranium and Beryllium; Phosphate of Uranium and Manganese; Cuproso Potassic Cyanide; Cyanide of Iron and Barium; Cyanide of Cerium and Copper; Cyanide of Copper and Molybdenun; Cyanide of Copper and Barium; Cyanide of Copper and Iron; Cyanide of Copper and Zinc; Cyanide of Cerium and Silver; Cyanide of Copper and Cadmium; Cyanide of Copper and Manganese Cyanide of Cobalt and Copper; Nitrate of Uranium and Silver Nitrate of Uranium and Lithium; Nitrate of Uranium and Barium; Acetate of Uranium and Copper; Acetate of Uranium and Silver.

WHY FRANKLIN STILL LIVES.

There are, I conceive, two chief reasons why the name of Franklin is so constantly on our lips and his memory so impressed upon our hearts—why, in other words, he really lives for us instead of being a mere fossil in the strata of history. One is that as an embodiment of practical learning, shrewd mother wit, honesty, and patriotism he is a typical and in many respects unapproachable product of true Americanism. The other is that he is the most complete representative of his century that any nation can point to. With regard to the typical character of his Americanism few cavils will be raised, but with regard to the claim that he best represents the eighteenth century there will probably be not a little dissension. Washington, Dr. Johnson, Frederick the Great, and Voltaire might each and all be put in competition with the sage who snatched the lightning from heaven and the scepter from tyrants, and would have many supporters. But in none of these does the age of prose and reason seem to find such an adequate and complete expression as in Franklin. Washington is beyond his own or any century; Dr. Johnson does not sufficiently represent the age on its rational side; Frederick is too extreme a combination of daring and sublime seriousness of purpose and petty affectation; while Voltaire is at once too intense and not radical enough, and is, after all, too entirely a man of letters. Franklin, on the other hand, thoroughly represents his age in its practicality, in its devotion to science, in its intellectual curiosity, in its humanitarianism, in its lack of spirituality, in its calm self-content—in short, in its exaltation of prose and reason over poetry and faith.—Professor W. P. Trent in "McClure's Magazine" for January.

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[7] Trans. Am. Inst. Elect. Eng., Jan. 10, 1888.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - 1564 Monadnock Block, Chicago, Ill.
Philadelphia Office - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - -	per year.	$3.00
Four or more Copies in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

Vol. XXIII. NEW YORK, JANUARY 6, 1897. No. 453.

FIFTEEN YEARS' ASPECT OF TECHNICAL JOURNALISM.

BY C. J. H. WOODBURY.

(*First Editor of The Electrical Engineer.*)

AMONG the few books that I am sometimes pleased to call my library, there are none which have a greater attraction to me than the bound volumes of The Electrical Engineer, comprising the entire series, beginning with the first issue of the modest publication preceding the title of the present paper. An important feature of interest of this remarkable series of volumes showing the world's progress in electricity and allied subjects during the fifteen years, has been the advance in technical journalism. Well might a person remark in comparing one of these earlier monthly numbers with the present weekly issues, "Look here upon this picture and on this." Although a review of this continuous record of years agone naturally turns one's thoughts to the retrospective, yet the true concentration of interest should be on the affairs of to-day, looking to the past only for the definite purpose of its application to the present time.

The technical paper of to-day, might well bear as a motto the oft-quoted inscription to the memory of Sir Christopher Wren, the architect of St. Paul's, over one of the doors of that edifice, "If you seek a monument, look around." The enlarged scope and importance of the electrical technical journals, is only proportionate to the greater extent of the interests to which they are devoted. This is fundamentally due to the increase of capital invested in the electrical industries. With this growth, has developed a market both for subscribers and advertisers. It is here as in all fields of life, that the occasion has developed men suited to the work; the editorial pages have changed from the extremes of the work of men who were either solely writers or solely physicists, to those who blend together the trained ability of both extreme types; journalists have become electricians, and electricians journalists. The logic of figures to prove the extent of this great advance in technical journalism might best be obtained from the publisher's books which would give a statement showing the increase in circulation, advertising accounts, as well as the added number of columns and the improvements in typography graced by finer illustrations, but these remain for the reader only to give his impression of a greater usefulness in the development resulting from such work.

An important element of the progress in technical journalism is due to the wider application of photography; not only in the half-tone engravings, but also in the general use of the camera, enabling those interested in the constructive branches of electrical engineering, to illustrate their work with photographs, which are reproduced identically.

The greater diversity of electrical interests has rendered the technical press more independent; there is less editing by advertisers and therefore the well considered criticisms of technical papers are becoming more valuable. The applications of electricity are so far beyond the acquirements of any one individual even a specialist, and its rate of progress has been so rapid, as to outstrip the publication of books, so that technical journals have become a part of the reference libraries, of those engaged in any element of electrical work. The electrical journals offer a weekly encyclopædia, bringing individuals in touch with the progress, chronicling the advance of the art which enlists the resources of the capitalists in co-operation with the investigations of the electrician in a work whose application extends to the welfare of all.

A VOTE OF CONFIDENCE.

IF there is one thing more distasteful than any other to The Electrical Engineer, it is to talk about itself, praise its own efforts or success, and try by disparagement to crowd its contemporaries off the face of the earth. The readers of this journal have to endure some shortcomings in it, but as much as possible they are spared the waste of space on effusive self-glorification. The present issue of The Electrical Engineer, marking its fifteenth anniversary and the beginning of its sixteenth year offers an unusual temptation to depart from wonted reticence, but no more will be made of it than to say that, after the term of existence marked by the earnest and brilliant efforts of others before the present management of the paper, the special technical contributions to its columns and the magnificent patronage in its advertising pages, are accepted as a vote of confidence, which in turn pledges to even higher aim and better work in the future.

The first issue of the Engineer in January, 1882, when absolutely no other American electrical journal had been started, and when it proposed only a modest monthly appearance, contained 16 pages all told. The present number contains at least eight times as many, the pages being now of the same size as then. During its career, the Engineer has seen vigorous weekly electrical journals spring into being, but having itself become a weekly in 1890, it has now for six years past more than recovered the ground lost as a monthly, and measures up with its friends on even terms of equality. Indeed, it is possible that The Engineer as the oldest electrical journal is shown by this issue to be also in other respects at the head; but a paper is certainly not judged on its own valuation and mere figures of bulk or circulation are not the safest indications always of true merit.

The publication of a programme of what The Electrical Engineer will do hereafter is not easier than it would be to define the actual development of electricity in the coming years. It can only be said that in the growth of the great electrical arts lies the fullest incentive that any journal could ask, to the best and most conscientious performance of its duty. To assist in this unfolding is itself a reward; and as the field enlarges the opportunities for all will multiply.

We cannot let this issue go to press without extending our thanks publicly to the contributors, men on whose position in the electrical field there is no necessity to enlarge, who have by their admirable articles, made its contents so unusually interesting and valuable. Their kindness to us and our readers on this occasion is deeply appreciated.

THE INCANDESCENT LAMP—PAST AND FUTURE.

A SURVEY of the past fifteen years would be incomplete without mention of the incandescent lamp, the changes it has undergone and the effect it has had on the industry at large. So far as the changes are concerned, it stands to the enduring credit of Mr. Edison that not only the main principles, the materials of its construction, but its very form have remained practically the same as he left them when he announced his system of incandescent lighting as commercially practicable. Of course, we do not ignore the many details which have been introduced looking to cheapening of the process of manufacture which have indeed had a marked influence on the commercial side of the incandescent lighting industry. Nor can it be denied that the efficiency of the incandescent lamp has been vastly increased since it was first brought out. In the early days, six or eight lamps to the horse power was the usual guarantee, whereas fifteen is now the standard practice. This means a lamp giving one candle-power for 3.1 watts consumed. One cannot look upon the past without a conviction amounting almost to a certainty that still further improvement will and must be made in incandescent lamp efficiency and that the twenty-to-the-horse-power lamp will before very long make its appearance. There has long existed a struggle among central station operators to strike the correct mean between the life and the efficiency of lamps; in the one case to reduce the cost of renewals, in the latter to reduce the coal bills. It is true that the recent enormous reduction in the first cost of incandescent lamps has changed considerably the aspect of the case, but other considerations, of not less weight, make the striving for the twenty-to-the-horse-power lamp as desirable as it was at any time in the history of the art. Twenty lamps to the horse-power means operating them at less than 2½ watts to the candle-power, so that the "standard" would be a 37½ watt lamp. Such a lamp would at once reduce the station coal bill 25 per cent., and would involve reductions of expense in other directions. Or, looked at in another way, it would increase the station capacity by a like fraction, thus converting, say, a 10,000 light station into one of 12,500 light capacity, without any increase in running expenses. With the fixed charges and expenses remaining practically unchanged, as they would, such a station would be able to increase its income nearly 25 per cent., and this, in many cases, would mean an increase in net profits of probably 50 per cent., and more. Other advantages accruing from such a change in the lamp standard might be mentioned, but enough has been said to indicate the far-reaching nature of the high efficiency lamp.

Of late a tendency has made itself manifest towards the use of high voltage, that is, 220 volt lamps. In principle the adoption of such a lamp is desirable as economical on the side of conductor cost, but we do not look upon this matter as of the same degree of importance as that attaching to the higher efficiency lamp. As a matter of fact the high voltage lamps manufactured at present have an efficiency not exceeding 4 watts per candle, so that even to-day their employment is advisable only under special conditions.

The difficulties standing in the way of a successful 220 volt lamp will be apparent when it is considered that a 3.1 watt lamp must have a given surface per candle and that a lamp to operate at the same efficiency, but at higher voltage must have a resistance proportional to the square of the voltage. This would mean that a 50 watt 220 volt lamp would require a filament one-half as thick and twice as long as that of a 110 volt lamp; this would call for a filament 2½ thousandths of an inch in diameter and 18 inches long. Incandescent lamp makers will better than any others appreciate what this means.

Looking at the subject broadly, there are two directions in which the light-giving efficiency of the incandescent lamp may be increased, and these are, (1) by increasing the temperature at which the filament is run, and getting the filament to stand that temperature; and (2) paradoxical as it may seem, to give the filament a much poorer radiating surface, so that at the same temperature it will yield more light rays and consequently give more light for the energy expended, as pointed out by Mr. John W. Howell in a communication appearing on another page.

It would seem problematical whether incandescent lamp filaments could be run at higher temperatures than those now in vogue without decreasing the life of the lamp; or rather would it appear that more encouraging results may be looked for in the other direction mentioned above. Some experiments have already been made with this end in view, in the application to the filament of the rare earths which give out a large proportion of light when heated to incandescence, a property so well utilized in the Welsbach lamp.

It must not be forgotten that since incandescent lighting became an established industry, its competitor gas has received more attention than it did during its whole preceding life, and with corresponding results. The last 15 years have witnessed not only a remarkable reduction in the cost of production of the gas itself, but decided advances have been made in increasing its light giving value.

We do not believe that gas in any improved form or appliance can ever succeed in driving the incandescent lamp from the field, or in ever more than temporarily affecting its progress, but the experience of the last few years seems to lead to the conclusion that it might be desirable to increase the present 16 candle-power standard to, say, 20 candle-power. The former standard was adopted originally to conform to the then existing standard, or rather to measure up favorably against the average gas burner, but the present standard of the latter has increased and the incandescent lamp might with advantage, perhaps, be brought abreast of it. Nor must it be forgotten in this connection that the incandescent lamp has an electrical competitor in the arc lamp, a rival by no means to be despised in some respects. Nevertheless when one considers the odds against which the incandescent lamp has had to struggle, it speaks volumes for its inherent staying powers, that its use has never for an instant shown a decline, but is, on the contrary, constantly on the increase, at an increasing ratio of growth.

POINTS ON CAR FARES.

It seems difficult to get some papers to do even the barest justice to the street railway companies. Here is an example from the New York "World":

"Commissioner Meriwether, of the Missouri Bureau of Statistics, has made an exhaustive study of the subject of street railway franchises and cheaper fares. Among other facts illustrating the possibilities of a reduction to three cents without crippling the companies, he cites the result in Glasgow, where with a maximum charge of a penny a mile the business has returned 10 per cent. dividends after paying fixed charges. Such facts seem hardly credible in communities accustomed to paying five-cent fares, but they will become credible finally and then fares will come down."

Now this "illustrates" nothing of the kind, and having ourselves tried the Glasgow cars we know practically that it doesn't. In this country the 5-cent fare (or 2½ pence) will carry a man far more than 5 miles. On Manhattan Island it carries a passenger from the Battery to McComb's Bridge, a distance of nearly twice five miles; and the passenger rides in comfort and convenience that is hardly dreamed of in Glasgow, which city has just sent experts over here to learn how our street railway companies do things, it is so far behind the times. If the New York "World" wants a scale of fares based on "a penny," or 2 cents per mile, that is quite another question. The American public appears to have a decided preference for the flat rate, one fare, which encourages the settlement of people with moderate incomes in cheap homes in the suburbs to an extent the European knows nothing about. The street railway companies are perfectly willing to take three cents but they will no longer be able to give the bulk of their patrons six cent rides. Besides, it is not yet proven that the Glasgow system is really paying its way and taking care of all charges and depreciation, let alone earning 10 per cent.

STEAM ENGINES AND ELECTRICITY.

Among the contributions which we print in this issue is one not devoted specifically to an electrical topic, but which is worthy of the most earnest consideration by all interested in the generation of electricity. For while we may be on the threshold of important practical advances in the generation of electric current direct from carbon, we shall still be required to employ the steam engine as our source of power for some time to come. Any advance in that direction is bound to make its influence felt in electrical work, and no better evidence of this fact could be desired than the history of the steam engine in relation to electric lighting and power work during the last fifteen years. Prof. R. H. Thurston makes this aspect of the question the subject of an admirable essay which we print on another page. It shows in a clear and concise manner just where the art stands to-day in steam engine economy and what we may hope for in the future. There is evidently one principal direction in which advancement lies and that is in the use of higher pressures. The curves of steam economy accompanying Professor Thurston's article are particularly instructive as showing the performance and relative place of the actual engines of to-day.

BEGINNING THE NEW VOLUME.

As a general thing the changes introduced in The Electrical Engineer from year to year are slight. The style and size of page adopted at first, 16 years ago, has proved excellent and more and more weekly journals, including those in the electrical field, have come to it. Outside of that, changes are limited to typographical arrangement, and this year the Engineer has made a few changes looking chiefly to ornamentation and the closer classifying of the matter. The List of Contents has been transferred to the last page in order to secure more room for the editorial discussion of questions of the hour.

THE PASSING OF THE DRIVING PULLEY.

BY SCHUYLER SKAATS WHEELER, Sc., D.

(Prest. Crocker-Wheeler Electric Co.)

THE industrial arts have probably never experienced a more rapid and positive growth of a new principle than the acceptance and development of direct electric power has shown in the three years just ended.

Such rapidity of advancement especially in view of the expensive nature of the materials involved (machinery) and the necessarily conservative nature as a class, of those practicing in these arts, point positively to one truth—a high ratio between the economic advantages obtainable, and the disadvantages, of all kinds, represented by the labor, expense and delay of making the change. In the language of the electrician, the Rapidity of Adoption equals the Incentive divided by the Difficulties.

The electric transmission of power has now, and since the comparatively recent publication of some rather full descriptions of work in this line by the writer, become so far standardized that practically all makers of machinery are now accepting or soliciting orders for their products arranged for direct electric driving. It has for some time past been well pointed out that while a motor geared or belted to a tool presents considerable advantage over belt connection from a shaft, greater simplicity as well as power economy can be gained by partially re-designing the tool so that the motor can be incorporated into it closer to the working part; as, for example, with its armature upon the drill spindle of a swinging arm drill, or on a shaft removed by one reduction from the arbor of a miller or lathe. Heretofore all machinery, being belt driven, has necessarily been designed with reference to the necessity of multiplying up or reducing from the speed of its cutting parts by suitable gearing so as to attain the speed at its point of mechanical driving, which is suited to the frictional capacity, best speed, etc., required in practice with belts. Belts often, therefore, require wheels to receive them, and supporting bearings, with extension enlargements and modifications of the frame of the machine, with trains of gearing which absorb power, that are no longer necessary with the electric motor directly applied and—the passing of the driving pulley.

LONG DISTANCE TRANSMISSION.

BY CHARLES P. STEINMETZ.

(Elec. Engr. General Elec. Co.)

ALREADY in the early days of electrical engineering, 20 years ago, high alternating potentials were used for series arc lighting. With the advent of the arc lamp these alternating circuits disappeared and continuous current arc circuits were established with voltages rising with the increasing extension of the lines, apparently without being considered as particularly dangerous. The stationary transformer introduced the alternating current system again, now as constant potential system for incandescent lighting, with primary lines of 1,000 volts, and later on occasionally 2,000 volts, the latter voltage, however, being considered as dangerously high. Still a few years ago, when with the further extension of alternating circuits an increase of generator voltage became necessary, 3,000 volts was considered as too high a generator voltage, and 2,500 volts was adopted, but fortunately soon discarded in favor of 3,000 volts; and at present as standard primary distribution potentials 1,000, 2,000 and 3,000 volts are used with an over compounding of the generators up to 20 per cent. to cover losses in lines and transformers, giving thus a range of voltage up to 1,200, 2,400 and 3,600 volts, respectively.

Primary distribution plants now are installed mostly at 2,000 volts, very few at 1,000 volts, but quite a number at 3,000 volts. One of the largest systems installed has adopted 4,000 volts for distribution, and in a few special cases 5,000 volts is used, with a range of generator voltage up to 6,000 volts. This latter voltage, however, is still very seldom considered for distribution, but is quite frequent for long distance transmission directly from a high potential generator. A number of such systems are in operation, and even 10,000 volts directly produced in the generator is taken into consideration.

At these higher transmission voltages, however, step-up transformers are generally used with low voltage generators. Gradually the practice has established itself to cover the range up to 5,000 or 6,000 volts by direct supply from a high potential alternator and to use step up transformers from 10,000 to 12,000 volts.

Most of the long distance transmissions now installed are either at 5,000 to 6,000 volts directly fed from the generator, or, where the distance is greater, 10,000 volts at the receiving end of the transmission line is used, with step-up transformers, and the generator voltage under load raised to cover the drop of voltage in the transmission, thus giving a range of line voltage of 10,000 to 12,000 volts. No large plant of higher voltage than this appears to be in commercial operation in this country, but distances of thirty-five miles (Fresno) have been covered by this voltage.

The difficulties, due to the high voltage in lines and apparatus, have in these years of development decreased, that is, the methods of insulating line and apparatus have developed faster than the voltage has been increased, so that the present 10,000 volt transmission is far more reliable in its operation than the 1,000 volt circuits of the early days.

Ten thousand volt transmissions seem to be safe to operate in any climate. If, however, a considerably higher voltage should be chosen for the high potential transmission line, a consideration of the climate in which the line is to be operated seems to become necessary.

Naturally a considerable amount of work, theoretical as well as experimental, had to be done before these high voltage transmissions, now so numerous, could be undertaken. The effect of high alternating potentials has been investigated very carefully, not by electrostatic machines or Leyden jar discharges as in the early days, but with large transformers and engine power behind, for voltages up to and beyond 160,000 volts effective or 230,000 volts maximum, voltages which will jump over 16 inches of air and pierce practically any insulation.

The present extended use of high potential transmissions became possible only by the development of the alternating current motor. As long as alternating currents were suitable only for lighting but not for motor work, their field of application was limited. The stationary motor as day load offered a more uniform load curve, and the rotary converter and synchronous motor opened the whole field of electric railroading to the alternating current transmission. At present such transmissions have developed in three fairly distinct directions.

1. Long distance transmission of mechanical power.—Generator and synchronous motor are connected together through the high potential line, either directly or by step-up and step-down transformers. The alternating current line is here equivalent to a belt connection between the turbine shaft and the synchronous motor shaft miles away. The whole installation is usually very simple, generator and motor kept at constant excitation at all loads, and thus the voltage in the line is only approximately constant but varies with the load.

2. Long distance transmission for distribution to lights and stationary motors.— Here the high potential line terminates in the step-down transformers at the receiving substation. This substation is in all its features equivalent to the central station of an ordinary electric light and power distribution, the step-down transformers taking the place of the generators. The distributing network is fed either directly by alternating currents from the step-down transformers on a low tension system with mains and feeders, or a high tension system with 1,000 or 2,000 volts distributing lines and individual transformers, or a combination of both, using low tension distribution in the center of the city and reaching further outlying districts by high tension lines. Or distribution takes place by a continuous current three-wire Edison system through rotary converters. Even in the latter case, however, larger motors are frequently connected directly on the alternating circuit.

In such a system of long distance transmission for distribution to lights and stationary motors, all generators are operated in parallel and mostly separately excited by a turbine driven exciter. The excitation is controlled so as to maintain constant voltage at the center of the secondary distribution, and the distributing lines leading from the substation are controlled by induction regulators.

Transformation to continuous current by rotary converters allows the use of three wire mains and feeders in the low tension distribution and permits of connecting directly to, and feeding into, existing direct current systems. The distribution by alternating currents requires four wire mains for economical distribution on the low tension system, but avoids the losses in the rotary converters and the necessity of using large rotary machinery in the substation. Thus a decision whether alternating currents or continuous currents are preferable in the distribution system generally depends upon the local conditions.

3. A distinctly different branch the long distance transmission for electrical railroading, has been developed. Even in large stations railway load fluctuates so greatly and suddenly as to make it desirable to separate the railway load altogether from the lighting load, except where it constitutes only a small proportion of the total load. The load fluctuates too rapidly to make hand regulation of the generator excitation practicable. Thus an automatic system of control had to be devised, in which the generators are kept at constant excitation and the control of voltage in the whole system effected by varying the phase relation in the alternating current circuit, in a manner wnich can best be explained by the description of some of the existing plants.

In the transmission from Oregon City to Portland two high potential generators at Oregon City of 450 kilowatt each, are used for railway work, and supply over separate high potential lines two rotary converters of 400 kilowatt each. The generators are kept at constant excitation corresponding to 6,500 volts at open circuit. The length of the line is 14 miles, the loss of energy in line and step-down transformers about 10 per cent., the resistance voltage about 20 per cent. at full load. The generators feed directly into the transmission line and with constant excitation, in the absence of phase control, over 600 volts would be found at no load and less than 500 volts at full load at the continuous current brushes of the rotary converters. The rotary converters, however, are supplied with a very weak shunt field and a very powerful series field. In consequence thereof they are greatly under-excited at light load, so that their counter e. m. f. is considerably below the impressed e. m. f. In consequence thereof they take a considerable lagging current over the line at no load. The e. m. f. of self-induction in generator and line is 90 degs. behind the current and since the current is lagging behind the e. m. f. of the generator, the e. m. f. of self-induction is practically in opposition to the induced e. m. f of the generator and subtracts itself herefrom, bringing the voltage down to 500 volts at the commutation brushes of the rotary converter at no load.

With increasing load the excitation rises, due to the series field of the rotary, until at full load the rotary converter is greatly over excited and its counter e. m. f. beyond the impressed e. m. f., and thus the alternating current forced to assume such a phase relation as to demagnetize the converter field. That is, it is made leading. With a leading current, the e. m. f. of self-induction, which is 90 degs. behind the current, is nearly in phase with the induced e. m. f. of the generator and thus adds itself thereto, and increases the voltage by what may be called partial resonance, so that at full load, although the current is very much larger than at no load, the drop of voltage between generator and rotary converters is greatly less, the drop due to the resistance being compensated for by the rise due to self-induction and leading current. The voltage at the commutator brushes rises from 500 volts at no load to 550 volts at full load.

This control of phase relation is perfectly automatic, gives a minimum amount of idle currents in the system under load, and has proved very satisfactory wherever it has been installed for long distance railway transmission, as, for instance, in the plant mentioned above, which has been in continuous operation for several years and is being extended at present.

THE ACCOMPLISHED UTILIZATION OF NIAGARA.

BY W. B. RANKINE.

(Secy. Niagara Power Co.)

IN response to your request for succinct data as to the net result of the enterprise at Niagara, in regard to which The Electrical Engineer has made so full a record during the past six years, I am glad to be able to submit figures of a remarkably encouraging character. The project has never promised so well as now, either in practical operations or in those financial results which, as Mr. Brunel insisted, can alone justify even the greatest engineering plan.

Since work was begun in 1890, we have had at least four financial crises, and other influences, deterring the establishment of new industries requiring power. Considering these general and well-known adverse conditions, coincident almost with its life, the wonder is that this company has steadily progressed, and, as above indicated, has virtually reached the point of self-support. Under such conditions, and in view of the necessarily experimental character of the work, it would have been folly at any earlier date to seek to provide for an installation larger than necessary to demonstrate that this enterprise can accomplish real work and promise real profits.

The plans of the Cataract Construction Company and the works of the Niagara Falls Power Company are so far completed that delivery of power to customers in Buffalo has been successfully instituted, and the calls for power under contracts actually executed (and in excess of the present capacity of the works) will provide annual rentals which, with contracts in negotiation, represent a total income from that source falling not far below half a million dollars.

The present electrical installation comprises three dynamos, each of 5,000 electrical horse-power, of which one should be kept as a reserve; but the demand has made such reservation impossible, and the contracts already made for 15,825 electrical horse-power exceed not only the prudent, but the actual, capacity of these works, which require immediate extension, with every prospect of prompt and profitable employment.

The proposed extension involves doubling the present capacity of the transmission line to Buffalo which already in successful operation, is delivering 1,000 electrical horse-power; the extension of the wheel-pit for its full length, so as to have capacity in all for ten 5,000 horse-power turbines and dynamos; the installation of seven 5,000 horse-power turbines and dynamos, in addition to the three now in operation; and the extension of the power house to cover the new installation. The work of such an extension of the wheel-pit is about one-third completed; the right of way from Niagara Falls to Buffalo is complete; the pole-line already erected has a pole and cross-arm capacity for 20,000 electrical horse-power, with copper conductors in place for 5,000 electrical horse-power. Upon definite proposals already received, the entire installation above described can be accomplished within the year 1897.

As a concrete presentation of the facts, I will add a list of the contracts for power up to election day, 1896. No more eloquent statement as to results achieved could be given if I were to fill a volume of your journal:

HYDRAULIC POWER.

	H. P.
Niagara Falls Paper Co	7,200

ELECTRIC POWER.

Pittsburg Reduction Co. (aluminum)	3,050
The Carborundum Co. (carborundum)	1,000
Acetylene L. H. & P. Co. (calcium carbide)	1,075
B. & N. F. Elec. Light & Power Co. (local lighting)	500
Walton Ferguson (chlorate of potash)	500
Niagara Electro-Chemical Co. (peroxide of sodium)	400
B. & N. F. Electric Railway (local railway)	250
N. F. & S. B. Railway Co. (local railway)	250
(All from October 1, 1896.)	
Buffalo Street Railway Co. (22-mile transmission)	1,000
(From November 15, 1896.)	
Acetylene Light, Heat & Power Co.	
(From February 1, 1897)	1,000
(From March 1, 1897)	1,000
(From delivery, say, November 1, 1897)	2,000
Mathieson Alkali Works (soda ash)	
(From June 1, 1897)	2,000
Buffalo Street Railway Co	1,000
Buffalo General Electric Co. (lighting)	3,000
(From November 15, 1897)	
Totals	25,225

SUMMARY.

Total hydraulic power sold—Niagara	7,200
Total electric power sold—Niagara	13,025
Total electric power sold—Buffalo	5,000
	25,225

ADDITIONAL.

Albright & Wilson, Ltd (electro-chemicals)	400
1896—Grand total	25,625

It will be obvious, at a glance, that Niagara has already started on its career as a great chemical center, and thus justifies the predictions that the chemical trades would center ultimately around the sources of cheap power in large quantity.

TELEPHONY AND TELEGRAPHY

FIFTEEN YEARS OF TELEGRAPHY.

BY WILLIAM MAVER, JR.

(*Author of "American Telegraphy."*)

ALMOST contemporaneously with the beginning of this journal, there was introduced one of the most important innovations that had taken place in the practical operation of the telegraph, namely, the use of the dynamo machine in place of gravity battery for the purpose of generating the electromotive force necessary to the transmission of telegraphic signals. This application of the dynamo machine was first persistently advocated and finally successfully exploited both to meet the requirements of ordinary Morse as well as duplex and quadruplex telegraphy, by Mr. S. D. Field, about the year 1880. The dynamo machine was at first only applied to the main or trunk lines of the telegraph service, but it was, and now is, very generally utilized also for the "local battery" service. From the first installation it may be noted that this innovation was a marked success. More recently the storage battery has been largely utilized by telegraph companies for these purposes also and it is probably within bounds to place the number of gravity cells displaced by these two agencies at not less than two hundred thousand. Not the least of the advantages derived from this change is the great saving of space in places where space is very valuable, but at the same time the economy of operation is great, and the reliability and generally improved service derived from the use of the dynamo and storage battery have been very marked. Storage batteries were also used in telegraphy in England at least ten years ago, and by Mr. S. D. Field in San Francisco in 1878.

Another noteworthy and exceedingly important advance in the practice of telegraphy within these past fifteen years has been the more or less general use of hard-drawn copper wire in place of the galvanized iron wire so almost universally employed for aerial wires before 1884, which was the year in which began the extensive use of hard-drawn copper wire for telegraph purposes. From its inception the use of this wire was a success, and its importance can scarcely be overestimated. For not only does its superior electrical qualities, as compared with iron, give it decided advantages, but without these advantages its vastly greater durability would render its employment highly advisable, now that it has been shown to possess the other mechanical qualities essential to a successful telegraph wire. In point of durability, when exposed to the ordinary elements in the atmosphere of town and country, there is really no comparison, the average life of an iron wire being probably not over 12 years, at the end of which time, owing to the effects of corrosion, it is virtually useless for any purpose; while the life of a copper wire, so far as the effects of corrosion are concerned, is apparently unlimited, and if for any reason it should be put out of service it still retains an important value as metal.

The size of the hard-drawn copper wires thus first erected was No. 14 and No. 12, weighing, respectively, 110 pounds and 170 pounds per mile. The copper wire now much used in this service weighs about 200 pounds per mile. An idea of the vast amount of copper thus utilized may be gleaned from the fact that in a 20-wire pole line between New York and Buffalo, a distance of nearly 440 miles, 880 tons of the metal would be necessary, not counting the tie wire.

With regard to the art of telegraphy, so far as relates to the methods of transmitting signals that have been adopted, it cannot be said that any very material progress has been made within the past 15 years. It was prior to that period, about 1876, that the last notable advance was made in this direction, namely, the successful introduction of the quadruplex by Edison, by means of which the existing wire facilities were, at a bound, virtually quadrupled, or as compared with the duplex system which had only recently been perfected at the time of the advent of the quadruplex, practically doubled.

It is known also that the Wheatstone automatic system has been introduced within the time mentioned upon the lines of one of the telegraph companies of this country, with a certain amount of success, but its application has not been by any means general, which is in marked contrast to the practice in this respect in Great Britain where this system is very largely employed, more especially in the transmission of press dispatches.

In connection with this latter system it may be noted that a very important improvement in the speed of signaling on combined aerial and short cable circuits has been obtained in the latter country, by an ingenious arrangement of condensers around and about the differential coils of the relays, but the writer is not aware to whom credit for the arrangement is due. Messrs. Preece and Sivewright, who give statistics and other information on this subject, show that on certain circuits the speed of signaling has been increased fully 100 per cent. by means of this simple device.

Another noteworthy improvement in telegraphy within recent years is that in which it is combined on the same wire or wires with telephony, thereby giving a system, or method, termed simultaneous telegraphy and telephony. This combination was first made practically possible, it is believed, by the "graduating" devices of Prof. F. Van Rysselberghe, by means of which the telegraphic currents were rendered harmless in their effect upon the telephone receiver. This system has been in operation in Europe for a number of years and it is now in operation in this country somewhat extensively, and it is understood quite successfully. When it is considered that the two wires of the metallic circuit of long distance telephone wires may be simultaneously employed as single Morse wires, without practical interference the one with the other, the value of this combination will be the better appreciated. And in fact the practicability of operating both of the wires of the metallic circuit as Morse duplex circuits was demonstrated several years ago. The writer is not, however, aware that this latter arrangement is at present practiced.

In the direction of rapid signaling by chemical automatic methods, nothing has been done in actual practice recently. This field has not, however, been entirely neglected, for the well-known inventor, Mr. P. B. Delany, has been at work perfecting a chemical automatic system which has several marked advantages, chief of which is his plan of indicating the dots and dashes, not by long and short marks, as hitherto, but by giving these characters a different position on the received slip. The great obstacle to fast signaling by chemically prepared paper, namely, "tailings," is thus very measurably overcome or rendered nugatory.

In the line of fast printing telegraph systems it may be noted that Mr. C. L. Buckingham has devised apparatus capable of transmitting and receiving at the rate of over 100 words per minute, but the system has not as yet gone into practical operation.

One other somewhat recent improvement in telegraphy which may be noted, is the Delany synchronous telegraph system, which is now in operation in Great Britain and by means of which form four to six messages may be transmitted over a single wire in either direction at the same time, and to this extent it excels the quadruplex, the limit of which is the transmission of two messages in both directions concurrently. It is also well understood that the Delany synchronous system may transmit a much larger number of messages in either direction on circuits of moderate length and capacity.

In overland telegraphy the apparatus employed both in single and duplex and quadruplex working has been materially improved, one tendency being to the use of a lighter metal, such as aluminum, wherever possible. Another advance has been in the adoption of the typewriter by the operators almost generally in the large offices in this country, as a means of copying dispatches as they are received.

In long submarine cable telegraphy within the past decade and a half the improvements have related mainly perhaps to speedier signaling, and as a means to this end may first be mentioned the Muirhead "double block" arrangement of condensers which displaces the usual ohmic resistances in the arms of the Wheatstone bridge. The device is said to have increased the speed of signaling by about 15 per cent. The intrinsic value of this improvement is greater than at first sight appears, for, taking the average rate of speed on the Atlantic cable duplexes to be now 25 words per minute, each way, this improvement added a capacity of, say, 8,000 words per day to each cable. This at 25 cents per word adds practically three-quarters of a million dollars per annum to the earning capacity of the cable.

Another improvement in the operation of long submarine cables was the introduction of the Cuttriss magnetically vibrated siphon recorder, which in a more or less modified form is now in use on the majority of such cables. The utility of this device consists in the avoidance of the delays that frequently occurred in the highly ingenious electrified ink siphon recorder of Lord Kelvin, which delays were due chiefly to changes in atmospheric humidity.

Still another recent improvement in the details of operation of cables is the utilization of automatically transmitted signals. The messages are prepared for transmission in a manner analogous to that employed in the preparation of messages for transmission by the Wheatstone automatic system, namely, by punching holes corresponding to dots and dashes on strips of paper. These strips are then passed through an automatic transmitter, but of course at a speed not much, if anything, greater than is possible by manual transmission. The aggregate gain over manual transmission is, however, perceptible, a result which is due to the fact that the maximum capacity of the cable is utilized, the transmitter being automatically kept at the top speed of transmission, and thus no time is lost by the varying speeds of an operator, or by the practically unavoidable delays caused by the operator in pausing to decipher an obscure word of a message, this latter delay now occurring at the punching apparatus. Another advantage due to this employment of the automatic transmitter is that the respective characters of the signals as received on the siphon recorder are much more uniform than when transmitted manually, and are therefore more readily deciphered.

In this relation it may also be noted that Mr. W. P. Phillips has recently introduced upon the New York-Washington lines of the United Press Association an improved automatic sender which is giving very satisfactory service. The messages as prepared for transmission by this sender are embossed on a paper strip by a Morse "register," excepting that the embossings are in duplicate or triplicate, as desired, longitudinally,

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thus, . —— ——. . . . . . etc., the subject matter
. —— ——. . . . . .

being sent to this register on a local circuit by expert operators. The embossed paper is passed under the lower end of a rigid vertical lever which is suitably pivoted. At the upper end of the lever are placed the contact points corresponding to those of a Morse key on a main line circuit. Normally, as when there are no embossings under the lever, a retractile spring draws the lever into a position where the main line circuit is open. On the contrary, when one of the raised characters is under the lever, it is pushed toward the contact point, closing the circuit for a time corresponding to a dot or dash. The embossed paper is caused to pass over an upwardly rounded plate, and in thus passing it is caused to conform to the shape of that plate. By this arrangement the raised character is drawn abruptly down from the end of the rider, giving the latter free course to return to its normal position between each character. On the New-York-Washington line, press matter is easily transmitted by this device at the rate of eighty words per minute. At the receiving stations, similar Morse registers are employed to receive the matter at this rate of speed, and the paper strips thus embossed are then passed through another automatic sender in a local circuit containing a Morse sounder. The speed of this sender is regulated to suit the capacity of the receiving operator. This automatic sender gives virtually the capacity of two wires operated on the ordinary Morse method.

The spread of the telegraph network throughout this country still continues; the largest telegraph company here having opened an average of one new office every day during the past year.

The increase of mileage of telegraph wire in this country has increased from about 350,000 miles in 1882 to probably 1,000,000 miles at the present time. If, however, it be assumed that 20 per cent. of the existing wires were equipped with duplex or quadruplex apparatus in 1882 and that 25 or 30 per cent. are thus equipped to-day, the increase of actual wire facilities will be considerably greater than appears on the surface; in other words, approximately, in the ratio of 420,000 miles in 1882, to 1,300,000 in 1896.

At the same time, judging from available figures, it is probable that the amount of business handled by the telegraph companies of this country for the past few years has not kept up to that of the immediately preceding years. The general depression in business has doubtless accounted for considerable of this probable loss, but it is also likely that the keen competition of the telephone has weighed largely in bringing about this result. Another explanation of the lack of material increase in the number of messages transmitted telegraphically in this country during the past few years has been found in this, that many of the best patrons of the telegraph service have considered it advantageous to lease wires for their own use. Notwithstanding all of which, however, the aggregate number of telegraph messages transmitted during the present year in this country, probably exceeds the number sent fifteen years ago by fully twenty-three million, not, on the whole, an insignificant increase.

If now, confining one's self to this country, one might venture a prediction as to the future progress of telegraphy—a thing which custom makes permissible, and, indeed, almost renders obligatory when retrospections have been indulged in—it would be that if, fifteen years hence, the historian of that period shall be able to chronicle the fact that the telegraph companies (or will it be the government telegraphs?) of that day have handled twenty-five million more messages during the year then closed than were transmitted the fifteenth year previously, this feat will have been accomplished, it is safe to say, by a radical change in the present methods of the telegraph service. For if the encroachments of the telephone into what has been, until recently, the exclusive domain of the telegraph, are to continue, it is seemingly evident that any such increase as that just intimated must be obtained by catering to, or possibly by creating, a class of service with which the telephone cannot compete. Will this be in the direction so strongly urged by Mr. Delany and others, namely, by offering a service analogous to the postal mail service, or what? And will the methods of transmission and reception of business remain as at present, or will resort be had to automatic or printing telegraph methods? Time will tell.

FIFTEEN YEARS' ADVANCE IN SUBMARINE CABLEGRAPHY.

BY GEO. G. WARD.

(*Vice-President, Commercial Cable Co.*)

THE improvements and advances in submarine telegraphy may fairly be judged, I think, from the work done in the North Atlantic, where I have necessarily enjoyed special opportunities for watching and noting the effect of the various changes tried, abandoned, or adopted, as part of a great system uniting the two most active and progressive portions of the human race.

It seems to me that there are three main points in which submarine cable work, as exemplified by the conditions in the North Atlantic, has made great strides since The Electrical Engineer was founded in 1882. In the first place, the facilities have been greatly increased. In the second, the rapidity and legibility, and, consequently, the accuracy of transmission have been much improved, chiefly by resort to better cables and perfected terminal apparatus. In the third place, the service has been so cheapened that it is within the means of almost every one to use the cable, and in nowise be called extravagant.

The increase of facilities lies not so much in the greater number of cables as in the quality and better disposition of the new ones. In 1882 there were eight cables in operation. Now there are eleven. But in 1882 there was not a single cable coming direct into New York City, and it was a common thing for communication between the great centers of European and American commerce to be interrupted for periods of serious duration. In 1884 the first great step in providing reliable communication was made when the Commercial Cable Company laid two cables across the Atlantic and breaking through the traditional practice of landing in out-of-the-way places for fear of shipping, boldly brought a connecting cable into the craft laden waters of New York Bay.

This enterprise has been amply justified and rewarded, for no cable has been less subject to interference or damage. From the moment it was laid communication has been permanent. It is a matter of history that this cable has been the only means by which any intelligence could be brought into or sent out of New York City and has been availed of for sending messages by way of Europe back to Boston and Montreal for distribution to other cities on this continent. Other cables have since been brought to New York, so that now it seems almost impossible that communication can ever be interrupted.

As to the advances in the rapidity of transmission there is record of a bona fide transaction between Manchester, England, and Victoria, British Columbia, in ninety seconds. One can hear daily in the Cotton Exchange of New York City messages read from the rostrum officially timed as having left Liverpool one or two minutes previously. Only recently the Commercial Cable Company was complimented for transmitting a message filed at Liverpool at 2:59½ p. m. in time to transact business before the New York exchange closed half a minute later. So steady, rapid and reliable is the work of the Atlantic cables that merchants are inspired to take such extreme chances.

The rapidity and accuracy of ocean telegraphy is achieved by the increased conductivity of modern cables, improvements in Muirhead's system of duplex telegraphy, Wilmot and Cuttriss automatic sending instruments, Dickenson and Cuttriss forms of receiving coil suspension and adjustment, and Cuttriss vibrator.

Added to these and as important as any is the marvelous skill of the trained cable operator. Carefully compiled statistics show that one error occurs in about ten thousand words. Individual operators succeed in preserving a faultless record, but the standard is one error in thirty to forty thousand words. In the majority of instances the errors are telegraphically trifling and inseparable from the hazardous nature of the business. To any one familiar with the details of long cable working and the character of the words used in cablegrams, these results are simply wonderful.

Considering the fact that the actual earnings of the Atlantic cables has remained practically a fixed quantity for the last 15 years, notwithstanding the increased number of cables and the reduced rates, I think the public has reason to be satisfied with the service they receive and the price they pay for it. I have no hesitation in saying the Atlantic cable service has been brought to a high state of perfection and is to-day the best in the world. In 1882 the rate was 50 cents per word. In 1884 the Commercial Cable Company appeared on the scene and opened for business with a 20 per cent. reduction, which led to a tariff war lasting upwards of two years. Finally a common agreement was entered into between all the companies, fixing the rate permanently at 25 cents per word.

One point that impresses me is the larger use of the cables by the press, encouraged by the liberal rates and facilities inaugurated by the Commercial Cable Company. European and American newspapers to-day receive the bulk of their foreign news by cable. They no longer confine their dispatches to reports of battles and great political events, but use the cables freely to inform their readers on trivial matters, fashions, society gossip, storm predictions and even the state of the weather at distant places.

I have watched closely the efforts made within the fifteen years to telephone across the ocean. I do not say that this will never be done; I can only record the fact that the attempts have not been successful thus far.

Considered from a practical point of view, with the enormous capital outlay invested in an ocean cable, I do not see how ocean telephony can become commercially available. At the present time, in order to return a fair profit on the amount of capital invested, every second of time has to be usefully employed during business hours. A merchant can send a cablegram for 75 cents. If the telephone were employed, taking the present charges for long-distance telephony in the United States as a standard, a five minutes' conversation between New York and London would hardly cost less than $75, an obviously prohibitive price for any extended use.

With the perfect methods of duplexing and within the limits of the recording instruments now in use, the cables already yield all the speed that is obtainable from the materials used and manner of their combination. Greater speed can be obtained by increasing the size of the conductor, but with the increased size of the conductor practical difficulties arise in the handling and laying of the cable and the recovery of it in case of damage. Further, it is better practice to lay two moderate-sized cables than one very large one. Therefore increase of speed can hardly be looked for with the present type of cables unless a recording instrument can be devised, the moving parts of which have little or no inertia. Photography has entered the field and results have been obtained which are highly interesting, but of which the practical value cannot yet be estimated.

Several novel features of construction of cables have been proposed in order to overcome the retarding effects in long cables, but although much is to be hoped for from investigation and experiment, nothing has yet been suggested that attracts the serious attention of practical men.

THE USE OF A MID AIR TELEPHONE WIRE WITH KITES.

BY WILLIAM A. EDDY.

On December 5, 1896, I sent aloft a pilot kite at 4:30 p. m., arrangements having been made with Dr. William H. Mitchell, an electrical experimenter of Bayonne, N. J., where my telegraph and telephone experiments with kites were carried out, to begin the work as soon after dinner as possible, about 7 p. m. I found the wind extremely weak, probably not over 5 miles an hour at the earth, and for that reason I sent up a very light tailless kite covered with very thin manilla paper, and having very light sticks. It was a tailless kite, known throughout the world as the Eddy kite, devised in 1891, and presented to the public free of patent in 1892. It is the kite which I introduced at Blue Hill Observatory, ten miles south of Boston, in 1894, with which, using nine kites in tandem, I reached an altitude with my top kite at Bayonne of 5,595 feet on November 5, 1893. With seven of these kites, assisted near the base of the line with two Hargrave kites, an altitude above sea level of 9,385 feet was reached at Blue Hill Observatory on October 8, 1896, which is undoubtedly the highest kite altitude ever reached in the world. This great ascension was managed by Clayton, Fergusson and Sweatland.

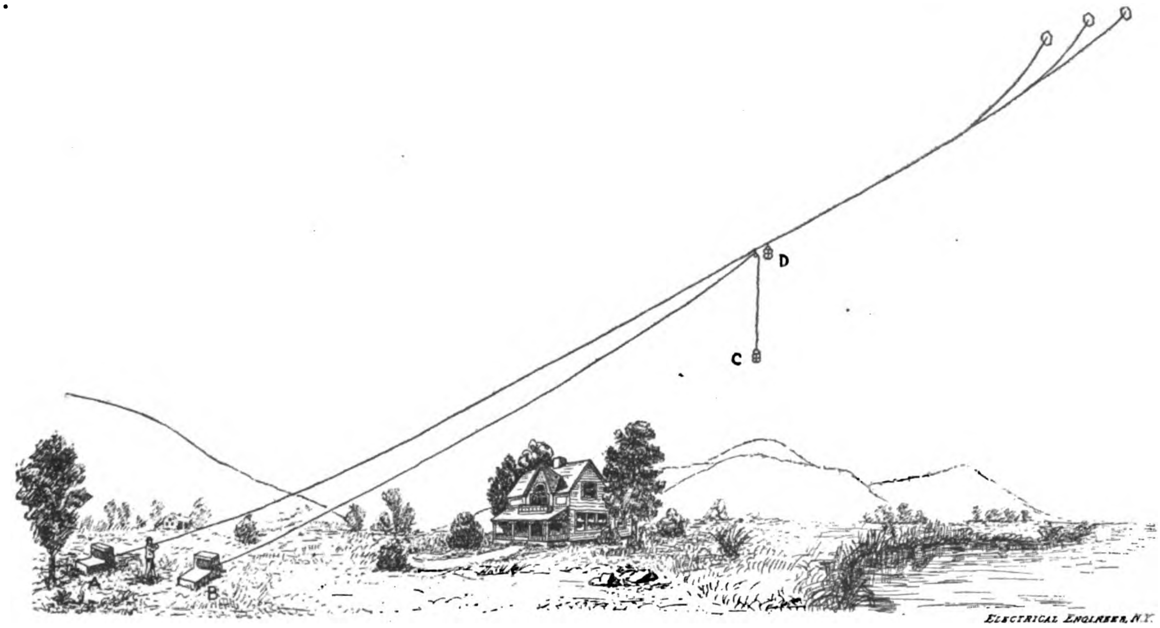


FIG. 1.—EDDY KITES SUPPORTING TELEPHONE CONDUCTOR AND LANTERN.

With a number of these kites flown one above another on the main line I have long been at work at Bayonne, from 1890 to 1891 with tail kites, and from 1892 to 1896 with tailless kites, lifting many different kinds of experimental apparatus, such as small aeroplanes, lanterns, flags, silvered reflectors, and electric wire and tinfoil collectors, collectors in the sense that an open frame with netting was coated with tinfoil and sent up into the air where it collected atmospheric electricity. I was preceded in this atmospheric electric experiment by Benjamin Franklin in 1752 and Alexander McAdie at Blue Hill Observatory in 1885, both of whom used tail kites.

During my atmospheric electric experiments I found that in dry weather it was necessary to send my collector to a heigher point in the air than in moist weather. I proved this by measuring the humidity with wet and dry bulb thermometers.

I had two or three thousand feet of thread-like copper wire which was bare of insulation and which was ready to be paid out upward along my heavy kite cable, which by 7 p. m. was well sustained in the air by the first pilot kite just mentioned (6 feet in diameter), and two slightly heavier kites, 7 feet in diameter. The wire had been used in atmospheric electric experiments with success; it was wound on a reel with movable spools which could be replaced in case the wire ran out.

About 7:30 p. m. Dr. Mitchell, the electrician, arrived on the open lot from which the kites were flying with one lantern aloft. The wind declined, and the pull of the kites, which were flying toward the northeast, became so weak that for a time I feared it would be necessary to defer the experiment. Luckily the wind strengthened, and by 8 p. m. the wire was paid out from the wire reel across the lot to a point on the kite line about one hundred feet from the kite reel. The kite cord was then run down to meet the end of the wire which was passed through three harness rings fastened across the kite line and bound to a rigid piece of bent wire. A permanent red lantern, D, Fig. 1, was attached near the rings to show the point at which the running wire was suspended from the kite cable. Then the kites were paid out from the kite reel, A, and at the same time the bare wire was paid out from the reel, B, while a plummet lantern, C, was fastened to the end of the running wire. If I stopped the kite reel and paid out the running wire then the lantern was to descend rapidly some distance away beyond intervening obstacles; while if I stopped the wire reel and at the same time paid out the kites upward and away from me, then the lantern would rise in the air as the kites receded.

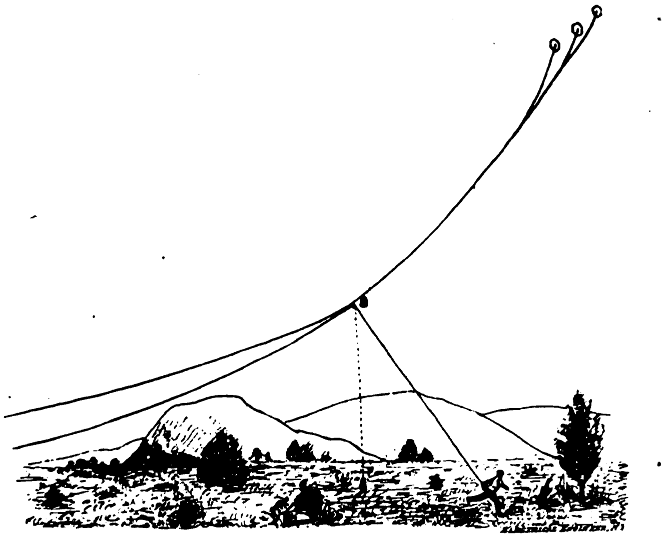


FIG. 2.—RUNNING THE KITE TELEPHONE LINE.

This is what really happened later, but on this first trial the friction of the wire against the harness rings through which it ran was so great that the lantern would not descend, and the wire broke, dashing the plummet lantern to pieces. I finally found an old pulley, which had been used for another purpose, about 3 inches in diameter, and this started off well, but the wire jammed in behind the wheel and again broke, causing the plummet lantern to fall about 400 feet upon a hard stone pavement in front of the residence of Col. C. W. Fuller. The lantern globe was smashed to atoms. However, I soon had another lantern in the air and this time succeeded. The wire with the plummet lantern, C, at the end of it reached the ground about 1,000 feet away, and Dr. Mitchell immediately grounded it with a brass grounding rod. He then came back to the base of the kite line where Henry L. Allen and I were managing the reels. He then ran a connecting bare wire from an iron pin driven into the earth through the two terminals of a small hand telephone without a bell attachment, to the wire which had been carried up the kite string and grounded at the other end. At the end where the kites were held the wire was not detached from the wire reel. Dr. Mitchell then told me to listen continuously at the telephone. I did so for some time, and heard nothing. I was about to give it up when I heard a faint clicking sound, which was the adjustment of the wires to the two poles of the telephone at the other end. Finally the first kite telephone message in the world came over the wire, sharp and clear: "Do you get me?" I answered "Yes. Good." After a few more words I looked at my watch and found it was 9:35 p. m.

I attribute the great clearness of the sound theoretically to the help from earth and atmospheric currents. I am now preparing to experiment with this midair wire to see if I can get results entirely without the magnets in the telephone at each end of the wire. I assume, of course, that the telephone will not work if merely grounded without magnetic currents already emanating from each telephone, unless a magnetic storm were in action, such as invades telegraph wires at rare intervals.

I have found strong atmospheric currents during four years of persistent experiment with atmospheric electricity from my kite wires, since October 8, 1892. Prof. Henry had long ago shown us that a lightning flash from a Leyden jar would magnetize steel needles. And why may not these persistent atmospheric currents, always present whenever my wire penetrates upward 600 feet, have sufficient force to operate an ear telephone?

Later, Dr. Mitchell connected a Morse sounder run by one cell to the telephone wire. The telegraph signals could be heard at the other end of the wire with great clearness. With a strong battery the message could have been sent from my kites by way of the main telegraph or cable system to San Francisco or around the world.

Such a wire, with a telephone instead of plummet lantern at the end of it could be dropped a mile away. We have just noticed that at Blue Hill Observatory, without telephoning or telegraphing, they paid out with the kites more than three miles of piano wire, on October 8, 1896. Telephone and telegraph communication could be opened in this way with a besieged garrison in time of war, as shown in Fig. 2.

THE TELEPHONE IN SOUTHERN NEW ENGLAND.

President Tyler, of the Southern New England Telephone Company has made a statement showing his institution to be in prosperous condition. They have 8,000 established stations and operate in 140 towns. The gross earnings for the fiscal year ending December 31 will be $550,000; the net earnings, $160,000.

The new stock has all been taken, and all but $97,000 of the $355,000 debenture bonds have been redeemed. Of the $630,000 in new stock issued, $630,000 was subscribed on or before the date set for closing the books.

President Tyler believes the company will earn $50,000 above the sum necessary to pay 6 per cent. dividends on the capital stock which is now $2,500,000.

MEXICAN AND SOUTH AMERICAN TELEGRAPHS.

The Central and South American Telegraph has declared a quarterly dividend of 1¾ per cent., payable January 6. Statement for year ending Dec. 31 approximates a surplus of $640,000. For three months ending Dec. 31, the following estimate of earnings is published: Gross receipts, $231,000; operating expenses, $79,000; net, $152,400; other income, $2,726; total, $155,126; dividend payable Jan. 6, $135,198; surplus, $19,928; previous surplus, $621,170; subscription to Guayaquil fire relief fund, $1,000; surplus Dec. 31, 1896, $640,000.

The Mexican Telegraph Company supplies the following statement of estimated earnings for the quarter ending Dec. 31, 1896: Gross earnings, $85,536; operating expenses, $17,000; net, $68,536; other income, $8,129; total, $76,665; dividend payable Jan. 13, $47,815; surplus, $28,850; previous surplus, $521,876; surplus, Dec. 31, 1896, $550,727.

RESCUE BY THE CABLE STEAMER "MINIA."

Capt. Samuel Trott, of the cable steamer Minia, had the good fortune on his recent trip for repair work off St. John's, N. F., to rescue the wrecked schooner Pansy and her crew of five. Heading for port before a heavy storm, Capt. Trott sighted the Pansy in distress about 60 miles out, picked her up, saved the lives of the exhausted crew, and towed her in without compensation. The St. Johns "Weekly News" says: "The conduct of Capt. Trott in this connection is worthy of the highest praise, and shows him to be an ideal mariner in the true sense of the word. His prompt and willing assistance was, under Heaven, the means of saving the lives of all on board the Pansy; and furthermore, not only did he save the lives of the captain and crew, but he actually towed in the vessel herself a distance of 60 miles, free of charge. From the homes of many a fisherman in Newfoundland will go up the prayer, "God bless the gallant Captain Trott."

MISCELLANEOUS

THE BEGINNINGS OF ELECTRICAL EXPORT TRADE.

BY A. A. KNUDSON.

(Electrical Engineer and Inventor.)

As the past decade may be considered as the beginning of our export trade in electrical goods (speaking broadly), it has occurred to me that some information on the subject of its past and present condition, as well as future possibilities may prove interesting.

To this end I have obtained statistics and consular reports from the Treasury and State Departments at Washington which can be relied upon as authentic, supplementing it by information obtained while residing and doing business in two of the countries named, viz., Canada and Mexico, and from other sources.

CANADA.

Of the English speaking foreign countries with whom we do business, Canada is our nearest neighbor, and it is but natural that there should be considerable trade between the two countries. The real beginning of electrical exports to Canada, however, was about ten years ago, commencing with the telephone and electric light, and later with electric railways. Incentive to increase further trade has been given at various times, such as the Electrical Exhibition at St. John, N. B., in 1889, with which I was connected; also a later exhibition of electrical goods held in Montreal in connection with the Electric Light Convention and by frequent periodical trips of representatives from the different firms in the United States. On account of the Canadian duties as well as high freights, several manufactories have been established in Canada for producing American electrical goods; and on this account our exports cannot expect to be as large as conditions might otherwise warrant. As the statistics show, however, that goods to the value of about $240,000 were exported last year (1895), it seems that Canada is not such a bad customer in this line of trade. Besides this, the above valuation does not include steam plants and accessories which generally go with electrical installations.

MEXICO.

Trade relations with Mexico have steadily increased during the past few years, with the exception of a slight falling off in 1892 and 1893. One cause of the increase of our exports in the last two years has been the war of freight rates by competing companies, resulting in merchants and others stocking up with goods in Mexico believing that the low rates would be only temporary. There has, however, been a legitimate demand for electrical goods, and the prospects are for the future that this demand will increase. The Federal District Railway of the City of Mexico, which was purchased about a year ago by an American and English syndicate, is now about ready, I am informed, to equip its 160 miles of track with electricity, which will without doubt be done with American apparatus. A large plant of American electrical goods will be shipped about the first of the year to the City of Jalapa, State of Vera Cruz, by the Stanley Electric Company, for a water power transmission to operate an electric railway and furnish light for some three or four towns, a portion of the plant, such as wire, etc., having already gone. Other schemes to develope the water power of different sections of the Republic by electrical long-distance are continually being broached and taken up, the incentive being the growing scarcity of wood for fuel and the high price of imported coal.

The abolishing of the interstate tax law of Mexico, which went into effect July 1, 1896, is considered by many to be quite an advantage to those engaged in shipping goods to Mexico. The Mexican Exposition often spoken of which has been postponed from time to time, is now, I am informed by the Mexican Consul, indefinitely postponed. It will probably materialize, however, some time in the next two years, and be generally useful.

In the City of Mexico there are several resident representatives of foreign firms. Of the electrical American firms may be mentioned the General Electric and Westinghouse, and of the wire firms Washburn & Moen, and John A. Roebling's Sons Co. The Pelton Water Wheel Company also does a large hydro-electric business. These firms, as well as others in different lines of business, recognize the importance of having resident agents on the ground in order to compete with other foreign houses who are generally well represented. The United States, however, has the advantage in one respect; it is the nearest country from which to obtain goods, and this is a great point in our favor. From my observations while a resident in Mexico, however, I think it quite probable that sooner or later Mexico will follow Canada in regard to manufacturing electrical goods within her own borders, just as other industries have been started there by English and Germans.

The low price of silver (operating as a protective tariff) and the low price of labor, are reasons, besides the cost of freight and duties, why manufacturing will probably be started in electrical lines in the near future in Mexico. A good deal of capital is being attracted to Mexico from both England and the United States, which is being invested in railways, mines, and electrical plants.

CHINA.

Our American Minister writing from Pekin under date of April 6, 1896, to the Department of State, Washington, says: The railroad development of China has attracted the attention of American financiers and builders of rolling stock and equipment. Many agents of American firms are now in this country awaiting the adoption of some definite plan by the Imperial Government. At least two combinations of American capitalists, represented here by agents, are prepared to build and equip from beginning to end any railroad system which China may desire. Later advices to the State Department report that one of the above syndicates, the American Trading Company, with offices at Shanghai, are bidding for the construction of a railway from Soochow to Chin Kiang, and for the building of an electric street railway in the foreign portion of Shanghai. Our minister also states that out of our total exports to China in 1895, amounting to upwards of $4,000,000, more than one-half was kerosene oil. This shows a desire for light at all events in that benighted country, and if the natives can be made to see the advantage of electricity as an illuminant over kerosene as other nations do, we should expect a substantial increase in our electrical exports, which now amount to practically nothing. The year 1895 showed only about $6,000 worth sent to China. Japan also took about $2,000,000 worth of kerosene oil in 1895, about the same amount as China.

JAPAN.

The total value of our distinctively electrical exports to Japan in 1895 appears to have been $24,000. The amount should have been much larger, and if the recent "missionary" visits of Japanese engineers mean anything, the amounts must increase greatly. Even during the past year, the Cramps have received orders for two Japanese men-of-war, and these will have electrical apparatus on them running up into large sums of money. Japan has always appreciated our electrical apparatus. Some of the first Edison installations went there. Some of the first Sprague motors are still in operation in Japan, and American telegraphs and telephones abound. If we will study the advice given by the American Consul at Osaka, there is no question about the increase of an electrical trade with friendly and progressive Japan.

GUATEMALA.

The American Consul in August last writes: In announcing the Central American Exposition which is to be held in Guatemala in 1897 the German boards of trade especially recommend manufacturers to exhibit tools and hardware of all kinds, as well as implements and machinery used on coffee and sugar plantations. Great efforts will be made for a good showing at that exposition. Banking and railroad building is conducted largely with German capital. The Consul also states: "There is every reason for our American manufacturers to be untiring in the solicitation of South and Central American trade. To be well represented at the coming fair with a full line of goods needed down there and by a person fully acquainted with the country, the people, and language, is only the beginning of the introduction of American goods." It may be said that the Germans have not captured all of the trade in Guatemala. Quite a business is being done with the South and Central American countries through commission houses in this city. One of our large electrical manufacturing firms is about shipping an important electrical plant for Guatemala, with a probability of more goods of the same kind going later on.

In regard to the Central American Exhibition, a copy of the rules and regulations, as well as other information, can be obtained by applying to the Guatemalan Consul General's Office, No. 4, Stone street, New York. Two articles of these rules we quote, as they may be of interest: "Article 2. The exhibition will be inaugurated on the 15th of March, 1897, and will close on the 15th of July, following. Article 8. On making application for space for exhibits the number, size, and nature of the objects must be stated. All applications must be made to the central committee before the 31st of August, 1896, but they will be received on and after the date of the publication of these regulations." I am informed by the Guatemalan Consul that up to this time not one application has been received for space from any of our electrical firms. It would seem, therefore, to be high time that intending exhibitors were looking into the matter.

VENEZUELA.

Mr. E. H. Plumacher, the consul at Maracaibo, in a report dated February, 1896, dwells on the friendly feeling towards this country, and emphasizes the importance of utilizing it in our trade relations. I can only echo his sentiments, for the enormous risks we have assumed in behalf of Venezuela should lead to reciprocity and better relationships. The Republic has been a fair buyer of electrical apparatus, and if cultivated would do better yet. I may note that this month a large shipment is being made by one of the leading electrical companies of dynamos and other apparatus for an electric lighting plant in one of the Venezuelan cities and other shipments are to follow.

PERU.

The American Consul writing under date of May 29, 1896, from Callao, forwards a copy and translation of an editorial from El Comercio of Lima, of May 16, discussing the increased trade with the United States. This paper attributes this to the direct steamship communication now existing between New York and the west coast of South America, by which material reductions in freights have been effected. The article also advocates the establishment of American steamship lines between San Francisco, Valparaiso and intermediate ports, and between New York and New Orleans and the Amazonian regions of Peru.

Under date of July 6, 1896, Mr. Alfred Solf, United States Consular Agent at Chiclayo, writes that an electric plant is wanted there and perhaps at other places in the neighborhood; and he desired to hear from American manufacturers, so that he may supply them with full particulars of the plant required.

SOUTH AFRICA.

The trade with the Transvaal and other countries of South Africa is principally in the hands of English and Germans. This would seem natural, as both England and Germany have colonies in that country. Our Consul, however, writes, under date of February, 1896, "that while the importation from non-British possessions has constantly increased, the greater part of this falls to the United States and Germany. The trade with the Transvaal passes more and more via Delagoa Bay, while German goods destined for other countries of South Africa go almost exclusively by way of Cape Town." Our Consul also says: "There is no doubt that Germany is becoming a formidable competitor in these markets which still depend largely on Europe and the United States to supply their wants." Our late Consul at Cape Town repeatedly called attention to the opportunities offered to develop our trade with South Africa. It is to-day, perhaps, the most promising field in existence for extending our export trade. A country possessing the enormous wealth which the Transvaal has revealed to the world must become a large buyer from the great exporting nations and continue so many years. South Africa to-day is full of American electrical apparatus for light, power and mining.

SUMMARY.

Statistics furnished me by the Treasury Department at Washington show approximately the amount of electrical goods exported to all countries during the past ten years. I say approximately, as electrical goods are not separately specified. Under the heading of "Instruments and Apparatus for Scientific purposes, including telegraph telephone, and other Electric," there were shipped goods as follows:

Year.	Value.	Year.	Value.
1887	$599,262	1892	1,388,117
1888	714,514	1893	1,345,621
1889	1,033,388	1894	1,534,277
1890	1,429,785	1895	1,912,771
1891	1,575,444	1896*	2,522,217

*When it ended (June 30, 1896.)

If we estimate that of these amounts 90 per cent. were for electrical goods, which would not be far off, a fair idea may be had of foreign trade in this line. It will be seen that with the exception of the years 1892 and 1893, which show a slight decrease, probably due to business depression, there has been a steady increase in our export trade. There has been a decided tendency in Europe to take our electrical apparatus, buy out the rights, and make it over there. We derive an increase from that source, which does not reveal itself in any tables of exports.

In conclusion it would seem that as we are likely soon to have another revision of our tariff law, it would be much to the advantage of electrical manufacturers if the former reciprocity treaty was re-established, not only with South American countries, but with Canada and perhaps Mexico as well; admitting our electrical goods free in countries wherever it is possible in exchange for certain goods to be admitted free of duty in this country.

It may be urged as an objection in the case of Mexico, that our electrical goods with a few exceptions are now admitted free. This is true, but when Mexico, like Canada, begins to manufacture (as already pointed out), then we may look for a prompt imposing of a protective duty in that country, and it may be wise to anticipate such action in advance.

In this connection, it may be of interest to give an idea as to what England is doing in the way of exporting electrical apparatus. To that end I give the value of electrical goods shipped during one week in each of the last two years: For week ending Nov. 17, 1895, £8,591; for week ending Nov. 17, 1896, £7,571. These goods were shipped to some 30 different ports in various parts of the world.

When it becomes more widely known abroad that the United States is shipping direct connected and other electric lighting and railway apparatus to England, we think this should have an important influence on our securing a larger share of the export trade than we now have for electrical goods.

THE IMPROVEMENT IN WIRE AND CABLE MANUFACTURE.

BY HENRY A. REED.

(Secy. and Treas. Bishop Gutta Percha Co.)

WITH the compliments of the season and hoping that many returns of your own natal day will find you prosperous and happy, I endeavor to comply with your request for a short synopsis of the development of the insulated wire industry during your fifteen years of effort to advance electrical industries.

There was little demand for high insulation in this country prior to 1882, except for subaqueous telegraph cables. I think that the only wires underground at that time were in a cable between the New York Stock Exchange and the Western Union main office. Those wires were insulated with gutta-percha, made into a cable and drawn through long logs bored like old-fashion wood pumps. Up to that date nearly all of the river cables had been made by the Bishop Gutta Percha Works, being insulated with gutta percha.

For several years prior to your first appearance, A. G. Day had been making a good quality of rubber insulated wires which were very generally used for leading from telegraph offices to the first pole, and for a very few inside cables. The inside wires were generally what are still known as "office wires," being insulated by cotton braid saturated with paraffine. Day had made a few river cables which were quite satisfactory, but people were better acquainted with gutta percha and bought it.

The same conditions which at about this period (1882) seemed to make room for another electrical journal created a demand not only for more insulated wire but for greater variety, and higher average quality. The telephone, which had been publicly exhibited less than six years prior to your birth and was for some time considered by the public only a clever toy, had shown its capabilities to a large extent and business men felt that they must use it or be behind the age. To explain or even to mention the various experimental cables made to meet only partially understood requirements of this new-comer, would extend this article far beyond reasonable limits, but I will say that the man or woman who first suggested "twisted pairs" should have been well rewarded here and given a free pass to telephonists' heaven.

Up to 1882 electric lighting had been almost entirely by arc lamps with wires on poles. I believe that the first underwriters wire was made by Mr. W. W. Marks, the first superintendent of the Bishop Works. He covered the wires with three successive braids of heavy cotton, each coat thoroughly saturated with white lead paint, which had lead in it. Each successive coat was compressed and the last braid had two or three coats. Some of this first wire is still doing duty and may continue for several years, but somebody discovered that dirt was cheaper than lead and very soon the so-called underwriter's wire was correctly named undertaker's wire. People lost faith in paint and went for rubber with a rush.

The rubber field was inviting, and made more so by the introduction of steam pipes in the streets which rendered gutta percha useless in their vicinity. Hotchkiss, the enterprising agent of Kerite, made a good deal of hay in the shine of electricity, but soon Grimshaw came from England with his patent hook well baited. Brother Gallaher got hooked, but being amphibious he managed to live after being landed, and soon learned to make good rubber insulation which he called "Grimshaw" in memory of the hook, although it was not made à la Grimshaw. He formed the New York Insulated Wire Company in 1884. He has done a great deal of good work and still remains in the hottest of the fight, showing few scars.

A little later "okonite" insulation came, claiming a mysterious origin and a more mysterious composition. Both origin and compound seemed dark, and they have always chosen dark backgrounds; but their stuff had virtue in it, and big pushers behind it and for many years, especially in the West, the cry was, "If ye blows for Candee, ye drinks mit me."

About the time that Gallaher and Candee were getting into shape Dr. Habirshaw and the intrepid Requa were pulling together trying hard to make something that was cheap and good. They seem to have got discouraged on the lines they were pursuing and struck rubber. The concussion was so heavy and the rebound so great that they went in different directions, never to meet again; but they both got into the swim. Habirshaw called his company "The Gutta Percha and India Rubber," which is half true, and that is more than can be said of most rubber claims. His "red-core" insulation is rightly held in high esteem and he is one of the ablest men in the business. Requa pulled a strong oar till he got into "Safety," and is now the highest roller in the lot.

Up to 1885 the Bishop Company's motto was "Nothing like gutta percha," and there are still a few people who don't like "Bishop wire" because it softens in the sun.

Mr. Bishop having died July 4, 1872, on the same day as ex-President Adams, the business was conducted by Superintendent Marks for the widow until her death in 1881, and for her executor until 1885, and was therefore continued in the old tracks until the latter year, when the present company was organized, and no important changes were made in the work until 1887, when the present manager was given charge.

Having been in telegraphy for 16 years and for several years engaged as expert in the "Simpson-Colgate Insulation" patent suits, he was supposed to be posted on insulation in general. He also went for rubber, selecting as the best type then extant, the celebrated "Hooper's white core" which had done good service for many years in telegraph work in England and India, and had stood satisfactorily the fogs of the former and the burning sun of the latter. While using rubber, pure and compounded, for electric light work and all places exposed to great heat, this company still recommends gutta percha for submarine cables and claims that for flexible cords its Balata" is up top. It still nails to its flag the motto. "Bishop Means Best," and claims to make no second grades.

Besides the five companies mentioned above, there are at present eleven more, some being large and strong, sixteen in all, making rubber insulated wire.

Where $200,000 would probably have paid the cost of all high insulated wire and cables made in this country in 1882, the sales last year are estimated at about $5,000,000. A very large portion of this was for underground work for electric light and for electric railway feeders.

I believe that the first cables to successfully carry high tension currents underground were made by the Bishop Company and placed in conduits in 125th street and in Broadway and Fourteenth street, New York, in the spring of 1888, and that they are still working. They were insulated with three coats of rubber; the one next the wire containing no sulphur; the compound of the other three coats contained 3 per cent sulphur for flexible vulcanization. The rubber was protected by rubber tape and encased with lead. Nearly all of the successful cables in use to-day for high voltages are similar in construction. The Standard Underground Cable Company, the Western Electric Company, and some others, have made for several years large quantities of telegraph, telephone and signal cables by saturating the cotton wound wires with hot paraffine, bittite, rosin, wax or pitchy compounds encased in lead. These answer well for low tension currents as long as the lead holds.

Paper cables with rosin oil as an insulator have been made by several parties and, being cheap with high insulation, are much used; but they also depend upon the lead to keep their feet dry. The best working telephone cable for underground work is insulated by dry paper wound around the wire in such manner as to leave room for as much dry air as possible. Telephone currents stick pretty close to their tracks, not being coaxed off by poor conductors, but want some room for flourishes, which gutta percha and rubber does not allow them.

One of the thorns in the sides of insulated wire men has been the architect who knows nothing of electricity and the electrical engineer who knows less about insulated wires. This has been largely remedied recently by certain competent engineers, who have made a special study of insulation, and now our main trouble is the dirt craze, which should have the title of the exploded silver craze, "16 to 1."

Pure rubber is a higher insulator than gutta percha, but not so easily applied to the wire. Fortunately it is able to carry a large amount of adulterant which renders it more tractable and much cheaper. I believe that a large portion of the people who are insulating wire with rubber compounds, can make good stuff and would do so if they could get paid for it, but when people who want wire invariably buy that which they get at lowest price and the cost is regulated by the proportion of adulterant costing three cents per lb., and of rubber costing over a dollar per pound, the temptation to use sufficient rubber for good results is not strong.

PATENTS AND ELECTRICAL INVENTIONS.

BY HENRY C. TOWNSEND.

(Patent Lawyer, formerly Chief Examiner, Class Electricity, U. S. Patent Office.)

TWENTY years ago under the stimulus of the achievements of Pacinotti, Gramme, Siemens and others in developing electric energy from mechanical power, there began the new age of progress in electrical inventions and it was then the privilege of the writer to be a spectator behind the scenes of the inception and early rapid growth of the art commercially, as evidenced by the numerous applications for patent filed in the United States Patent Office by Edison, Thomson, Brush, Weston and others. About the same time there sprung into being the new art of telephony.

Up to that period the efforts of inventors, exerted through the forty or more previous years, had resulted in the accumulation of a host of patents in this and other countries touching almost without exception every branch of the art to which the attention of inventors has since been directed, and this despite the fact that commercially little had been done in any of them, barring perhaps that of telegraphy. To the public generally the whole subject was an unopened book. But little litigation had taken place and the courts generally were unfamiliar with the topic.

At even a later period and not many years ago, it was necessary for the writer, as attorney for inventors, to contend frequently and strenuously against the requirement of the Patent Office Examiners that any claim for a system of circuits or for an apparatus involving a switch or circuit controlling device as a part thereof, should specify in all its details the mechanical form or construction of that switch. The expression, for instance, "shunting switch," was not satisfactory, but it was necessary in the view of the examiner to specify a lever (if a lever were used) contacts, connections, etc., in detail, with the result of limiting the claim, detracting from its clearness and confusing in the mind of the public the true nature of the invention. The day of such requirements may safely be said to have passed.

But inventors have suffered not alone in the Patent Office from misguided views as to the meaning and scope of claims upon electrical apparatus. Some ten years ago the Supreme Court of the United States held that a new system of railway signaling, which involved as a part or element a means for closing a circuit by the passage of the train, was not infringed by a system identical in all other respects, excepting as to the circuit closing devices, because the patentee described and showed, as a circuit closing means, a section of insulated rails, while the infringer used a circuit closer mechanically actuated, although as a matter of fact the two devices had been known in the art for years as equivalents of one another and the specification stated that the patentee did not limit himself to the particular devices described for closing the electric circuit at points from which the signal was to be operated.

The decision so outraged the sense of justice of inventors and electricians pretending to any large knowledge of the art of electricity and its applications, that the writer may be pardoned for thus speaking of it, even at the risk of seeming to be guilty of lack of the proper respect which a member of the bar should feel for the opinion of our highest court of justice.

It is not many years since a valuable patent, lying at the foundations of the present systems of electrical distribution, was emasculated through an unskillfully drawn disclaimer, intended by the patentee as a simple declaration that he did not claim to have invented one of the ways in which his invention had been applied, but interpreted by the court as a surrender of his right to hold the user of the invention in that particular way as an infringer, an interpretation only to be tolerated on the theory that the court's knowledge of the nature of electricity was so crude as to incapacitate it for interpreting the patent. That was quite early in the period when active litigation over electrical patents began. The later history of litigated patents seems to indicate a profounder or a more familiar acquaintance with the subject generally on the part of our courts and counsel. At any rate, the time has gone by for counsel to experience the enervating dread that in the critical stage of his argument the court will interrupt to ask "Mr. ———, What is electricity?"

The early years of the last decade were halcyon days for the professional electrical inventor. The tyros with a smattering of knowledge of the subject of electricity, supplemented in many cases by only a little higher order of knowledge of mechanics, rushed into the new field of activity opened up by the commercial introduction of incandescent and arc lighting and telephoning. Companies were organized upon patents for inventions based upon most trivial variations of machines or apparatus that had been previously known for years. Some who read these lines may recall the formation in those days of a company with hundreds of thousands of dollars paid in capital upon the strength of a patent for a dynamo machine whose armature had been improved by using four coils instead of the three which had been previously known and patented to a prior inventor.

The telephone art saw many similar instances of capital embarked on the strength of patents for apparently endless variations in arrangements of telephone contacts and mounting of the same, but these enterprises fell into early decay through the complete enforcement of the Bell patent.

But the same period has seen also many enterprises, founded upon meritorious inventions, predoomed to failure because not addressed to a prevailing need or because involving too wide a departure from methods and arts then prevailing. Thus, early in the eighties, much effort, research and capital was expended in systems for telegraphing to moving trains, for distributing correct time and for telegraphing by what is known as the multiple synchronous system.

The lesson to be drawn by the electrical inventor from the failures experienced in these and other lines is perhaps that he should confine himself to inventing along the lines of commercial progress instead of venturing into new and untried fields. This is, however, a course which, had it been sordidly followed, would hardly have resulted in the evolution of a telephone, a phonograph or any of the other marked advances in the art which have sprung from the assiduous efforts of electrical inventors.

However, by closely following the rule the inventor may not, as one of them has put it, experience too frequently those periods "of inventive activity but financial depression" to which unfortunately some of them are subject.

It is to be perhaps regretted, from the standpoint of the inventor, that the fierce war prevailing not many years since between the advocates of the high tension and low tension systems of distribution has come to an end. We no longer hear the high tension system stigmatized as a "cheap makeshift only, possessing no element of permanency," and its promoters branded as "apostles of parsimony."

Nor have electrical inventors generally to fear that their occupation will decay under assaults or appeals such as that which illumined the pages of a certain anonymous, red pamphlet attributed to unfriendly "gas interests" and which was thus worded: "Our lives and those of our families are at risk and it behooves every citizen to look to it that we are not to have our very hearthstones caged in by a network composed of an element antagonistic to both life and property, although presented to us in the guise of a boon and a light to our way."

Nor need the progress of invention stop because of any doubts engendered by the sage observation, true perhaps now as then, contained in the familiar red "Warning from the Edison Electric Light Company" of 1887, to the effect that "A consolidation of ownership of patents which are of themselves intrinsically worthless, does not add to their legal status or value nor to their commercial value."

It is a genuine subject for regret that so few electrical patents have been sustained and that so much time is required in determining their validity. Even now the end of litigation begun in 1886 upon some electrical patents of prime importance has not been reached.

Nothing can, however, more effectually discredit the whole patent system and impair the value of patents to inventors than the frequent overthrow of them in the courts upon the ground that an anticipation of the alleged invention is found in prior patents or publications. It is a reproach to the system, as at present administered, that so many electrical patents should suffer in this way, and it behooves electrical inventors as a class to devote their energies to seeing that the Patent Office is better equipped for its work of examination. The value of the patent system in promoting the progress of the arts and sciences is unquestionable and our system as organized should not be discredited, but its shortcomings should be supplied, or, if it be not capable of successful operation on the present lines, it should be radically amended.

ELECTRICAL MEASUREMENTS.

BY PROF. W. A. ANTHONY.

REFINEMENT in electrical measurements may be said to have begun with the manufacture of submarine cables for telegraphic transmission, and it reached a high degree of development in 1855 to 1860, under the pressure of the Atlantic cable work. In 1861 a committee upon electrical units and standards were appointed by the British Association. This committee went to the root of the whole matter, proposed a consistent system of units, made experiments to establish their values, and prepared physical standards by which the values determined were embodied in a form for comparison and duplication.

Down to 1880 the importance in the arts of electrical measurements was mainly in connection with telegraph lines and cables. The latter, especially, required instruments of great delicacy and precision, because of the extremely small currents employed upon them. The marvelously delicate galvanometer and the quadrant electrometer of Sir William Thomson were an outcome of the requirements imposed by the development of telepraph lines. The measurements to be made were almost wholly resistances of conductors and insulation, the electromotive forces of battery cells, and capacities.

This was the condition of things in 1880, when the development of the dynamo electric machine and of electric lighting systems, created a demand for electrical measurements of a totally different character, and under very different conditions. On telegraph lines the measurement of current was of little consequence. The electrical energy consumed was small and its amount was not taken into consideration. Very little attention was paid, therefore, to the efficiency of apparatus. It was of far more importance to save labor and to secure unanimity from interruptions and delays in the service than to save in the electrical energy employed. Hence there was little call for measurement of currents.

With the development of electric lighting systems, however, where the energy employed was expressed in hundreds and thousands of horse-powers, the measurement of currents and potentials came to be of highest importance. Measurement of resistance while still of service, passed into the background. The currents to be measured were of magnitudes before unheard of. For the measurement of such currents special instruments had to be devised, as nothing previously constructed would serve the purpose. So with electromotive forces; they had previously been expressed in terms of the number of battery cells employed, or were measured by balancing them against cells of known e. m. f. Such means of measurement were, to say the least, very inconvenent for the measurement of electromotive forces of dynamo machines, or the differences of potential at different places in the circuit. From 1880 on, appeared a number of special instruments intended to meet the requirements imposed by the new conditions. The writer remembers using in 1881 the dynamometer form of current measurer of Siemens and Halske and a voltmeter of the same firm, consisting of a bell magnet in a coil of fine wire. In both these, electrical forces were balanced by a spiral spring by which the movable member was brought back to zero before reading. In the same year the instruments of Deprez and Carpentier were on the market. Following quickly after these were the graded galvanometers of Sir William Thomson and the well-known instruments of Ayrton and Perry. Then came the Thomson balances where the mutual action between currents was opposed directly by the force of gravity; and finally were brought out the instruments of Edward Weston, in which the force of a current in an artificial magnetic field is opposed by the force of a flat spiral spring.

Hosts of other instruments more or less well known have appeared and are on the market.

The measurement of heavy currents has presented and still presents grave difficulties. It is almost always done by dividing the current into two parts in a given proportion and measuring the smaller. What amounts to the same thing, the potential difference between two points upon a conductor carrying the current, is measured by means of a delicate voltmeter. The resistance between the two points being known the current flowing may be determined. Or the resistances, and, therefore, the subdivision of the current between them, may be entirely unknown, and the instrument as a whole calibrated by reference to known standards.

At the present time current measuring instruments are standardized by measuring a difference of potential and a resistance, or by reference to a silver or copper voltameter.

With such means at hand for standardizing current measuring instruments we are almost forgetting the true definition of the unit current and coming to look upon it as derived from the units of resistance and potential instead of being itself the foundation upon which the others rest, and from which they must at first have been derived. The true definition of the unit current is: It is that current which, flowing in a thin conductor of unit length forming an arc of a circle of unit radius, produces at the center of that circle a unit magnetic field. Or, what amounts to the same thing, and puts the definition in a form such that measurements in terms of the unit may be exactly realized in a n apparatus: The unit current is that current which, flowing in a thin conductor forming a complete circle of unit radius, produces at the center of that circle a magnetic field whose strength is 2π.

The tangent galvanometer, if of such size that its dimensions may be accurately measured, furnishes the means of exactly measuring a current in terms of the unit as above defined. So would also an instrument constructed upon the principle of the Thomson balance. Such a measurement of current is an absolute measurement, depending upon no arbitrarily chosen or imperfectly determined units, but resting only upon the fundamental units of length, mass, and time.

It was necessary in effect to make such a measurement before the true value of the volt or of the ohm could be determined. It was such a measurement that the British Association committee attempted in 1864 for the purpose of fixing the value of the ohm. But, as we now know, their determination was in error by more than one per cent. In 1880 the true value was still unsettled, although it was known that the standards in existence were to some extent in error.

It was this that led the writer to project the great tangent galvanometer of the Cornell University which was not, however, finally completed until some time in 1885. This instrument was so designed that its dimensions could be accurately determined. It contained within itself the means of determining the strength of the earth's magnetic field with which the field produced by the current was compared. The coils were such that current all the way from a fraction of an ampere to a hundred amperes or more could be directly measured. Its needle was quite dead beat and readings could be rapidly taken.

But such an instrument would have been worthless for general use. It was necessary to locate it at a distance from all other buildings, where the magnetic field could not be varied by any accidental or erratic causes. Probably no place could be found for such an instrument within the limits of a large city. Its special use was in standardizing other instruments. Although it could be and was used for measuring directly the currents in such tests as were made at the Cornell laboratories.

But the need for going back to first principles in the measurement of currents has now passed. By means of numerous absolute determinations the values of the several units have become definitely fixed and physical representatives or embodiments of those units have been devised, and it is now possible by reference to standard resistances and Clark cells to measure currents to an accuracy of one-tenth of one per cent., and then check the result by reference to a silver voltameter.

But it is not alone the methods of measurement that have undergone a change. The currents to be measured have increased enormously in the last fifteen years. Currents reckoned in thousands of amperes are in use now where tens of amperes were in use fifteen years ago. In resistance measurements also the quantities to be measured have undergone great changes. Formerly it was telegraph lines and cables having resistances of hundreds and thousands of ohms that were the main subjects of measurement. Now conductors and armatures of dynamo machines having resistances reckoned in millionths of an ohm must be measured as well. For the measurement of such small resistances the old bridge and resistance set is useless and methods that before were hardly known except as possibilities had to be brought into use. The fall of potential method finds to-day perhaps almost as extensive employment as did the bridge and rheostat fifteen years ago.

But it is not alone in the measurement of the old quantities —current, potential, and resistance, that changes have taken place. With the development of the dynamo machine other quantities have assumed an importance that they had not before possessed.

The quality of iron that goes into a dynamo is of prime importance, and yet it is something about which fifteen years ago, very little was known. Now special instruments are at hand for the measurement of magnetic permeabilities and in every dynamo manufactory samples of the iron and steel employed are tested.

Again the employment of alternating currents in lighting and power tranmission has brought to the front another series of measurements which before had found very few applications. Now, induction constants are becoming as familiar as resistances. Henrys are as important as ohms. Phase difference, too, must be considered and "angle of lag" has become a part of the vocabulary of the ordinary wireman who has had to do with the installation of alternating current apparatus. All this was almost unknown even ten years ago, except to readers of abstruse mathematical treatises upon electricity.

Of all these various advances in the art of electrical measurements, perhaps the most important is the final establishment to a degree of precision sufficient for all the purposes of the industrial arts, of the values of what may be considered the fundamental electrical units, the ampere, the volt, and the ohm, and the definition of the physical representatives of these values in a form that it is possible to reproduce without resorting to an absolute determination.

THE ELECTRICAL SUPPLY HOUSE PAST AND PRESENT.

BY W. H. McKINLOCK.

(President, Metropolitan Electric Co.)

It is a pleasurable task that I set myself to perform, at your invitation, coupled with feelings of, I trust, pardonable pride, to officiate in any capacity at the Crystal Celebration of "The Oldest Electrical Paper in America."

The electrical supply business at the period your paper first saw the light (electric) was unknown to the commercial world. It is true there were those who manufactured and dealt in electrical apparatus and supplied such articles as telegraph instruments, medical batteries, fire alarm apparatus, etc., but the electrical supply house, pure and simple (the word "simple" here is used as a figure of speech only, for it is a matter of common knowledge that the electrical supply business is considered the most difficult to conduct of any branch of the great industry, centralizing, as it does, the mechanical, technical and commercial), did not come until the telephone and electric light were fully developed; or, perhaps it would be more nearly true to say the supply business grew out of the development of the telephone and electric light, and is a necessary adjunct thereto.

The West is peculiarly adapted for the supply business, and that is where it has had its greatest growth and enlargement. As the young science began to be recognized in the industrial arena, factories sprung up in the East, where labor and capital are cheaper, to give it form and facilitate its progress. This left the great West as a distributing point for the finished product, and Chicago as the chief city and center of the new enterprise. Supply houses were started in a small way as experiments, and were found to be profitable. Electric light plants, electric railways, telegraph and telephone companies found it more convenient and profitable to order from one house all the little parts necessary to maintain and enlarge with, than to order from a hundred different places, thus reducing the labor of shipments, expense in carriage charges, account keeping and kindred annoyances. And just here comes in the difficulties of the supply man. He must keep in advance, or at least abreast, of the development of the science. He must be able to tell the difference between a German silver contact point and a platinum contact point upon a bell that may sell for a quarter, or to give a scientific test of the corpuscles of the blood by means of the X-ray. A man comes into your place of business from some small town, where he is considered all-wise, for the purpose of buying a plant outright and putting it up himself. It may be a small plant, to be sure, but as he knows very little about applied electricity, you must be able to show him just what he wants, and by your assisting him in pointing out the necessary carrying capacity of the dynamo, the size and kind of wire, the style of lamps he should have, you can make a fair sale; but, alas! such opportunities are rare, indeed, these days.

The supply business, however, has come to stay, and is a necessity to the station manager, and to the whole people at large (for who does not use electricity in some form nowadays?) as the butcher, baker and candle-stick maker is to the housewife. There is a saying that competition is the life of trade. It has almost been the death of trade in the supply business. As between the supply house and manufacturers, and supply house and supply house, the former is perhaps the more disastrous, for the supply houses in competition with each other are upon an equal footing, to an extent—the best man wins. But when the manufacturer endeavors to compete with his own products in the hands of a supply house, there can be no escape from ruinous prices, distrust of customers, sharp practices, and a lower morale of the business, sure to end in disaster for either or both. This method has been pursued from time to time by some manufacturers on account of an unwillingness on their part to accord the supply houses a position in the field. Many of the larger manufacturers, however, have found it to their advantage to employ the supply houses in the West to introduce their goods and act for them as their representatives.

A supply house from the very nature of the business must not be prejudiced against any article of merit, and should furnish anything its customer may order, if he can do so without loss to himself, and his customer's trade is desirable. One instance in point: A customer a thousand miles away ordered, among other things, 10 lbs. of Wienerwurst sausage, and because Wienerwurst was sausage, and, strictly speaking, not an electrical product, should we not furnish it? We certainly should, and did, and had the everlasting confidence and trade of this same electrician.

The capital necessary to run successfully a first-class supply house is no mean consideration, for where a large number of accounts are made, a major balance of them are always open on your ledger, thus wrapping up a large portion of your surplus. Then, too, the varied line of goods necessary, and the large amounts of each required to fill an order, or several of the same kind, promptly (for promptness and dispatch are cardinal points to be well regarded) make up a considerable portion of your sinews of war. The building and putting into the hands of probable or even possible buyers of your wares, of catalogues, which in theselves are the sine qua non of things electrical, is an expense which must be taken from your capital, and regarded as an investment to be provided against out of the profits later on.

It is needless for me to say that it is impossible to visit all probable purchasers once a year. Some you can visit oftener, and to those never, you must furnish cuts and descriptive explanations of the uses of the goods you have to sell.

In a word, the supply man must be alert to everything that is about to be put on the market, and often suggest to the inventor things needful, and be able to explain to his customer all about it, and the whys and wherefores thereof. His position enables him to be beforehand with new inventions, seeking remunerative reward, for if he be wide awake, he is sought after as well as seeking.

MUNICIPAL PLANT RESULTS AT HAMILTON, O.

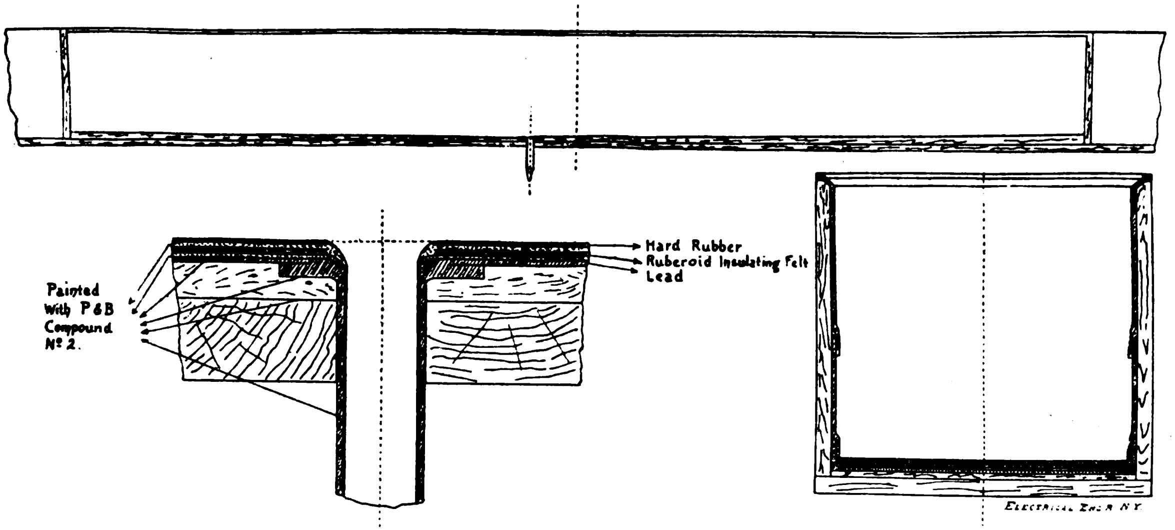
The trustees of the Hamilton gas works say they will close the electric light plant and discontinue street lighting after January 1, for the want of money to operate the plant. The city is already out an amount stated as high as $50,000 and the people are slow to put their hands in their pockets for $50,000 more.

BUFFALO is to celebrate the arrival of Niagara power within its limits with an "electrical dinner" at the Ellicott Club on January 12. A representative gathering is expected.

LINING FOR STORAGE BATTERY COMPARTMENTS.

AMONG the European cities in which accumulators are used for the propulsion of street cars is Hanover, Germany. In this instance the batteries are drawn upon while the cars are within certain city limits, while beyond these the trolley system is employed.

Much trouble has been experienced in the past from the action of the acid on the compartment in which the batteries are carried and various devices had been employed to overcome it, but without success, until the application of the P. & B. insulating compounds and Ruberoid felt removed all difficulties. As the use of storage batteries for this and other purposes is rapidly increasing it will be of interest to show in just what manner the work of making the batteries acid tight and insulating was carried out. This is detailed in the following communication from the Hanover Street Railway Company to Messrs. Allut Noodt & Meyer, Hamburg, Germany, who represent the Standard Paint Co., in Germany.



FIGS. 1, 2 AND 3.—METHOD OF MAKING STORAGE BATTERY COMPARTMENTS INSULATING AND ACID PROOF.

Great care is to be taken first, that the space shall not contain any metal screws, nails or like articles penetrating into it from the running gear or the body of the car. As this was the case with the car boxes in use thus far we have decided to put into our accumulator spaces a second bottom to which we will refer hereafter. It is necessary to examine all the spaces to be covered and to see that they are completely dry. This done we commence work by cleaning the walls of all dirt, oil-spots, etc. We thereupon fit very accurately the before-mentioned second bottom and finish it with an opening for the acid drain pipe. See Fig. 1.

We employed formerly two drain pipes which were fitted at both ends of the accumulator box. In order to avoid seams for the lead cases thereafter to be fitted, we employ now for each box but one drain pipe which, corresponding with the situation of the iron part of the running gear is removed 130 mm. from the center of the accumulator box. In order to promote the easy drainage of the acid, we fit the second bottom at an incline of 1 to 110, shown in section in Fig. 2.

After being fitted this bottom is taken out again in order that the lower bottom be given a coating of P. & B. composition No. 2, diluted with the diluter furnished. Thereupon the second bottom is well painted on the lower surface with the diluted P. & B. and pressed promptly to the lower bottom. In order to obtain a good union, we lay heavy iron pieces uniformly over the surface and let them rest there for three to four hours. We thereupon paint all the joints, flaws and holes of the box with diluted P. & B. composition very carefully and fill them up afterwards with the thicker P. & B. composition. We then give a good coating to the bottom as well as the side walls, the latter to a height of 100 mm. with the diluted P. & B. composition; after this coat follows a second coat with the undiluted material and a lead box is inserted promptly which in order to effect a perfect union is to be weighted down and the sides of which are to be smoothed off.

This lead box is made of sheets of 1.5 mm. thickness. The height of its sides is 100 mm. The edges are soldered only after the box is fitted in its place. The previously introduced drainage pipe is also to be soldered with lead. After an intermission of about 12 hours for the purpose of the permanent union of the lead coating all surfaces of the box are carefully painted with diluted P. & B. composition, and after they are again dried they are painted twice more with the undiluted P. & B. composition. The bottom is to receive a coat of special thickness and another intermission of about 15 hours is to intervene.

Then we commence with the pasting in of the P. & B. Ruberoid insulating felt ½ ply. The covering for the lower part of the box should be cut out of one piece. The width of the felt is sufficient to employ it bent over for the lining of the entire length. The sides are also to be put on in one piece. On all portions remaining uncovered the felt is put on so as to overlap the lower sheet. The upper end is lapped over and fastened by nailing a wood moulding over it; see Fig. 3.

Before inserting the felt the same is covered strongly with undiluted P. & B. composition and the inserted ruberoid felt is pressed with sticks to the bottom and sides until it adheres firmly in all places.

At the four corners of the bottom, suitable slips of uncut ruberoid are bent and pasted into place. All about the edges of the bottom there is to be fitted a strip of the ruberoid felt. After a few hours the whole is covered with a double coating of undiluted P. & B. composition. We then pour over the bottom evenly a quantity of the thick P. & B. composition about 2 mm. thick. After this is dry a hard rubber plate of 1 mm. thickness is covered over it. For this purpose the edges of this rubber plate are coated heavily to the width of about 50 mm. If the rubber plate is corrugated all the tops of the corrugations must be painted.

In order to obtain a good adherence all edges and walls or sides have to be covered with wooden laths held down by heavy weights.

If there should be any open joints or any openings on the edges of the plate they should be thoroughly and carefully filled with the thick P. & B. composition. If the work is done carefully and cleanly this coating will keep a very long time and need very few repairs. We cannot recommend at all the coating with rubber, as, notwithstanding our having used the very best material of rubber, the results we had were the very worst that could be imagined.

We are confident that the lining we employ will answer all expectations in regard to insulation and acid resistance.

ELECTRICAL ENGINEERING EDUCATION.

BY FRANCIS B. CROCKER.

(Professor of Electrical Engineering, Columbia University, N. Y.)

THE changes which have been wrought in electrical engineering education since The Electrical Engineer was established in 1882, are even greater than those that have occurred in the art itself, in spite of its remarkable progress. At that time only two of the five great branches of electrical engineering, telegraphy and telephony can be said to have been established on anything like their present basis, and even these have been enormously developed since that time. Electro-metallurgy, although the oldest practical application, was of little importance; in fact, only within the last two or three years can it be said to have fulfilled even a part of the great results which have long been expected from it. But there is every reason to believe that the ratio of its progress in the future will be greater than that of any of the other departments of electrical enterprise. These statements apply not only to electro-metallurgy specifically, but also to primary and secondary batteries and to electro-chemical work, which may all be included under the same general head. In 1882, the scientific as well as popular mind was still filled with the enthusiasm for the storage battery which was aroused by the announcement of Faure's inventions of the preceding year. In this case also the hopes were not realized until within a few years. Electric lighting was then well started on its successful career. The arc systems of Brush, Weston and Thomson & Houston had been introduced and accepted. The incandescent system of Edison had just been established upon a commercial basis. But the size of the plants, and the number of lamps in actual use were very small figures compared with those of the present day. The alternating current system which now constitutes such an important part of electric lighting, was not brought out for several years after that time. The other great branch, electric power, had its entire period of development since the founding of this journal. At the Munich Electrical Exhibition of 1882, Deprez demonstrated to the world the principles of long-distance transmission of power, for which he deserves far more credit than is usually given to him. He not only led the way in concrete results, but he brought out, or at least made clear, certain principles of the electric motor, including the relation between counter and direct electromotive forces and resistance, that were very imperfectly understood at that time. It was not, however, until about 1886 that the electric motor began to be generally used, and its application to street car propulsion was not successful for several years after that. It is therefore substantially correct to say that electric power, including its transmission and distribution, has started and reached its present position in the first rank of human agencies, during this short span of fifteen years.

This rough sketch of the advances made in applying electricity, represent in a general way the changes that have taken place in electrical engineering education, the latter being naturally and properly moulded by the former. Nevertheless, it has had a history of its own, due to its own particular conditions; and furthermore, it can be fairly claimed, as stated in the opening sentence, that its progress has been even greater than that of the arts and sciences with which it has to deal. In 1882 we have seen that in some directions, at least, considerable progress had already been made in electrical engineering, but at that time the corresponding education did not exist. The nearest approach to it were the mechanical engineering courses given in several colleges and technical schools in this country. These supplied the young engineer with the general training which is so important, and the special knowledge of mechanical principles and applications, including steam engineering, which are also needed; but they failed to give a sufficient knowledge of electrical principles and appliances. The amount of electrical instruction was very small, that is, the number of hours devoted to it, and in most cases it was not well suited to the new conditions. For example, frictional electricity, primary batteries and permanent magnetism were practically the only subjects considered. While the same fundamental principles apply to all electrical and magnetic phenomena, there is little or no direct application of these antique subjects to most of the modern uses of electricity. The writer believes in teaching electricity and magnetism according to their historical development, because that is the natural order in which the facts are acquired by the human mind; but great care should be taken to prevent the student from getting an exaggerated idea of the importance of static electricity, and in all cases instruction in dynamic or current electricity should immediately follow, and the proper relation between, and the relative importance of, the two should be clearly pointed out. Every electrical engineer has probably observed that the old-fashioned methods of teaching electricity in the colleges and schools often gives wrong notions to non-electrical persons, even though they may be otherwise well educated. The most familiar of these erroneous impressions is the idea that the dynamo works on the same principle as the frictional electrical machine which was the most prominent feature of the scientific apparatus of almost all colleges and schools, the recollection of which was made particularly strong and lasting by the "shock" usually administered to the members of the class. It is indeed a question whether the modern uses of electricity would not have been better and more quickly understood by the public if it had had no preconceived and self-satisfied ideas concerning electrical matters.

Nearly all of the men who entered the electrical profession up to 1882 and for several years after that, acquired most of their electrical knowledge by experience and self-instruction. At that time this journal was called "The Electrician," and it was also customary for men engaged in electrical work to be designated by the same name. The difference in title represents an actual difference in fact, the engineering side not having been recognized and developed at that time. Electricians as a body were then made up chiefly of those who were or had been engaged in telegraphy, the only branch that had been established for any length of time and the sole field for obtaining practical experience. In addition to these telegraph electricians there were a certain number of scientific men, usually professors of physics or chemistry in the colleges of this and other countries. These men naturally turned their attention more and more to this subject, which was in the line of their work and appealed to them on account of its intrinsic interest and growing importance. They contributed to it scientific methods, notably definiteness in terms and exactness in measurements which are characteristic of electrical engineering and make it an example for the other branches of applied sciences to follow. The ranks of electricians were also recruited from those having an inborn aptitude for the subject, and who entered the profession as a duck takes to water. In many cases these volunteers had had little or no preparation, but their natural taste, amounting in some instances to genius, was equivalent to or far better than mere education, particularly in those early pioneer days. These three classes constituted probably nine-tenths of the then small body of electricians, including its most eminent members as well as those of less prominence.

The enormous extension of the electrical industry soon created a demand much larger than could be supplied from the sources then existing. A demand also came in the other direction from those young men who were attracted to this new and promising field. The educational results of these demands were twofold; first more electricity and of a more modern character was taught to all students in colleges. The other outcome was the establishment of specialized courses in electrical engineering, in contradistinction to mechanical engineering or physical courses, that were modified to suit the new conditions. The theory upon which such courses are based is that electrical engineering is a definite and independent profession, parallel to civil, mining and mechanical engineering, but not subordinate to any of them. It involves some knowledge of these others in the same way that they require some knowledge of it. Until quite recently the independence of electrical engineering was not admitted by all, but now that it seems to be necessary to subdivide electrical engineering itself into two or three branches, it is evident that it can no longer be considered as an appendage to some other profession. In this age of rapid progress each profession will have all that it can do to take care of itself.

In designing an electrical engineering course the relative amount of attention to be given to the various subjects is difficult to determine exactly. In 1889, when the writer was called upon to decide this question, it was determined after careful consideration that a thoroughly substantial foundation in mathematics, physics, chemistry, and drafting is required, substantially the same as that demanded for civil and mechanical engineering, but with more physics and chemistry. This ground work can be laid either in a preliminary course, in which case the electrical engineering instruction is post-graduate, or it may be taught in the first two years of a four-year course. The former plan enables other general subjects, such as English and other languages, history, etc., to be included with the sciences; but the latter plan saves two years, which in this country is considered a very strong argument in its favor. The last two years of the course cover what might be called the professional work. Electrical engineering proper is begun in the second year, but it is not gone into deeply until the third and fourth years, during each of which it occupies about one-half of the sixteen or eighteen hours per week that is given to lectures and recitations. It also engages one-half of the time available for laboratory work during the the third year and about two-thirds of this time during the fourth year. Mechanical and general engineering cover the remainder of the work, considerable attention being given to structural as well as to dynamic engineering. If any change in this apportionment is necessary, it will probably consist in somewhat increasing the attention given to electrical subjects rather than diminishing it. In some institutions the proportion of electrical instruction is smaller than that indicated above, but it would seem to be inevitable that at least one-half the time must be given to electricity and its applications during the last two years. This is in addition to a thorough one-half of the time available for laboratory work during first two years, including general electricity and electrical measurements. A course in electrical engineering is compact and homogeneous, the subjects following each other or advancing side by side in natural and logical order. In this respect it is much easier to arrange such a course and carry it on than with mining engineering, for example, which includes outlyng matters like geology, mineralogy and surveying. The progress of a student of good intelligence and application is steady and sure. He usually has some difficulty in gaining a working knowledge of the action of the current. The human mind certainly does not take naturally to that idea, probably because the subject was not understood or even considered by previous generations. But after a certain grasp of the subject has been obtained, it seems to be possible to carry even average students as far as may be desired, even in advanced work. Some students of course have a greater natural taste for electrical information, but it is surprising to see men who have not shown any interest in electricity up to the age of eighteen or twenty years, become in two or three years really well versed in the subject and competent to do good work. That, to the writer, is the most unexpected result that experience has brought out in connection with electrical education.

Two criticisms are often made concerning electrical engineering education, according to one of which a graduate is not a full-fledged engineer when he leaves college, and according to the other, too many graduates are being turned out. Among the many answers to the first are:

1. The graduate has a thorough grounding in the fundamental subjects of mathematics, physics, chemistry, etc., which is very valuable not only in any technical pursuit, but also in ordinary business, and even in every day life.

2. He gets a general training and systematic methods of thinking, speaking, writing and working.

3. He gains a special and practically complete knowledge of electrical principles and applications as well as of allied mechanical and chemical subjects.

4. The total time occupied is four years. The same knowledge could not be picked up in ten years outside of an educational institution, and it is doubtful if anything like the same clearness and completeness of information can ever be acquired elsewhere.

5. The "practical" engineer knows certain branches intimately, but there are other equally important ones about which his mind is almost a blank. This is rarely the case with the educated engineer.

6. The principles of science remain unchanged so that any new invention or development is immediately intelligible to a scientifically trained mind, but has to be learned as a new subject by the practical man.

7. Electricity is so exact a science that theory can be applied directly to practice with only slight modification. For example, electrical measurements are made by the same instruments and methods and with equal accuracy in stations and factories as in college laboratories. The same machinery is also used.

8. Instruction should be firmly based upon correct theory, but it should lead the student up to the practical. Commercial apparatus and methods often make excellent examples of scientific principles. A certain amount of attention should also be given to economic and financial questions. It is not practicable, however, to give the student a certain commercial air and facility, but this can easily be acquired with a few weeks' experience in actual business. In fact, the great cry against the college graduate as a mere theorist, resolves itself when examined into this simple fact that it takes a little time to "break him in." But the period is not as long as it is for a boy from school, and after the graduate has been initiated he is a far more useful man.

It is quite a nuisance to "break" in almost any new man, but is not a very serious matter, particularly in this case, and does not involve one-quarter as much time and trouble as for a young physician. In this connection it is significant that all electrical companies prefer, and many of them require, that a young man shall be an engineering graduate in order to secure a position.

In regard to the overcrowding of the electrical profession, we can make the old but very true remark that "there is always room at the top." The writer is familiar with the experience of about one hundred young electrical engineering graduates, and in spite of the exceptionally hard times of the past few years, almost all of these men have secured fairly good positions and many of them are getting along extremely well. Certainly the average success is fully as great as in any other line of work, and it is a surprising fact that there have actually been more opportunities than men to take them, and it is usually harder to get a good man to fill a position than to obtain a place for a young engineer.

This by no means implies that the electrical engineering profession is a sure, short and easy road to fortune. Some individuals may not be fortunate in finding an opening; they may have some peculiarity of character or manner that renders them unsuited to a certain position or the enterprise with which they are connected may be crippled or stopped through no fault of their own. It should also be thoroughly realized that this profession requires fully as much hard work as any other. To be sure, the work is usually interesting, but it should be performed with more than ordinary intelligence, care and energy.

If, in course of time, electrical engineering does become overcrowded, which is by no means unlikely; even then an education in this branch would not be thrown away. As a mental training and a preparation for almost any business, it is equal to an academic course or time spent in educational or commercial work of any sort. In the future electrical matters will become more and more important to every one, and even though one may not be professionally interested in it, electricity is a grand and progressive science well worthy of the study of any mind.

LETTERS TO THE EDITOR

THE H. WARD LEONARD MOTOR REGULATION PATENT.

I NOTICE that you have published a statement relative to the counter electromotive force regulation of electric motors, wherein you have in effect given the public to understand that Mr. H. Ward Leonard prevailed over all other contestants in the interferences, among whom was myself. As such condition is totally at variance with the actual facts, permit me to explain the exact situation, that there may be no misunderstanding from a misrepresentation on the part of any one. As a matter of fact, my reductions to practices were prior to the conceptions of Mr. Leonard; and after Mr. Leonard had made propositions to me for an amicable adjustment of the interference, which were declined, he made a motion to dissolve the interference on the ground that the broad issue was not patentable over the prior art, introducing special patents. The primary examiner dissolved the interference upon this motion, citing a certain patent which anticipated all of the applicants but myself. I thereupon did not appeal, since the record in my case antedated the reference (my reductions to practice antedating the patent cited and my completion of the invention being considerably anterior to the reference). Leonard thereupon made a new motion, calling attention to the facts as above stated and asking that the examiner withdraw his decision and deny the patentability upon an earlier reference. This motion was denied. Thereupon Leonard limited his application to specific details which distinguished it from the other applications and from the prior references, and his patent 572,903 issued on Dec. 8, 1896. In that patent he has not a single broad claim, and on the other hand all of the broad claims, some thirty or more, remain in my application to be issued as the fundamental patent upon this system. Leonard's patent will be subservient to mine and a direct infringement upon my claims.

Under these circumstances, your publication implying that Leonard has succeeded in overcoming the contestants and securing the broad claims is evidently based upon a misrepresentation of the true facts. R. M. HUNTER.

Philadelphia, Dec. 30, 1896.

(Feeling that this matter is one of questions of fact between the two gentlemen interested, we have asked Mr. Leonard to state his case, and now append his reply to Mr. Hunter.—Eds. E. E.)

I have read Mr. Hunter's letter to you dated Dec. 30, 1896, which has sufficient truth in it to make it impossible to contradict him flatly, but his statement is far from fair.

I shall not attempt to rehearse the details of some six or seven very complex interferences involving nine different contestants, but will say that I have won every interference to which Mr. Hunter and myself were parties and that no interference exists between us at present. It is probably true that he has not abandoned his case, although in every issue between us I either prevailed or succeeded in showing the patent office that his claims were unpatentable.

Whether the claims of my patent are broad, or not, is of course a matter of opinion. I grant that they are not broad enough to make it necessary that I should swear back of all the art during the past eleven years in order to keep it alive in the patent office, and also to account for a delay of six or seven years in filing the patent application, and also to file affidavits as to the actual operation of a device which must bid defiance to nearly all the laws of nature before it can operate as claimed.

Mr. Hunter, however, is in the positon I have described. If by any chance he succeeds, by sufficient affidavits and sketches, in securing a patent which anticipates the good work in the line under discussion, done during the past eleven years by such men as Edison, Farmer, Lahmeyer, Pendleton, Rice, Bradley, Dillman, Weston, Mailloux, and many others, I shall certainly make no claim to it, and he will be entitled to all the credit that the securing of such a patent gives him as far as I am concerned. H. WARD LEONARD.

Hoboken, N. J., Jan. 2, 1897.

NEWARK, N. J.—The station of the Newark Electric Light and Power Company, P. N. Jackson, president, was wrecked by fire on Dec. 29, the fire starting apparently in a wooden switchboard. About twoscore dynamos were burned up or disabled. The damage is put at $175,000, covered by insurance. Resumption of service was very prompt.

"THERMO-ELECTRIC" OR NOT "THERMO-ELECTRIC."

IN your issue of Dec. 30, 1896, Professor Anthony says he "cannot see that the action of the Jacques cell is any different from the action of any other electrolytic cell, as, for example, zinc-platinum in dilute acid," except that the Jacques cell must be raised to a high temperature before there is oxidation of the carbon.

The difference is a very important one, I think, when we consider that in the case of the zinc-platinum couple in acid, alkali or water, or in any solution containing water, we have chemicals capable of attacking the zinc in an exothermic reaction; whereas, in the Jacques cell there is no substance, so far as he has made known its contents, that can, at any temperature up to the highest attainable by the oxidation of carbon, react on carbon exothermically; unless we assume that the formation heat of potassium ferrate is less than 145.5. To account for the result obtained by Dr. Jacques (1.04 volts) we must assume the formation heat of potassium ferrate to be zero. This means to assume that the highest known oxide of iron may, without either absorption or evolution of energy, be reduced to the metallic state—an assumption that seems to me entirely untenable.

The fact that certain exothermic reactions may not take place at very low temperatures, as explained by Prof. Anthony, is no proof that a high temperature will change an endothermic into an exothermic reaction. High temperature, instead of changing the endothermic into an exothermic reaction, merely supplies heat that must be absorbed in order that the endothermic reaction may take place. If the reaction can take place only through the absorption of external energy (heat), it cannot be galvanic and cannot, therefore, be like that of a platinum-zinc cell, whether it be thermo-electric or not.

C. J. REED.

Philadelphia, Jan. 2, 1897.

THE RADIATING POWER OF INCANDESCENT LAMP FILAMENTS.

The criticism which London Lightning makes upon Mr. Converse D. Marsh's ideal filament which radiates no light is perfectly proper; but their "Reviewer of Reviews" further on gets rather involved in his own argument by forgetting that the best filament is the one which at a given temperature yields the largest amount of light for the energy expended, or which, for a given ratio of light produced to energy expended operates at the lowest temperature. These conditions depend very much upon the radiating power of the surface.

Consider a filament operated by 50 watts and giving 16 candles. Keeping the supply of energy constant, if we made the surface a poorer radiator the temperature of the filament must rise to enable it to radiate the energy supplied, and being hotter it will yield more light, although the energy supplied remains the same. If the filament, with its original surface, be supplied with more energy until its light is increased to the same amount, its efficiency will then be less than the efficiency of the poorer radiator because the amount of energy has been increased.

If the energy be still more increased, the efficiency of the good radiator can be made equal to the efficiency of the poorer radiator; but its temperature will then be much higher, its deterioration more rapid and its life shorter.

These considerations demonstrate that the poorer the radiating power of a filament the less the energy needed to produce a given amount of light, and the lower the temperature of the filament at any given efficiency.

The base of lamp filaments is amorphous carbon, which is black and smooth. This is surfaced with graphitic carbon, which is gray and not always as smooth as the base. The radiating powers of these two kinds of carbon are about as 4 to 3, the amorphous carbon being 4.

A black, unsurfaced filament which with a given amount of energy, say, 50 watts, will yield a given amount of light, can be given a thin coating of graphitic carbon, and will then yield considerably more light with the same amount of energy supplied, 50 watts. This coating will increase the surface of the filament which makes the result all the more remarkable. This change is not due to smoothness, for the base is as smooth as the graphitic surface, but the improvement is due to the poorer radiating power of the graphitic surface.

Lightning's reviewer says: "Granted that a smooth surface radiates less heat, it also radiates less light, and therefore the temperature must be raised to get equal candle-power." I think this is a wrong conclusion. I grant that at the same temperature the poorer radiator will radiate less heat, but I do not conclude that it will radiate less light, for while the total radiation is less the proportion which is light is greater; and while I am not sure that the light will be fully equal to the light from the better radiator, I believe it will be equal.

This opinion is based on observations made upon lamp filaments of various kinds, having very different radiating powers, but as I have not been able to measure their temperatures, I state this as my opinion only.

This fact that a filament with a poorer radiating surface gives more light per unit of energy expended at a given temperature, or gives the same ratio of light to energy at a lower temperature, can be easily demonstrated; but whether the different filaments, at the same temperature, give the same light per unit of surface, is not so easily determined. I hope Dr. Nichols will enlighten us on this subject.

JOHN W. HOWELL.

Newark, N. J., Jan. 3, 1897.

THE PHYSIOLOGICAL EFECTS OF X-RAYS PRODUCED BY STATIC MACHINES.

I NOTICE in your issue of Dec. 23, 1896, a brief article by Mr. G. A. Frei, in which he states his conviction that X-rays, when produced by static machine discharges, are harmless—mentioning experiments which he had made to test this supposed fact. I have only to say in answer to the idea put forward by Mr. Frei that the injury to my finger, already described in your journal, was produced by a static machine with one-half hour's exposure. Of course, the machine was one of considerable output, comparing, in this respect, with a moderate size Ruhmkorff coil. I am constrained to think that if Mr. Frei uses a machine, the electrical output of which is equal to that of a fair size Ruhmkorff in exciting the tubes, he will have no difficulty in producing the injurious effect.

I would also like to call attention to the misconception of my remarks before the American Institute of Electrical Engineers, as reported in your Society and Club Notes, page 652, of the same issue. I am made to say that the static machine is the most powerful exciter, which is not by any means what I intended to say, as it altogether depends on the size and capacity of the static machine as compared with any other device for exciting the tube. Also, in regard to the use of a tube with selected unidirectional discharges, the statement is made that a hole was melted through a platinum piece 1-32 inch thick in three seconds. This is an error; the hole was melted through an ordinary thickness of platinum used in the tube, which was much less than 1-32 inch thick; and this statement is followed by the words, "and through 3-16 inch iron in a high vacuum." This is evidently a confusion of the penetrating action of the rays, as in the experiments we made, no melting of iron by Röntgen rays produced by the tube was produced, but the statement should be that when the vacuum was very high the rays could easily penetrate very considerable thicknesses of iron. Also, it was stated that the name-plate could be seen through a fairly heavy iron casting, no thickness being given, but it was also stated that the letters could not be distinguished, although the fact that letters were there was plain enough. These, of course, were the raised letters on the name plate.

ELIHU THOMSON.

Lynn, Mass.

SOCIETY & CLUB NOTES

NORTHWESTERN ELECTRICAL ASSOCIATION.

Mr. George Cutter, of Chicago, has kindly agreed upon the request of Mr. Mercein, secretary of the association, to take charge of the arrangements for the Chicago delegates. Mr. Cutter writes us that he expects to run a special car from Chicago to Milwaukee on Jan. 20, by the 8:30 a. m. train over the Chicago and Northwestern Road. Delegates are requested to communicate with Mr. Cutter, should they desire to avail themselves of this opportunity. The convention is to be held at the Hotel Pfister, Milwaukee, Jan. 20 and 21.

PROF. HOUSTON ON X-RAYS.

A lecture on the theory of the Röntgen rays will be given by Prof. E. J. Houston on Friday, Jan. 8, at 8:15 p. m., before the Department of Electricity of the Brooklyn Institute, at the assembly rooms of the Academy of Music. It will be illustrated by lantern slides, and promises to prove a very interesting occasion. We are requested to state that the service of silver presented to the new man-of-war, Brooklyn, by the people of the city will be on exhibition at the Academy the same night.

LITERATURE

AUTO-CARS.—By L. Serraillier. Trans. by D. Farman, M. I. E. E. New York. Whittaker & Co. 1896. Cloth. 8vo. Illus. 249 pages. Price, $1.50.

This is a timely and interesting book, which we can cordially recommend to all interested in this important subject, about which information is so scarce. Much is written, but little is known. Indeed, a melancholy feeling comes over one in looking through these pages to note how many types are impossible, how many are too expensive, and how few combine inventive ideas with mechanical knowledge. Most of the automotors here shown will go into the scrap heap in a year or two, but the art will rear itself on their remains. The record is fairly complete in this volume, although, as it was first published in France it is not surprising to see several American machines electric and other, omitted from the enumeration.

LEGAL NOTES

THE TESLA PATENTS REVOKED IN GERMANY.

The Elektrotechnische Zeitschrift quoting the Köln. Ztg. states that the suit of the Allgemeine Elektricitäts-Gesellschaft of Berlin against the Aktien-Gesellschaft Helios of Cologne, for the revocation of the Tesla patents was tried before the German Patent Office and resulted in the revocation of the patents according to paragraph 11 of the German Patent Laws. The case will be appealed to the Imperial Court by the Helios Company. Just what "Tesla patents" were revoked is not stated. The term is usually applied in this country to those dealing with induction motors requiring phase currents for their operation.

The paragraph of the German Patent Law above referred to reads as follows.

§ 11. A patent can be revoked after the expiration of three years, reckoned from the date of publication of allowance.

1. If the patentee fails to carry out his invention in Germany to a suitable extent, or at least to do everything that is necessary to ensure its being carried out.

2. If the grant of license to others for using the invention appears to be demanded in the interest of public welfare, but the patentee nevertheless refuses to grant such license upon adequate compensation and against sufficient security.

WALKER CO. VS. GLENOAKS AND PROSPECT HEIGHTS RY. CO.—A SUIT FOR BREACH OF CONTRACT.

Mr. J. H. Gates, the Chicago representative of the Walker Company, of Cleveland, Ohio, informs us that they have begun an assumpsit suit for $15,000 against the Glen Oaks and Prospect Heights Railway Company, J. H. Seiberling, M. Seiberling, A. G. Seiberling and F. Patee, all of Peoria, Ill., for breach of contract. It appears that the Walker Company contracted with the parties named for generators and motors, and that the order was cancelled without any cause. The Walker Company are making a test case of this, and have engaged the services of several leading lawyers. It is said that a decision for the plaintiffs will put a salutary check on the practice indulged in by some companies of ordering apparatus and then repudiating the contract even after the machinery has been built, but without any justifiable cause.

CONNECTICUT TROLLEY PARALLELS.

Paralleling steam railroads by trolley lines has received a check by a decision of the Connecticut Supreme Court, which has ruled in favor of the defendants in the case of the Montville Street Railway Company against the New London Northern, Norwich and Worcester, and New York and New England

Railroad Companies. The plaintiff's only recourse is appeal to the Legislature.

THE SCHLESINGER RAILWAY PATENTS IN SUIT.

John I. Duffee, of Philadelphia, by Augustus B. Stoughton and Valentine & Brown, attorneys, of Philadelphia, have brought four suits in the United States Circuit Court, at Baltimore, against the Baltimore Traction Company, the Baltimore City Passenger Railway Company, the City and Suburban Railway Company and the Central Railway Company, for alleged violation of a patent for a device used on electric railways, granted to William M. Schlesinger, of Philadelphia, Sept. 10, 1895, upon his application filed Nov. 24, 1885, and assigned by Schlesinger to Duffee.

REPORTS OF COMPANIES

THE ELECTRIC RAILWAY COMPANY OF THE UNITED STATES.

The Electric Railway Company of the United States, whose office is at No. 1 Broadway, has applied to the New York Supreme Court, through Cephas Brainerd, Henry M. Field, Stephen D. Field and other directors, for the voluntary dissolution of the corporation, and Judge Truax has appointed John Hone, Jr., referee in the case, and set down the order to show cause for April 7 next. The company has not done active business for two years, as litigation concerning its principal patent resulted adversely to the company in 1894. The company was capitalized at $2,000,000, divided into 20,000 shares, of which 8,001 shares are in the treasury. There are a large number of stockholders, the principal ones being the Rev. Henry M. Field, 3,872 shares; Frederick F. Thompson, 1,000; Stephen D. Field, 495; Stephen J. Field, 375. The liabilities are $33,250, of which $20,000 are bonds issued to the late David Dudley Field. The assets consist of three patents, $41 cash, office furniture and old materials.

ELECTRICAL STOCKS.

The New Year has not opened with the briskness that many expected, but the undertone of strength is remarkable, and 1897 is faced with much brighter anticipations than were felt when 1896 dawned. The mere fact that in its trade with other nations this country has become a creditor to the tune of $350,000,000 is enough to show how things are going, and to prove that such failures and liquidations as now occur are no longer signs of current distress, but echoes of the sad and terrible days that succeeded each other from the beginning of 1893 to the close of 1896 almost without interruption.

Turning to the present course of the stock market, we note that local lighting and street railway securities are in better demand and much firmer. The Christmas lighting and the holiday travel were both much better than last year and the indications all point to greater liberality in this respect. The stocks quoted on the New York Stock Exchange are fairly steady. During the week, 11,316 shares of General Electric were sold at from 31⅞ to 34⅛, and 7,091 Western Union at 82½ to 83¾. On the Boston market American Bell telephone has been quoted around 206. and General Electric pref. at 75 to 77.

CABLE TO HAWAII.

Representative Loud, of California, chairman of the Postoffice Committee, has introduced a bill providing for the construction of a cable to Hawaii and Japan by the Pacific Cable Company of New Jersey. It is similar to previous bills of this kind, with the exception that it provides that the company shall give a bond of $300,000 for the performance of contracts.

RALEIGH, N. C.—The power house and car barn of the Raleigh Electric Company was burned Dec. 31. Total loss. Nine cars and their equipment were in the barn at the time. The power plant consisted of two Edison bipolar 60 kilowatt 500 volt generators, one 650 light T.-H. alternator and two 500 light T.-H. alternators, three 100 horse-power boilers, two 70 horse-power Ball engines and two 11 horse-power Frick Eclipse engines. The insurance is stated at $12,500. The lighting portion of the plant was very successful while the railway part of the plant was barely making expenses. Mr. G. L. Bunch, E. E., writes us that the details of rebuilding and re-equipment are not yet settled.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

Central Stations:

THE ELECTRIC LIGHTING AT MANCHESTER, ENGLAND.—Enormous progress has been made during the last few years at Manchester, where the five-wire system of distribution has been very successfully introduced. Considerable improvements have lately been effected which are described in detail. Two substations and an accumulator battery have been added, the first for more successful distribution, the second for equalizing loads as well as for doing away with running the central station at night. Details with illustrations and diagrams in Lond. "Elec. Rev.," Dec. 4, '96.

ARE CENTRAL STATIONS DOOMED?—By Max Osterberg. A short article opening the question of central stations versus small plants, taking care of the lighting on one square block. The economy of the latter is briefly pointed out. "Engr. Mag.," Dec., '96. Editorial comment "Elec. Eng'r.," Dec. 2, '96. Discussion from the financial standpoint by "An Engineer," in "Elec. Eng'r.," Dec. 23, '96.

MUNICIPAL LIGHTING, OR PRIVATE CONTRACTS.—Mayor John MacVickar, of Des Moines, publishes some letters received from the General Electric Company and Brush Electric Light Company; both parties expressing their views in favor of private corporations.—"Am. Gas Light Journ.," Dec. 28, '96.

Dynamos and Motors:

CALCULATION OF DYNAMOS FOR DIRECT, SINGLE AND MULTIPHASE ALTERNATING CURRENTS.—By E. Arnold. The first of a series of articles in which the author gives some mathematical deductions which he believes will materially help in the design of dynamos.—"Elek. Zeitschr.," Nov. 26, '96.

LARGEST GENERATORS FOR LIGHTING EVER CONSTRUCTED.—A two-phase, 2,400 volt, 1,500 kilowatt alternator, with a frequency of 60 cycles per second and 116 r. p. m. in course of construction for the Allegheny County Light Co., is illustrated and described in "Scient. Mach.," Dec. 15, '96.

Lighting:

MEASUREMENT OF TEMPERATURE OF FILAMENT IN INCANDESCENT LAMPS.—By P. Janet. In "La Révue d'Electricité," author explains the principle of a new method for measuring temperatures of incandescent filaments. It consists in determining experimentally, by means which are subsequently indicated in the article, the amount of heat given out by a lamp filament when it cools down from its normal temperature of incandescence to that of the air, and then equating the quantity thus determined with the product of the calorific capacity of the filament by the unknown lowering of temperature.—Lond. "Elec. Rev.," Dec. 18, 1896.

ELECTRIC TRAIN LIGHTING ON THE SOUTHEASTERN RAILWAY.—Dynamo and storage battery outfit belong to each car. The novelty in the system is the means of getting constant voltage independent of the speed at which the train is going. Instead of allowing the speed of the dynamo to vary, and regulating the magnetic field to correct for this, the dynamo is suspended so that its weight gives the necessary tension to the belt. The weight of the machine and the torque on the armature then exactly balance each other at normal output.—Lond. "Elec. Eng'r.," Dec. 4, '96.

Miscellaneous:

TREATMENT OF LEATHER BELTING.—Max Krieger & Co., Berlin, Germany, have invented a composition which adds fat to belts which have lost their pliability, and abstracts it from those which already have too much.—Lond. "Elec. Rev.," Dec. 4, '96.

STEALING ELECTRIC ENERGY.—At the suggestion of Dr. Oscar May, the electrotechnical society in Frankfurt on the Main, has proposed to the Verb. Deutsch. Elektrotechn. to take steps for having the law dealing with theft changed in such a way as to make it include the stealing of energy. Details of resolution appeared in "Elektrot. Zeitschr.," Nov. 19, '96.

THE BLOCK SYSTEM.—Correspondence of Clement E. Stretton, C. E., and J. Pigg, relating to the development of the block system for railway trains.—Lond. "Elec. Eng'r.," Nov. 13, '96.

Power Transmission:

ELECTRICAL TRANSMISSION OF ENERGY IN SPAIN.—A 19-mile transmission plant, run with 150 horse-power turbines, to which are directly coupled 110 kilowatt Siemens alternators of 6,500 volts and 50 periods. A drop of 14 per cent. occurs along the line. The step-down transformers transform to 115 volts. From "L'Industrie Electrique," abstr. in Lond. "Elec.," Dec. 18, '96.

REFUSE DESTRUCTORS AND ELECTRIC LIGHTING.—Francis H. Medhurst, B. Sc., in a report to the Fulham Vestry speaks very favorably of the use of a refuse destructor from sanitary as well as economic points of view. While the present cost of barging away refuse is 2s. 3d. per load, the estimated cost of destruction is taken at 1s. per load. Allowing 5 per cent. for interest and sinking fund, there remains an annual saving of £735.—Lond "Elec. Rev.," Dec. 11, '96.

Railways :

A RAILWAY THROUGH THE SEA.—A small road run at Brighton, England, has cars of very peculiar construction. The roadbed is under water a good part of the time, due to conditions of the tide; the cars are built as a sort of platform. For illustrated description see Lond. "Elec. Rev.," Nov. 27, '96. This road was partly destroyed by a storm early in December.

ELECTRIC TRAMWAYS FOR BRADFORD.—Mr. Alfred H. Gibbings, borough electrical engineer at Bradford, presented a report on a proposed electric railway, showing the cost of running and supporting the combination of lighting and railway work.—Lond. "Elec. Rev.," Dec. 1, '96.

Telephony, Telegraphy, etc:

AUTOMATIC SWITCH FOR CENTRAL STATION CALLS.—By Jul. H. West. This method is gotten up principally to reduce the work of the operator to such an extent, that he has to deal simply with the connecting plugs, while the drops indicating the number of the subscriber, etc., are handled automatically. A similar system has been previously described, but the one now presented is said to possess several new features.—"Elek. Zeitschr.," Nov. 26, '96.

TELEPHONE CONDUITS AND SUBWAYS.—By Dr. V. Wietlisbach. Discussion of subways in Paris and St. Paul conduits; iron pipes, cement lined iron pipes, creosoted wood pipes, terra cotta ducts, cement pipes, construction, ventilation, manholes, drawing-in cables, cable heads; terminal boxes for pole lines.—"Elec. Eng'g.," Nov., '96.

TELEPHONE RELAYS.—In a short editorial note the difficulty underlying such an instrument is pointed out, the statement being made that the receiver diaphragm vibrates with much less intensity than does the transmitter diaphragm.—Lond. "Elec. Rev.," Dec. 11, '96.

LOCALIZING FAULTS IN SUBMARINE CABLES.—By Herbert E. Cann. Author refers to the early work of Mr. Kennelly's in this direction, but suggests various changes. Several tables accompany the descriptive part of the paper.—Lond. "Elec. Rev.," Dec. 18, '96.

PERSONAL

HERR JOSEPH KAREIS, formerly chief technical adviser in the Telegraph Department of the Austrian Ministry of Commerce, and latterly Councillor-in-Chief at the Telegraph Direction in Prague, Bohemia, has been appointed Imperial Aulic Counselor. Amidst all his most pressing official duties Herr Kareis has found time to act as editor-in-chief of the "Zeitschrift für Elektrotechnik," the official organ of the Elektrotechnische Verein in Vienna, which work he has performed with great ability and conscientiousness. We congratulate Herr Kareis on his well merited distinction and wish him many more years of usefulness.

MR. J. F. OUTWATER, who has represented Mr. Hugo Reisinger of 38 Beaver street, New York, has resigned his position to return to the Edison Electric Illuminating Company of Brooklyn, with whom he formerly was for eight years. Mr. Outwater leaves Mr. Reisinger with the latter's best wishes for success in his new and important position as purchasing agent.

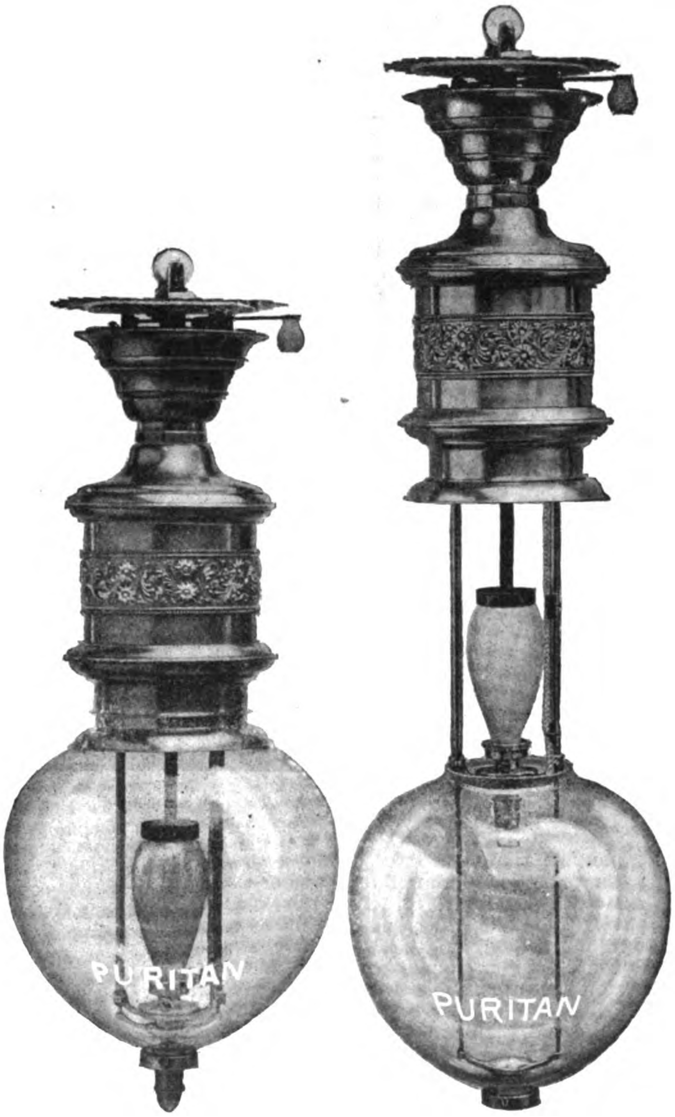
MR. EDISON and the graphophone people have come to terms, and hereafter there will be no fighting except against infringers of the joint patents.

C. J. CARNEY, a Philadelphia merchant, opining that lighting prices from the local company were too high, started a little plant of his own and has been supplying his neighbors. He is now being moved against, under the city subway ordinances, but says he is going to form a company and push the business.

TRADE NOTES & NOVELTIES

THE PURITAN ALTERNATING CURRENT ARC LAMP FOR 100 HOURS.

A SWIFT and almost instantaneous publicity and popularity has been achieved by the ingenious alternating current arc lamp, for long burning, just placed upon the market by the Puritan Electric Company, 150 Nassau street, New York City. The rapid development and revolution undergone by the direct current system of series arc lighting through the introduction of the enclosed arc, now so universal, is familiar to our readers, and it may be stated that the Puritan lamp is designed to play the same part for the rapidly extending circuits operated by the alternating current. The lamp which is shown here in two engravings is only 33 inches in length, and it is not only compact but very handsome in appearance, thus avoiding the usual attenuation and leanness characteristic of the ordinary arc light. Fig. 1 shows the lamp ready for burning; Fig. 2 shows it in position for trimming, with the globe let down. This mechanism for handling is very simple, but not more so than the details of interior construction and the devices for adjustment. Cored carbons, 7½ inches by ½ inch. are used, and give a very pleasant, steady and uniformly distributed light, when burning on circuits from 100 to 120 volts and from 7,000 to 16,000 alternations. This is wide enough range for all the practical alternating work of the day. A



Figs. 1 and 2.—Puritan Enclosed Arc Lamp.

noteworthy feature in this connection is the quietness of the Puritan lamp. It models after the clam in this respect rather than the choir.

Induced by their success with the alternating form, the Puritan Company are now introducing also a type to burn on continuous current circuits, needing only a slight manipulation of the resistance and nothing else. It is also being put on the market for regular series arc work, at 6.8 and 9.6 amperes respectively, so that it covers virtually the entire field of the arc and lays broad claim to universality.

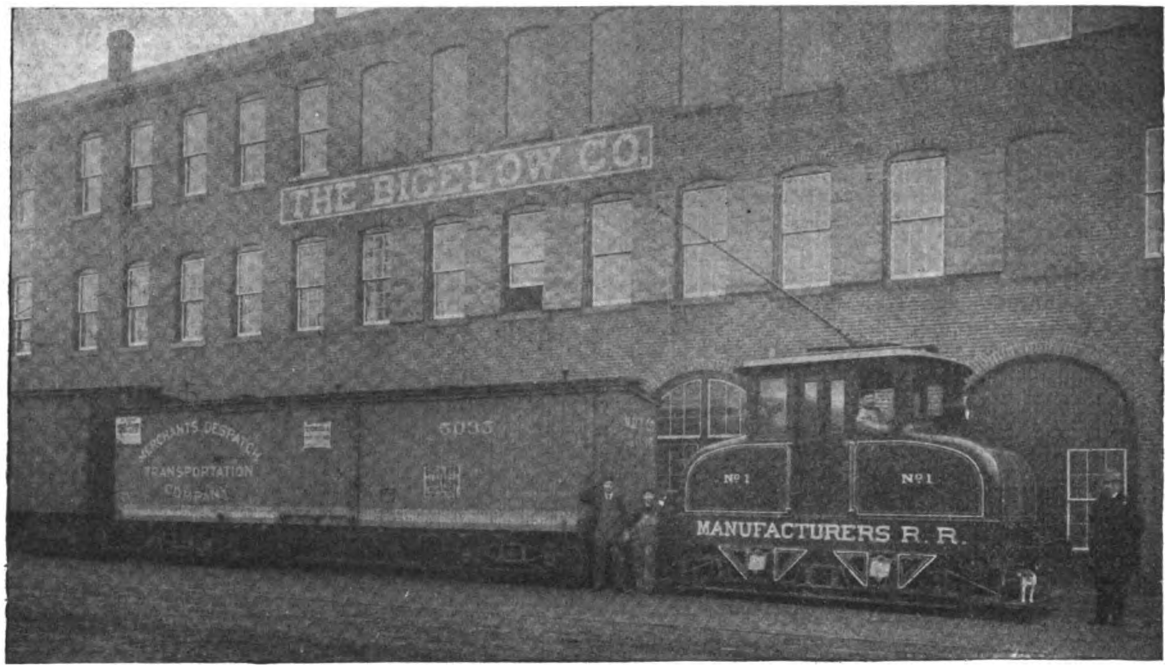
A great many of the readers of The Electrical Engineer are operating arc circuits of one kind or another, and the Puritan Electric Company address themselves particularly to them at this time, inviting their inquiries and correspondence, and above all their orders.

THE MANUFACTURERS' R. R. AT NEW HAVEN, CONN.

THE use of the electric locomotive for switching purposes in steam freight railroad yards is likely to receive a marked impetus by the fact that one is now employed in connection with the New York, New Haven and Hartford Railroad at New Haven, Conn.

This locomotive is in constant service switching freight cars between the main line of that road and a number of factories located along the river front.

The line over which it operates is about two miles long and is the property of several large manufacturers—the Bigelow Company, manufacturers of boilers; the National Pipe Bending Company, the Quinnipiac Brewing Company, the New Haven Rolling Mills, and others. It starts at the tracks of the N. Y. & N. H. R. R. at Cedar Hill Junction, which is located about one mile from the New Haven passenger depot, and follows a devious course throwing off sidings at each of the different factories. The track is of regular steam railroad type with heavy steel rails well ballasted and provided with switches and turnouts. In addition to the curves there is a 2½ per cent. grade against the load both ways on each side of Grand avenue.



THE MANUFACTURERS' ELECTRIC RAILWAY, NEW HAVEN, CONN.

The practice followed by the manufacturers hitherto in switching their cars has been for the freight engines of the N. Y., N. H. & H. R. R. to drop the cars at the Junction; from here they were hauled to the different factories by horses. This method was so slow, with the several curves and grades and so hard upon the horses, that the manufacturers were driven to the conclusion that some other method of traction must be employed. Steam traction was rejected, for the excellent reason that the line runs for some distance along a frequented thoroughfare where a switching engine would be a dangerous adjunct. That the steam locomotive would also be standing idle under steam for a large part of the day and consuming coal uselessly was also a weighty consideration.

Electric traction was finally adopted as presenting many economical and other advantages, and an order was placed with the General Electric Company for a 30-ton locomotive, which the company could guarantee would haul two loaded freight cars up a 2½ per cent. grade at a speed of seven miles an hour.

The locomotive was delivered at New Haven on Dec. 8, and on the 11th was put into actual operation without preliminary test on the line. Since that date it has been handling the entire movement of the cars between the factories and the junction.

On receipt of the locomotive, the manufacturers painted upon the cab the words "Manufacturers' R. R. No. 1," and after two weeks' experience are extremely proud of their new acquisition.

The dimensions of the locomotive are as follows: Weight, 58,000 lbs.; draw-bar pull, 7,000 lbs.; length over draw-bars, 16 feet 6 inches; height over all, 11 feet 6 inches; width over all, 8 feet 3 inches; wheel base, 5 feet 6 inches; diameter of drivers, 44 inches; number of drivers (with cast iron centers and steel tires), 4; size of journals, 5½ x 8 in.; gauge, 4 feet 8½ inches; voltage, 500; amperes full speed and normal draw-bar pull, 600; amperes, full speed and normal draw-bar pull, 300.

The motors are two in number, each axle being provided with its own motor. The motors are gearless and are supported upon a system of spiral springs resting on the side frames of the locomotive truck. The suspension being entirely upon springs, the wheels are free to adjust themselves to the irregularities of the roadbed and the wear on both tracks and motors is thus consequently diminished.

In the armature the iron clad type of construction has been followed; that is, the windings are placed in a mica lined slot cut in the surface of the laminated core. The armature and commutator are upon a sleeve through which the axles pass. The sleeve rests in bearings on the motor frame. Two projecting arms from the sleeve fit into the openings in an iron plate loose upon the axle and similar projections from the wheel enter the plate from the other side, so that, as the armature revolves, the wheels are revolved also. This coupling, being flexible, allows perfect freedom of motion. The commutators are of substantial construction and each motor has four sets of brushes.

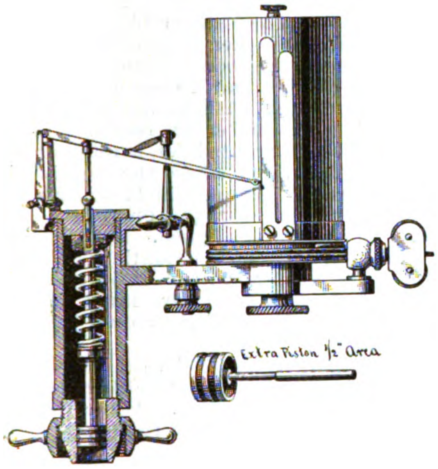
The interior of the cab is finished in cherry and contains the rest of the electrical equipment—automatic circuit breaker, controller, lightning arrester, reversing switch, air pump, air gauge, etc. The controller is the L2, series parallel type, arranged for the control of two motors. It is of the same general type as the K2, so familiar in ordinary street car practice and is provided with separate reversing switch and the magnetic blow out. The resistances are set beneath the shields and are of the packed ribbon type.

In the front of the cab and above the controller is a circular dial ampere meter reading to 500 amperes and facing the motorman is the air pressure gauge. On the other side of the cab, opposite the controller, is an oscillating cylinder air pump, driven by a motor. This furnishes air to two air tanks suspended beneath the cab and is automatic in its action.

The locomotive is provided with a chime whistle blown by the compressed air and a railroad headlight is set upon each shield. Beneath each one of the shields is an iron sand box provided with pneumatic feeding device.

Electricity for this locomotive is furnished from the Fairhaven and Westville power house, which stands on Grand avenue, about the middle of the line and the current is taken by trolley from an overhead wire suspended from brackets. The operation of the locomotive is marked by extreme smoothness and without load it can be run at almost any speed, and with load starts without jerk of any kind. It responds immediately to the motion of the controlling lever and can be backed up to a freight car for coupling as gently as the movement of a hand. One of the difficult duties it has to perform is the kicking of the freight cars over the curves in the New Haven Rolling Mill, in which there is one with a radius of only 50 feet. The locomotive can handle seven heavily loaded cars around this curve as easily apparently as it can two.

HIGH PRESSURE "ROBERTSON-THOMPSON" INDICATOR.



This instrument is designed with a special view to the indication of extremely high pressures without in any way interfering with its use as an ordinary low pressure indicator. This improvement consists in the substitution of a piston of one-quarter inch area, instead of the usual piston of ½ in. area. In order to enable the use of this smaller piston, the coupling is bored out to a smaller area, as is clearly shown in the engraving. By this means every spring may be used for pressure equal to four times the number stamped thereon, instead of two, as is the case with the ordinary indicator; that is, a 60-lb. and a 100-lb. spring, to 400 lbs. Where ordinary pressure is to be indicated, the extra piston which is furnished with it may be used.

The parallel movement is similar to the ordinary "Robertson-Thompson" indicator, being made of tool steel, with hardened joints, and providing for 2¾ inches of vertical movement in a perfectly straight line. The material and workmanship are of the best, and by the elimination of many of the complicated features usually found in indicators, the greatest convenience in use is assured.

By means of a telescopic piston rod the pencil point may be set at any height on the drum for use in connection with condensing engines. The drums are either 1¾ inches or 2 inches in diameter and provisions are made by means of taper bearings top and bottom, to take up all wear of the drum spindle.

The instrument may be changed from right to left hand in a few seconds. For use on ammonia compressors they may be had in steel. The manufacturers are Messrs. Hine & Robertson Company, 98 Cortlandt street, New York.

"CHIPS OF THE OLD BLOCK."

The younger generation is rapidly taking its place in the new field that the energy and genius of its fathers have created, and electricity is already one of the industries in which certain names are time-honored because of their identification with it. We are glad to note in the American Electrical Works, of Providence, R. I., the appearance of new blood in the persons of Messrs. F. N. Phillips and E. Rowland Phillips. These young business men are the sons of Mr. Eugene Phillips, and their taste for the intricate and difficult industry of insulated wire manufacture is therefore hereditary. For them, springing from such stock, it is simply impossible to make poor wire, and everyone wishes them as years roll by an even larger prosperity and reputation than their popular father has enjoyed these many years. As to the share taken in the business, it may be stated that Mr. F. N. Phillips has assumed the position of treasurer made vacant by the resignation of Mr. W. A. Hathaway, and that Mr. E. Rowland Phillips has been appointed superintendent of the works. Mr. Eugene Phillips, as president, and Mr. W. H. Sawyer, as secretary, who have borne the burden and heat of the day, thus receive valuable aid and reinforcement in this young but well trained enthusiasm, from which the happiest results may be confidently expected.

THE KEYSTONE SWITCHBOARD INSTRUMENTS.

THE Keystone Electrical Instrument Company, of Ninth street and Montgomery avenue, Philadelphia, are manufacturing a variety of switchboard instruments for direct and alternating current, which are very neat in appearance and possessing a number of valuable features.

Fig. 1 shows the type "K illuminated dial" instrument, the ordinary type K being without the illuminating device, but exactly similar in all other respects. Both of these instruments are handsomely finished in brass, grained by hand and lacquered. They are made in all ranges, both volt and ammeters, and are combination instruments, that is, will read with equal accuracy on either direct current circuits or alternating current circuits of any frequency. The company claim to have been the first to put such a switchboard instrument on the market.

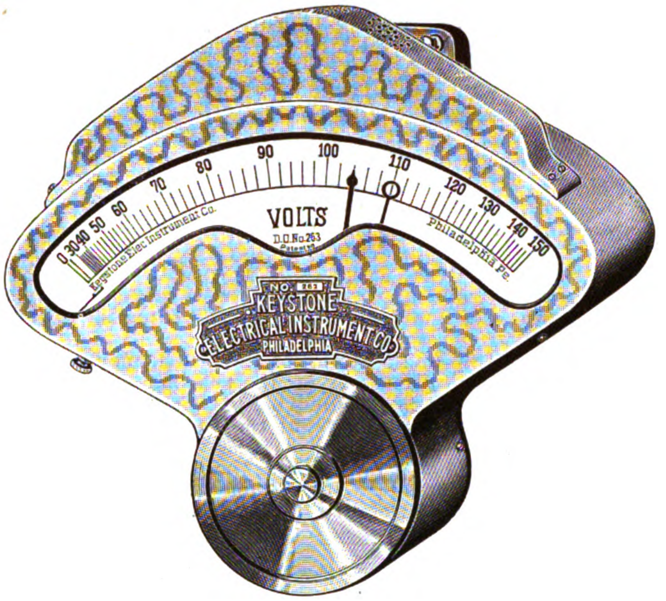


Fig. 1.—Keystone Type "K" Illuminated Dial Voltmeter.

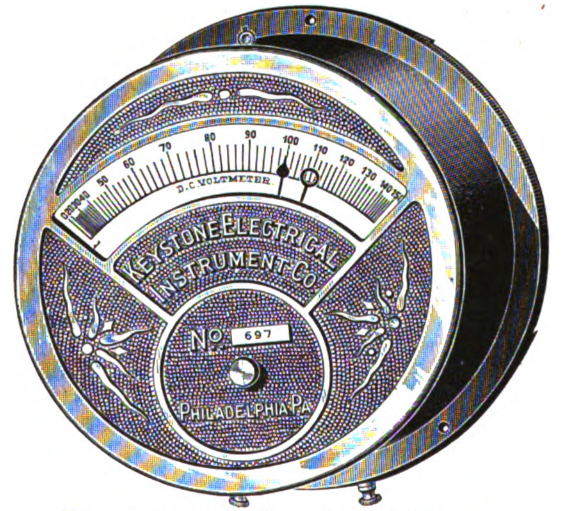


Fig. 2.—Keystone Type "R" Voltmeter.

Fig. 2 shows the type "R" instrument, the mechanism is similar to the type "K," but the case is smaller and is made in full nickel. The type "R" instruments are with combination systems, the same as type "K" or without. The latter is cheaper and very satisfactory when an instrument is wanted on one circuit only; they are calibrated for direct current or for alternating current of any specified frequency.

Fig. 3 shows the company's galvanometer ground detector mounted in a brass case grained and lacquered. This instrument is very useful in showing the extent of grounds and in indicating on which side of the line they are; it is intended to be left in circuit continually; it is designed for either direct or alternating current, as desired.

The Keystone Company also manufacture differential voltmeters mounted in type "K" cases with or without illuminated dial. These instruments are very useful when one or more direct current dynamos are run from the same set of bus bars.

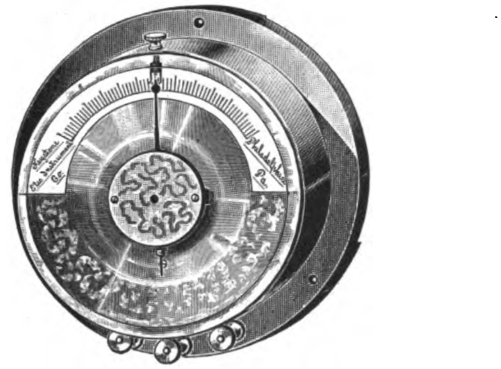


FIG. 3.—KEYSTONE SWITCHBOARD GALVANOMETER GROUND DETECTOR.

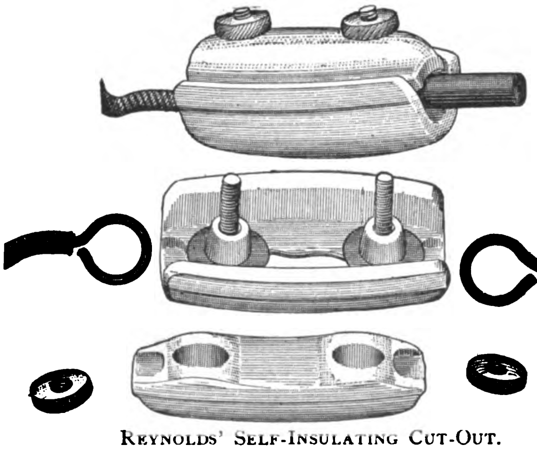
The workmanship and material of these instruments are of the best; the cases are dust proof; the bearings are jewelled, the pointers dead beat, and the moving parts are shielded from the effects of external magnetism; the ranges can be made anything desired.

These instruments are calibrated to the finest standards before leaving the factory, which is equipped with the latest and best standard units and testing appliances.

THE REYNOLDS SELF INSULATING CUT-OUT.

A decided novelty has been placed on the market, in the new "bug," the Reynolds self-insulating cut-out. This device is a radical departure from all other "bugs" and so thoroughly meets every requirement of simplicity, safety and size, that it merits careful attention.

It will be seen from the accompanying engravings that no covering is required, as complete insulation is obtained when the connection is effected by the union of the two parts. All other "bugs" can be connected up independently of any cover or insulation, and just herein lies the special advantage and safety of the Reynolds cut-out It can be connected up or refused quickly and a "ground with the fixture is impossible, as the clamping bolts are entirely encased in porcelain and thus are completely isolated from the circuit. Tape is useless with this device, which is an especially important point as regards safety. The Reynolds is claimed to be cheaper and smaller than any covered "Bug" on the market, and complies with Underwriters' requirements. It is being adopted by fixture and supply houses throughout the country.



REYNOLDS' SELF-INSULATING CUT-OUT.

The small size permits of a much smaller shell or canopy being used than heretofore; fixture manufacturers will appreciate this.

Mr. S. K. Reynolds, 136 Liberty street, New York, is the agent for its sale; his announcement will be found on the second cover page.

P. & B. PRESERVATIVE PAINTS AND INSULATING COMPOUNDS.

The Standard Paint Company, 81 and 83 John street, New York, are in receipt of a letter from an electric road which has used their armature and field coil varnish and insulating compound. The company state that they have found them in every way satisfactory. Many people are of the impression that the Standard Paint Company manufacture only the P. & B. insulating compounds and in some instances, although they are rare, they allow themselves to be persuaded that a mere preservative paint is as good as the P. & B. compound.

The company also manufacture and have for years excellent preservative paints. However, they do not possess all the insulating properties of their compound, but are claimed to be in every way superior to other so-called insulating or preservative paints, and are sold at prices far below them. They especially invite correspondence on the subject of preservatives from street railways.

We have before us a pamphlet on the subject of "Rustless Coatings for Iron and Steel," published by the American Society of Mechanical Engineers. We quote from the pamphlet as follows: "Mr. Wood, in his paper, under the group of 'lotions,' as he terms them, has apparently omitted to mention a paint which is sold in New York, and elsewhere, under the name of 'P. & B.' It is a solution of asphalt or bitumen, suspended apparently, from the unhappy odor which it emits, in bisulphide of carbon, and although the men dislike it at first, they get used to it, and once applied, I find it more permanent than any of the paints that I know of. I have used it out of doors and also for tank use. I remember an instance of a railing out of doors which has been painted for a number of succeeding years with coal-tar paint, and where the metal had been so neglected that it had rusted through in blotches and spots. Two applications of this paint were put on four years ago, and it is now as good as when first applied. It has been found equally good for tank use. It resists oxidation, and remains intact as well for brine as for water. It is so well known that I think many of the members here must be familiar with it, and I would like to know if their own experience has been equally favorable."

To demonstrate the superiority of their goods, the Standard Company are willing to send good-sized samples sufficient for practical tests of any of them free of charge. A recent circular also contains much useful information on the company's products.

MARYLAND BRASS MFG. CO.

The plant of the old Whiting Novelty Company, Aberdeen, Md., has been purchased by E. O. Bayles and others, and it will hereafter be run under the name of the Maryland Brass Manufacturing Company, which has started out with excellent prospects. The new company have added a quantity of new machinery, new boilers, etc., and have put their plant in first-class productive condition. They will manufacture metal goods of every description, from all kinds of metal, and will give special attention to a full line of electrical metal goods, for which they believe a large market awaits them.

The plant of the Maryland Company already covers some 10,000 square feet of floor space, exclusive of boiler and engine rooms, and includes machine and tool, press, plating, polishing, stamping, soldering, matting, power press, lacquer and general assembling departments, all of which are fully equipped. Mr. E. O. Bayles, the secretary and treasurer, who is well known industrially, and as a business man, will handle the financial part of the business, and the new concern under his leadership will be kept up to top notch. Mr. E. S. Whiting, whose name the company bears, remains as manager and superintendent, and with his well-known mechanical ability to which he can now give free play, the product will rank higher than ever. The new company swung into line on Jan. 1, and have already a large number of good orders to start with. They will be glad to put themselves in touch with any new lines of electrical metal work needing attention.

CRESCENT BLUE VITRIOL.—The American Electrical Works, Providence, R. I., are pushing their Crescent brand of sulphate of copper, or blue vitriol, whch, by its absolute freedom from iron, is specially suited for battery work, excelling in strength, purity and regularity of crystals. It is packed in barrels of 400 pounds, and in half barrels.

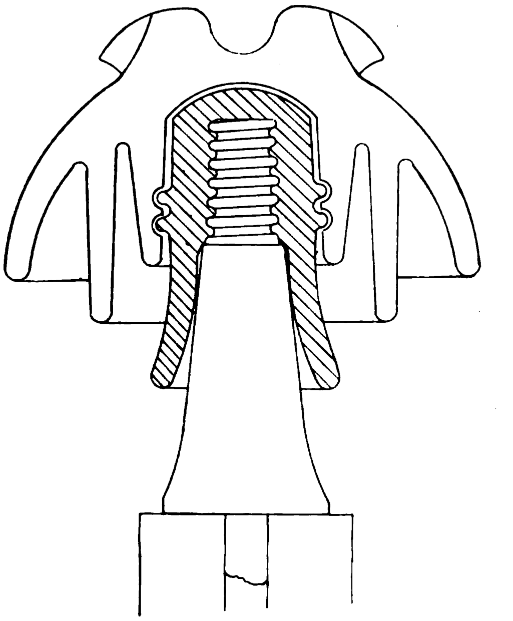
COMBINATION OF THE SIEMENS & HALSKE AND FORT WAYNE ELECTRIC CORPORATIONS.

As we go to press information reaches us of the combination effected between the Siemens & Halske Electric Company, of America, and the Fort Wayne Electric Corporation, with a capital stock of $6,500,000. It is stated that the existing plants of both corporations to the deal will be kept in operation as heretofore. It is understood that Mr. R. T. MacDonald is at the head of this formidable combination. To our Chicago representative, the Siemens-Halske Company have denied any knowledge of the matter.

NEW LOCKE INSULATORS FOR HIGH VOLTAGES.

We illustrate herewith a new insulator which has just been brought out by Fred. M. Locke, of Victor, N. Y. It is made of porcelain with a separate center insulating attachment, which may be made of either glass or porcelain. Its construction is mechanically and electrically strong, rendering it very suitable for carrying high potential currents. It has shown remarkably good results in transmitting large currents at a pressure of 15,000 volts over long lines. At a recent test with these insulators on Mr. Locke's steel pins, they carried 70,000 volts for four hours, without heating, arcing or breaking down.

These insulators present over twelve inches of surface between the wire contact and the supporting pin; about ten inches of this surface being on the under side of the insulators out of reach of direct rainfall. The faces of the bottom of the insulators are perpendicular and therefore do not afford any lodgement for foreign matter. Locke's patent steel insulating pin, the top of which is made of locust wood boiled in paraffine, is designed to be used with these insulators.



New Locke Insulator for High Voltages.

The adoption of this interesting combination of glass and porcelain will be closely watched. Mr. Locke states as the result of his study and tests that this union offers a wonderfully high resistance and results in a maximum of insulation with a minimum of puncture.

THE CUTTER CALENDAR.

We have received from The Cutter Electrical & Manufacturing Company, of Philadelphia, an extremely handsome and original calendar. The conventional calendar pad is mounted upon a heavy card 11 x 14 in. in size, upon which is printed a full detail section drawing of the well known I-T-E Circuit Breaker. The effigy of the circuit breaker is drawn to a three-quarter scale, and as a specimen of artistic printing it is quite remarkable. All the various metals used in the circuit breaker are printed in their equivalent colors or bronze, necessitating on each calendar eight separate impressions. The whole is then handsomely embossed and the effect produced is extremely novel and satisfactory. The arrangement of the design is such that any one having the least knowledge of the use to which circuit breakers are applied cannot fail to be impressed by the simplicity of its construction, all the parts being plainly represented and their functions clearly suggested.

The success which the Cutter Company have met with in the past year, in their development of this device, is extraordinary. Although they have devoted the best part of five years to the study of circuit breakers, it is only within the past two years that the device has been placed upon the market as an absolute success, electrically, mechanically, and, we may add, artistically. I-T-E circuit breakers have been specified in most, if not all, of the important buildings which have been erected in the course of the past year, and important shipments to various foreign countries are reported. The range of manufacture is large, more than ninety sizes and types of circuit breakers being manufactured.

We believe that this calendar will prove extremely valuable as a means of bringing the circuit breakers into still further prominence, and every one interested in this device should make sure of receiving a copy.

NEW DE VEAU TELEPHONE APPARATUS.

The engravings shown herewith illustrate the admirable new telephonic apparatus put upon the market by De Veau & Company, 32 and 34 Frankfort street, New York City, who have made a high reputation for their telephonic apparatus. Fig. 1 shows the De Veau desk set, and represents the latest type of this instrument. It can be used with either the buzzer and strap key or the magneto call. It has a wooden base, the standard and metal parts are all nickeled; and it is so swiveled that it can be swung through a full half circle. The hook switch is very simple and safe, open to inspection all around, and fitted with platinum contacts. The movement of the hook of course cuts the battery in and out. In the base of the set are the induction coil and the buzzer, and the calling key in the shape of a button. The set has green silk conductor cords. With only one cell of battery, the apparatus is very sensitive and loud. The set is very pretty and ornamental, and stands only about 9 inches high.

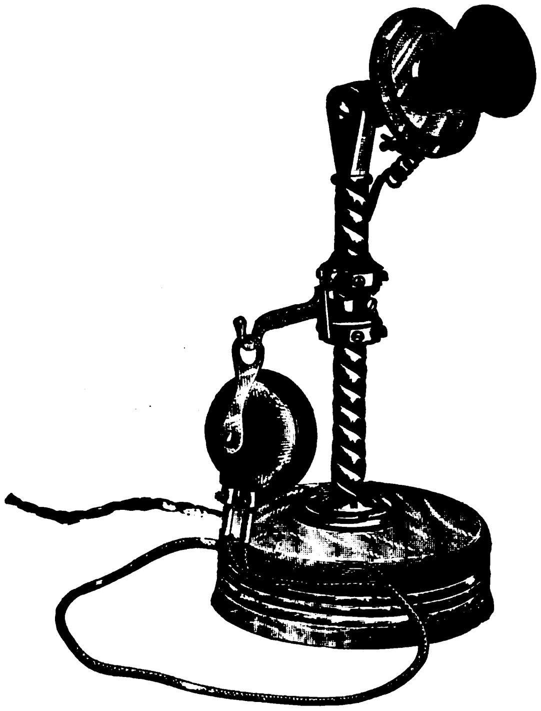


Fig. 1.

Fig. 2 shows the combination of the receiver and transmitter in one piece for the hand. It is only about 9 inches long and is thus very compact and convenient. The handle is of rubber and all the rest is metal nickel plated. There is a button switch to cut the battery in and out, in the side of the handle, and there is a screw for allowing the receiver to be raised or lowered in the handle tube to suit the convenience of the user. Otherwise both the receiver and transmitter are rigid and thus do not get out of adjustment. The induction coil is exterior to the apparatus and is placed anywhere adjacent that is handy.

Fig. 3 is literally a central telephone station in itself, and shows the De Veau metallic circuit intercommunicating telephone. Every one of the ten circuits shown is metallic, and as there is thus no common wire, there is a complete absence of inductive cross talk. The dial switch is composed of two parts, insulated one from the other so as to carry the two wires separated. The movement of the arms on the numbered and corresponding blank knobs makes the contacts for the talking circuits at each given point by pressing the knobs.

An important point is that the battery can be centralised if necessary, or desired, thus dispensing with the local battery at each station. In use, the dial pointer is turned to the number to be called; the button on the side of the box is pressed to ring up the other party, who, if disengaged, gets the signal. If the line is busy, the call is made again later. If free and ready, the receivers are taken from the hook and conversation begins at once without delay. A magneto can be used in place of the battery bell, if wanted. The transmitter swivels and is adjustably mounted on the box containing the induction coil and other detail devices required for conversation. This De Veau telephone apparatus is moderate in cost, well built, gives excellent service, and overcomes the great annoyance of induction which causes so much trouble and failure in telephone work. It is built in oak and walnut finish, and is an ornament wherever placed. The company will be glad to receive inquiries and orders.

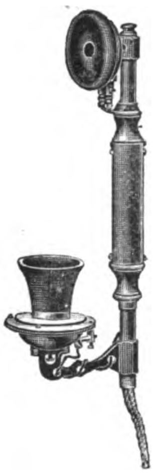


FIG. 2.

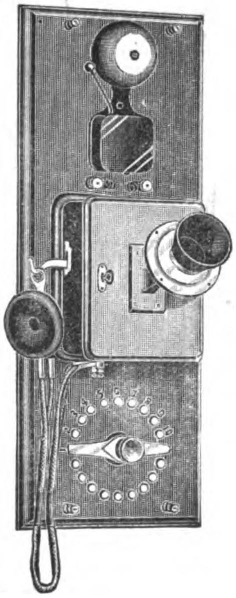


FIG. 3.

QUICK DELIVERY OF BRUSH ARC APPARATUS, AT NEWARK N. J.

Tuesday night, December 29, at 9:30 a telegram came to The Brush Electric Company, at Cleveland, announcing that the large station of The People's Light and Power Company, of Newark, N. J., was on fire and would be a total loss, and asked what they could do in the way of sending them new machines. After calling them up on the telephone, finding out exactly what they could use, the men were got together at the shop at two o'clock Wednesday morning and work was started on the large order. All of the old time Brush men were called to the shop and the way they took hold and got out the machines was simply marvelous. To put together, test, and box a dozen large dynamos within the space of 24 hours, will give work to a very large number of men and with the 50 or 60 men that were called upon to report at the shop at two o'clock in the morning it was a feat which no manufacturing company, we think, has ever been able to beat. Special arrangement was made with the Pennsylvania R. R. Company for a train with right of way from Cleveland to Newark. Passenger engines were taken to draw this train. At seven o'clock Wednesday morning seven cars were put into the siding of The Brush Electric Company's works and work was immediately commenced on the loading of the dynamos. At ten minutes after three the last dynamo was in and the train left the shop, going to the yards to get well oiled and carefully looked over before starting on the long journey. This train went by the Brush shop, going East, at 3:40. It arrived in Pittsburg at 8:40 and reached Newark Thursday morning about noon, being the first car load of machinery from any manufacturer to arrive at Newark. Thus, in the short space of time—37 hours after the receipt of the telegram announcing the fire—The Brush Electric Company had 18 big dynamos at Newark ready to be put into actual service and as a matter of fact some of these machines were put into service Thursday night.

Here is a record that any manufacturing company might well be proud of.

THE WALKER PLANT IN THE NEW WALDORF HOTEL.

The New Waldorf Hotel, which occupies the block between Thirty-third and Thirty-fourth streets on Fifth avenue, New York City, is to have one of the most extensive electric plants in this country and the Walker Company, of Cleveland, Ohio, have been awarded the contract for furnishing the electrical apparatus.

In many respects this plant is unique and interesting and possesses the distinguished feature of being the largest isolated plant in the world, having a capacity of 25,000 lights which are to be used only for lighting this building.

The engine room is to be one of the most elaborate and handsomely fitted rooms ever designed for the reception of any kind of machinery. It is to be somewhat on the plan of the marble engine room at Keith's Theater, Boston, but will be much more elaborate and extensive, the walls, wainscoating and ceiling being of onyx and tastefully decorated. The floor is to be of marble of a pleasing design.

Around the upper portion of the room is to be a balcony which completely surrounds the place and from which guests and visitors to the hotel may view the machinery below. In this way the engine room will be made one of the attractions of the hotel and will certainly prove as interesting an entertainment to a large class of its patrons as the court yard or the finest parlors.

The generators are to be of the Walker type manufactured in Cleveland, Ohio. There are to be six generators in all; four of them of 250 kilowatt capacity and two of 100 kilowatt capacity. The first named generators are of the extremely low speed of 90 r. p. m., and the other two run at 100 revolutions per minute.

If these machines were wound to deliver their output when run at a speed which would be considered the maximum safe working speed, they would be capable of suplying 50,000 lights, enough for a good sized city. This slow speed was desirable for two reasons. First, because the slow speed very much reduces the vibration of the machine and increases its life, and second, because this speed enables the direct connection of the dynamo to a Corliss engine. High speed engines are invariably used on all direct connection isolated plants, and the proposed Waldorf Hotel plant is probably the first of its kind in this respect. The engines are to be of the Allis-Corliss type, direct connected to the Walker generators.

The machines are to be multipolar, the field frame being of cast iron, while the pole pieces are of laminated wrought iron supplemented with a steel pole shoe, this being a special feature of the Walker machinery.

The armatures are to be of the regular Walker straight-toothed end coil type and are to be provided with the company's regular end flange which forms a substantial cast iron pocket to support and protect the ends of the coils. The windings are to be of the barrel type and by this means almost all of the wire comes under the influence of the pole pieces and is active. The machines are to be especially well finished. All brass parts are to be buffed, polished and laquered and the bodies of the machines are to be filled, smoothly enameled and elaborately decorated.

The Walker Company's machines have always been particularly noted for the practically negligible movement of the brushes from no load to an enormous overload.

Mr. John Jacob Astor, the owner, is famous for his knowledge and interest in electrical matters and has determined to have the finest plant of its kind installed in his hotel, and toward this end has secured the services of the eminent electrical expert and engineer, Mr. C. O. Mailloux, of New York City, to supervise this extensive operation.

Those principally interested in the Walker Company are ex-Governor Flower, J. W. Hinkley, Perry Belmont, Anthony N. Brady, of New York, Dallas Sanders, of Philadelphia, and several Boston capitalists, together with S. E. Williamson and Jacob B. Perkins, of Cleveland.

"PIONEER."—One of the severest tests known in the field of electric lighting was lately completed at the well known shoe house of Cammeyer & Company, Sixth avenue and Twentieth street. From a practical and scientific standpoint every point was carefully considered and the order to light the large building throughout awarded to the "Pioneer" enclosed arc lamp.

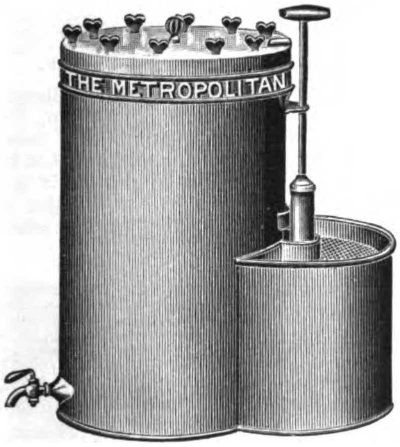
THE "HABIRSHAW WIRE" NEW YEAR RECEPTION.

With Dr. Habirshaw himself at their head, the staff of the India Rubber and Gutta Percha Insulating Company held their New Year reception on the last day of 1896, at the sales headquarters, 15 Cortlandt street. This celebration has come to be regarded as a fixture by the electrical fraternity, and the number now gathering to exchange greetings and good wishes runs into hundreds, "everybody" being there. Messrs. Godfrey, Harrington and Olsen make ideal hosts, and no attention was neglected that could make their guests feel at home. Liquors of every description, cigars of the choicest brands, a cold collation, scores of good fellows and an unending succession of good stories—all new—contributed to make the event once again delightful and memorable. When it comes to combining technique with popularity, the "Habirshaw crowd" is hard to beat, and the evidences of kindly feeling towards them all, and their company's products, were overwhelming on Thursday afternoon last.

THE METROPOLITAN OIL FILTER.

In oil that has been used for lubricating journal-bearings there are very small particles of metal worn from the bearings which are suspended in the oil. These particles of metal may be effectively removed from the oil by forcing the oil under pressure through a diaphragm or other body of porous material, the material being thus permeable to the oil when finely divided, but the pores being of insufficient size to permit the passage of the particles of metal. The removal of the particles of metal thus held in suspension makes the filtered oil practically as good for lubricating purposes as it was originally.

A filter specially designed to remove these fine particles is the Metropolitan oil filter, illustrated in the accompanying engraving and manufactured by the Metropolitan Electric Company, of Chicago. In this apparatus there is provided a receiving-tank into which the oil to be filtered is poured, a perforated cover being provided for the tank, which prevents the entrance of foreign matter, such as waste and the like. A pump forces the oil from the receiving-tank into a pressure-tank, the pressure-tank being air-tight, whereby a pressure may be produced in the tank by forcing into the tank a sufficient quantity of oil, or, if there be but a small quantity of oil in the receiving-tank, air may be pumped into the pressure-tank to provide the required degree of pressure. A pipe extends from the pressure-tank to a filtering-receptacle in which is placed the filtering diaphragm of blotting paper; the oil is thus forced through the diaphragm under pressure and passes to an oil-tank, from which it may be withdrawn for use as desired.



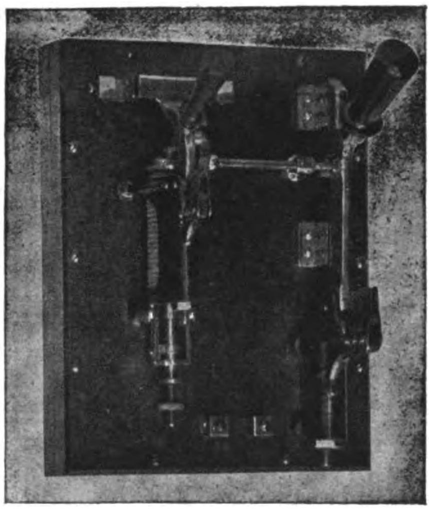
The Metropolitan Oil Filter.

LARGE TROLLEY CONTRACT IN NEW YORK CITY.

The Third Avenue Railroad Company has just concluded a contract with the General Electric Company for the electrical equipment of its new extension from 165th street and Amsterdam avenue, via the Kingsbridge Road to Spuyten Duyvil Creek, a distance of about two and a half miles. The power house will contain a battery of 15 Babcock and Wilcox boilers having a total capacity of 2,500 horse-power. The engines will be of the Allis-Corliss type from the shops of the E. P. Allis Company, and will be three in number of 1,100, 700 and 500 horse-power capacity respectively. Each engine will be directly connected to a G. E. multipolar railway generator, of 800 kilowatt, 500 kilowatt and 300 kilowatt capacity respectively. The switchboard will be of the standard G. E. panel type, and will be equipped with the most recently developed switchboard apparatus. The overhead wires will be suspended from brackets set on ornamental central poles and each alternate pole will carry a 1,200 candle-power arc lamp, current for which will be generated by two direct-connected 125 arc light Brush dynamos. The feeders will be laid underground. The cars will be of the handsomest construction obtainable and will be set on double trucks. Each car will be equipped with two regular motors of the capacity of the G. E. 1,000, one motor being set on each inside axle. The first motor contract contemplates 50 double motor equipments.

THE ELDEN ALTERNATING CURRENT CIRCUIT BREAKER.

The accompanying cut illustrates an alternating current circuit breaker recently patented, and now being brought to the attention of users of alternating apparatus, by L. L. Elden, 305 Congress street, Boston. The breaker is designed to be placed directly on the dynamos, in a position easy of access, and is quickly and easily connected in circuit. It is claimed that this device is a sure preventive for all the troubles that short-circuits, lightning discharges, etc., cause central station managers; and the record of the device, in stations where it has been in use, is reported to be an exceptional one. At a recent test of the breaker, at the station of the Boston Electric Light Company, it was shown that the application of a dead short circuit at the switchboard produced no visible effect on either engine, dynamo or belt, and, but for seeing the circuit breaker open, none present would have known that a short circuit had been applied. All the alternating machines of this company were equipped two years ago with these breakers, after putting them to severe tests, and since that time the manager states that they have saved the company many times their cost and have never failed to operate in any case.



Elden Alternate Current Circuit Breaker.

The adjustment of the breaker is accomplished by means of weights and fixed distances, with an entire absence of springs, making its operation absolutely reliable at all adjustments. This circuit breaker embodies a new device to prevent arcing at the switch jaws, which is certainly effective as there is no sign of arcing when the breaker opens, even under very heavy loads of two to three hundred amperes. It would seem that this breaker would prove to be of interest to all users of alternating apparatus.

A TEMPERED COPPER EDICT.

The Mitchell Tempered Copper Company, of Corry, Pa., have issued a very striking edict in the shape of a neatly finished bull. It is made of their metal, and very cleverly done, both artistically and as showing the excellence of the material. It stands three inches high, is four inches long, and makes a good paper weight. Our readers should write for one each. The Mitchell stock farm is of large capacity, and the proprietors believe that with this bull they are achieving what the Scotch would call a coup d'etat, in the way of surprising their friends.

DRUM ARMATURES IN BATTERY MOTORS.

FOR some time there has been little progress made in the design of battery motors, but lately the Kent Electric Manufacturing Company, of Worcester, Mass., have been improving their machines greatly by the substitution of a drum armature in the place of the common three-pole. If, in any place, high efficiency is required, it is with battery motors, where the current supply is limited to a very great extent.

Fig. 2 shows the three-pole armature between two field mag-

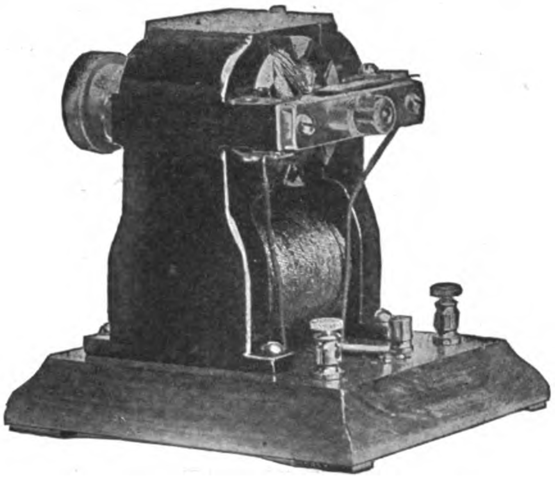
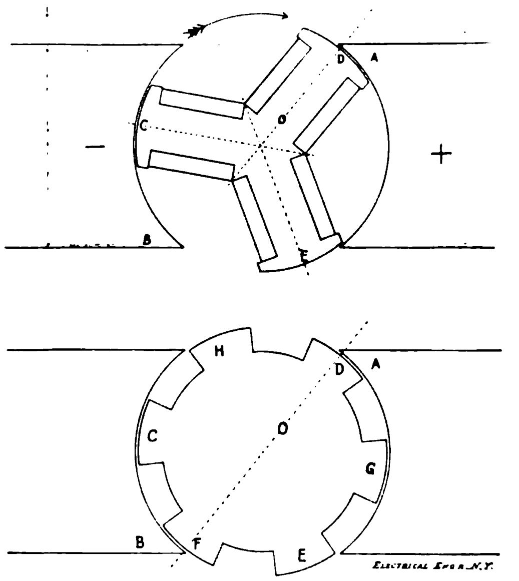


FIG. 1.—KENT DYNAMO MOTOR.

equipped with their drum armature. The armature of the machine is 2⅛ inches in diameter by 1¾ inches long, and has a magnetic cross section of three square inches. With the ordinary three-pole armature, the magnetic torque is unevenly distributed at the different positions in a revolution. This gives a rattling motion to the armature, especially with a load, and consequently a great wear on the bearing.

Fig. 2 shows the three-pole armature between two field mag-



FIGS. 2 AND 3.—KENT BATTERY MOTOR.

nets. At the position in which the armature is shown there is a pull between A and D which gives the armature a torque in the direction of the arrow; also in the direction of the radius O. As the pole E is magnetized positively, there is, of course, no torque between E and the positive pole, and as the distance between B and E is very great, there is very little torque between these. As there is practically no magnetism in the pole C, there is little torque between this and the negative pole of the field. Now, this leaves the radial pull between D and A with nothing to balance it on the other side of the armature, consequently the whole armature will be pulled in that direction.

Again, as the pole E approaches B there will, in the same way, be a radial pull between E and B with no support on the other side. since D has moved round, and has practically no magnetism. Then the whole armature is pulled in the direction B. This motion from side to side creates a great wear on the bearings, and in a short time the bearing will wear and come to have the oval shape.

Fig. 3 represents the new Kent armature, which practically has 6 poles. Now, as pole D approaches pole A, and the radial pull O D is exerted, there will be a corresponding radial pull diametrically opposite in the direction of O to B. In the same manner as H approaches A, E will approach B, and so on.

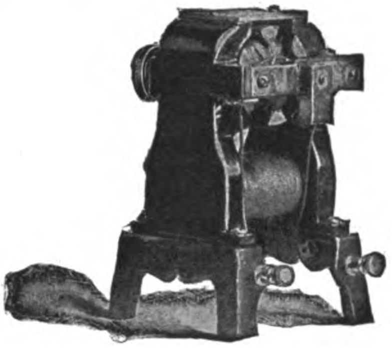


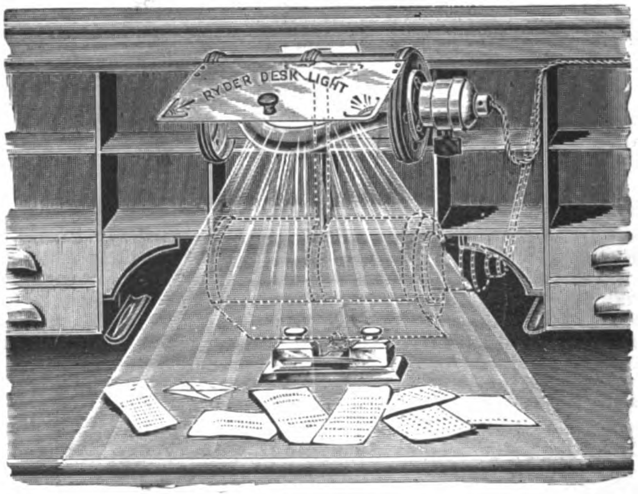
FIG. 4.—KENT MOTOR ON IRON BASE.

Thus, it will be plainly seen that this armature will not be pulled from side to side, thus giving a constant, steady torque.

One of the most gratifying results of these machines is that they will run as a dynamo, which also proves their efficiency as a motor. Another feature is the self-oiling bearings, which are shown in Fig. 4. The chamber just below the shaft contains a wick saturated with oil which lubricates the bearings. These machines have a capacity for work requiring about the same power as a sewing machine.

THE RYDER DESK LIGHT.

WE illustrate on this page a new desk light just brought out by the firm of A. H. Ryder & Co., 180 Broadway, New York City. It contains a number of new and special features, and is regarded by the makers as constituting a distinct advance in this field. The appliance is made to attach easily to the upper front or partition of the desk, and the lamp inside is thoroughly hooded, so that one gets all the light on the papers and none of the glare in the eye. The screening portion, however, travels smoothly on flanges at both ends and thus a considerable upward or downward range of angle can be given to it. The end adjustment permits fitting to any style of roll or upright desk, and there is also a very ingenious side adjustment, which allows the light to be specially directed at will to either side. A great feature is the manner in which by its travel upon itself, so to speak, as shown by the dotted lines in the engraving, the whole thing can be folded down inside the desk, out of the way. It thus avoids all the dust and dirt that inevitably accumulate on apparatus left exposed, for the woman who sweeps out one's office usu-



RYDER DESK LIGHT.

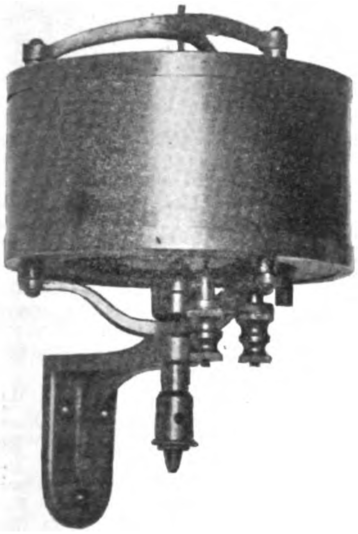
ally cleans the floor only to fill the air with dust that settles all through the night and that often becomes a nuisance and danger for electric and other apparatus, even to the extent of short circuiting a lamp or insulating a fan motor commutator bars. Mr. Ryder avoids all this by simply storing away the lamp in the desk.

The cylinder contains also an ingenious device for holding the lamp socket in place, and for adjusting to any make. The cylinder itself is corrugated with white enamel inside, casting a most brilliant reflection. In the cut, the eye shade is thrown up higher than it is used in practice, to show how the parts are placed together, etc. The shade of course is adjustable at will.

A. H. Ryder & Co. make also this general design in single and double portable lights suited to flat top desks and tables, and as an ornamental attachment for music racks. The workmanship of all styles is admirable, and the prices are such as to make it an inducement to buy. The firm will be glad to receive inquiries and make attractive quotations.

THE COX THERMO GENERATOR.

THE accompanying engraving illustrates the latest form of thermo-generator designed by Mr. H. B. Cox, who has established works for its manufacture on a large scale at St. Albans, Herts, England. These generators are operated by a Bunsen gas burner and once started require no attention for an indefinite period. They are designed to take the place of primary batteries for all purposes to which such a battery can be applied, and are adapted for telegraph, telephone, medical, X-ray, fan motors, and a great variety of other light work.



THE COX THERMO GENERATOR.

The Cox generator, which was fully described in The Electrical Engineer of Sept. 9, 1896, gives an output of 5 amperes at 2½ volts with a consumption of 2½ cubic feet of gas per hour, and can also be operated with an oil burner. The convenience of such an apparatus, doing away, as it does, with the annoyance of batteries, must be evident, and now that the generator is ready for the market, a heavy demand for it may be looked forward to.

EXTENSIVE SUBWAY SYSTEM FOR SYRACUSE, N. Y.

The city authorities of Syracuse have just granted a subway franchise to Eugene Hughes & Co. A large expenditure is involved. Mr. Hughes makes the following statement:

"I have only to say that I asked for the franchises in good faith, and that I intend in good faith to construct and operate under them. The bond furnishes adequate security and the subway franchise provides a most fair way for the city to acquire ownership. Last summer I made application to the city, and, up to date, no person or company has offered more favorable terms or considerations to the city. I expect that the subway will yield a fair revenue upon the investment until such time as the city succeeds to the ownership. A properly constructed subway in this city will cost much more than I have heard stated by others. I have done considerable contract work and know about what such work costs, and I now say that within the next year a subway system satisfactory in every particular and sufficient to meet the requirements of the communiy for the next 20 years, will be constructed throughout the business portion of the city. The opposition of the old companies does not surprise me, and the proposition of my fellow townsmen shows for itself that it is less favorable to the city than mine. We intend to give cheaper and better telephone and electric light and power service.

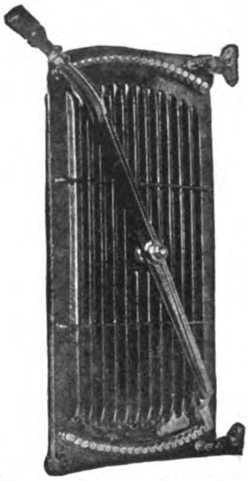
John F. Gaynor and myself are the principal parties interested in these franchises. For incorporation purposes more than two persons are necessary, but the other interests will be practically nominal.

We hope the people who are now opposing these enterprises will suspend their judgment until we can demonstrate what we can and will do on behalf of the city."

The subways are to be built during the year 1897, and it is said that a good deal of new lighting and other work will also be taken in hand.

NEW LEONARD THEATRE DIMMER.

THE accompanying illustration shows a new form of theatre dimmer just being introduced by the Ward-Leonard Electric Company. This theatre dimmer is of the well-known Carpenter enamel type and effects a most remarkable economy in price and space. Although the former rheostats of this company have been conspicuous because of their low price and small space the present type makes a reduction in both price and space of not less than 50 per cent. As will be noticed from the illustration this form of dimmer when arranged in banks entirely avoids the necessity of any connecting wires. These dimmers are made either interlocking or non-interlocking, as desired.



WARD-LEONARD RHEOSTAT.

NEW IRON ARMORED CONDUIT OF THE I. C. & I. CO.

As will be noted in our advertising columns, the Interior Conduit and Insulation Company, of New York, announce that they have placed upon the market a new and improved iron armored insulating conduit. This conduit is a development of their well-known iron armored conduit which has met with such success during the past few years. The results attained in iron armored conduit as manufactured by the above company while being far in advance of any old method of wiring, have nevertheless indicated certain lines wherein this product could be improved to more efficiently fulfill its functions. To attain this end the company have bent their best endeavors during the past few months, not only to obtain a better article, but at the same time secure one which could be produced at a lower price and thereby assist in cheapeening the cost of first-class electrical work. This conduit is far superior, possessing advantages in that it is extremely light, has a smaller outside diameter for a given internal diameter, and, moreover, has greatly increased insulating properties. The insulating lining being of a flexible nature, it is not affected by bending and the insulation under such conditions is not impaired. It will withstand a temperature of 175 degs. Fahr. without becoming in any way softened or "tacky." Any ten-foot section will show an insulation of 11 megohms after being filled with water for ten days.

This new product has met with instant recognition by the trade at large, and the Interior Conduit and Insulation Company have thus still further enhanced the value of their well-known system of electric wiring.

ADVERTISERS' HINTS

CHAS. BESELER, 218 Center street, New York, advertises stereopticons and magic lanterns.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., invite comparison of their goods with others. They are headquarters for distributing boxes.

A. A. McCREARY, 136 Liberty street, New York, is better prepared than ever to furnish metal half shades in aluminum and tin.

IDEAL ELECTRIC CORPORATION, New York City, state what they claim and what they do not claim for their new 100-hour arc lamp.

THE GOODYEAR VULCANITE COMPANY, 353 Broadway, New York, make a specialty of hard rubber goods for electrical purposes.

THE WARD-LEONARD ELECTRIC COMPANY, Hoboken, N. J., have greatly reduced the price of their theatre dimmers. There are over 1,000 in successful operation.

THE SPRAGUE ELECTRIC ELEVATOR COMPANY, New York, give a list of buildings varying in height from five to thirty-one stories in which they have installed from two to twenty-three machines.

M. H. WEIL & COMPANY, 725 Broadway, New York, are open for accounts in novelties and specialties.

EMIL GREINER, 146 William street, New York, is making an X-ray focus tube which he claims to be the best.

I. S. SPENCER'S SONS, Guilford, Conn., furnish fine gray iron castings and also high-grade brass and composition castings.

THE ADAMS-BAGNALL ELECTRIC CO., Cleveland, O., illustrate their "ad." with diagrams of connections of the arc lamps manufactured by them.

THE STILLWELL-BIERCE & SMITH-VAILE Co., Dayton, O., engineer and equip complete water power plants, guaranteeing the highest efficiency and closest regulation.

THE BRYAN-MARSH COMPANY, 136 Liberty street, New York, have made their "ads." very interesting with microscopic views of the different parts of an incandescent lamp, of which they manufacture and sell great quantities.

THE GENERAL ELECTRIC COMPANY call attention to the fact that they are the only electrical company who manufacture complete electric equipments for every class of work

THE LECLANCHE BATTERY COMPANY, New York City, remind the trade that for twenty years their batteries have maintained a high position in the field. Their record has been an enviable one.

WAGNER ELECTRIC MFG. COMPANY, St. Louis, Mo., are supplying high potential switches for street railways, central stations and isolated plants.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, 15 Cortlandt street, New York, will, as in the past, maintain the undisputed quality of their wires and cables.

THE E. G. BERNARD COMPANY, Troy, N. Y., say their dynamos and motors are a perfect combination of science and mechanical skill.

THE CONSOLIDATED ELECTRIC SUPPLY COMPANY, Bennett Building, New York, are the agents for the "Teutonic" incandescent lamps and "Consolidated" insulated tubing.

PETEREIT-WEHRLE MFG. COMPANY, 206 Center street, New York, furnish novelties in brass turning, screws, cocks, gas and electric fittings.

HEBER WELLS, 155 William street, New York, makes pattern letters for iron and brass castings of any size and style.

W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., claim their switches and switchboards lead the world.

THE C & C ELECTRIC COMPANY, New York, show a direct-connected 16 kilowatt generator for isolated lighting, which is equally adapted for marine service.

THE WESTERN ELECTRIC COMPANY, New York and Chicago, state they are headquarters for shades, reflectors, hoods, etc.

THE S. & B. ELECTRIC COMPANY, 74 Fulton street, New York, call attention to their "Famous" primary batteries, X-ray outfits, motors, medical batteries, and general supplies.

THE NEW YORK ACCUMULATOR & ELECTRIC COMPANY, 150 Nassau street, New York, furnish storage batteries for all purposes.

THE GARVIN MACHINE COMPANY, New York, equip complete plants for the manufacture of electrical goods and machinery and carry at all times a full line of metal working machinery.

THE CENTRAL ELECTRIC COMPANY, Chicago, offer hearty congratulations to The Electrical Engineer on the attainment of its sixteenth year and at the same time wishes all other electrical engineers a happy and prosperous New Year. The wish cannot be other than cordially reciprocated.

J. B. COLT & CO., 115 Nassau street, New York, carry in stock everything in the line of stereopticons and magic lanterns. Their patrons include many well-known institutions of learning, hospitals, theatrical companies, etc.

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY, 342 Dearborn street, Chicago, continue to manufacture and sell telephones for interior, local and long-distance work.

THE SHULTZ BELTING COMPANY, St. Louis, Mo., have not been saying much recently, but they find no trouble in selling their belts and they are popular as ever.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., show in their "ad" this issue the model machine shop built by them for the Ball & Wood Company, at Elizabethport, N. J.

THE ELECTRICAL MERCANTILE AGENCY, 316 Broadway, New York, issue a credit reference book containing the names and ratings of all the electrical houses in the United States and Canada. They also maintain a collection department.

THEO. AUDEL & CO., 63 Fifth avenue, New York, have just published "Hawkins' New Catechism of Electricity." It is an excellent means to obtain a practical knowledge of the subject.

MR. ALFRED C. COURSEN is now associated with Mr. Edward P. Thompson and Prof. Wm. A. Anthony, at 5 Beekman street, New York, where he will assist them in their large business in American and foreign patents.

THE BEATTIE ZINC WORKS COMPANY, Reading, Mass., are kept busy in meeting the orders for their patent amalgamated, self-cleaning zincs and those who use them find them to be without scale and very efficient.

BILLINGS & SPENCER COMPANY, Hartford, Conn., carry in stock, commutator segments for all the standard makes of dynamos and furnish special sizes and shapes to order.

BRYANT ELECTRIC COMPANY, Bridgeport and Chicago, have just put on the market a new line of rosettes for which they claim special merits. Their new catalogue is now ready for distribution.

EDWARDS & CO., 144th street and Fourth avenue, New York, have lately introduced an ingenious new electro-mechanical gong. It is of much value for fire alarm use in factories, mines and railroads, as it is so constructed that it cannot fail to sound at the proper time.

THE CLIFTON MANUFACTURING COMPANY'S insulating conduit has been approved by the New York fire department and the National, New York and Boston Boards of Fire Underwriters.

H. L. CHINA COMPANY, Charleston, N. H., supply insulators, tubes, cleats, etc. They publish this week a letter from one of their old customers who pays a very high tribute to the quality and durability of their goods.

WM. H. WESTON & CO., 1307 Buttonwood street, Philadelphia, continue to manufacture switchboards, knifeblade switches, quick break switches and all fixings needed for their installation.

BIBBER, WHITE COMPANY, Federal street, Boston, Mass. have purchased stock and good will of Bibber, White & Co., and the New England Electric Supply Company, and are prepared to quote prices on supplies for the electrical and kindred trades.

SCHIFF, JORDAN & CO. say: "Do not write us unless you want absolutely the highest grade carbons."

FUEL ECONOMIZER COMPANY, Matteawan, N. Y., state that by their system a saving of 10 to 20 per cent. in fuel may be effected.

PECKHAM MOTOR TRUCK AND WHEEL COMPANY show a cut of their "extra long" truck with extension rods for long open cars.

HUGO REISINGER, 38 Beaver street, New York, supplies the "Electra" highest grade Nuernberg carbons for alternating and direct currents and also for enclosed arc lamps.

THE H. B. CAMP COMPANY, Aultman, Ohio, have sold over 5,000,000 feet of their vitrified clay conduit.

JAS. C. WORMLEY & CO., Marquette Building, Chicago, are allowing 10 per cent. discount on incandescent lamps for the next thirty days. They are also offering testing apparatus for 300 lamps for $1.50 cash with order.

THE CROCKER-WHEELER ELECTRIC COMPANY, 39 Cortlandt street, present a wonderful but by no means complete list of power plants they have installed aggregating over 8,825 horse-power. This company have made a careful study of electrically driven power tools and the plants they have thus equipped have been most satisfactory.

JAMES LEFFEL & CO., Springfield, O., build water wheels for heads of from 3 to 2,000 feet. Among their installations may be mentioned the plant of the Niagara Falls Hydraulic Power and Manufacturing Company, where 7,000 horse-power are developed at a head of 205 feet.

STANDARD PAINT COMPANY, New York City, it is needless to say, find the demand for their goods to be brisk.

THE H. P. BALL MANUFACTURING COMPANY, 101 Beekman street, New York, advertise switches and switchboards. This means everything in both lines.

THE BISHOP GUTTA PERCHA COMPANY, New York, say their motto is, "Nothing but gum," and good gum at that, making a specialty of meeting the most trying conditions.

THE METROPOLITAN ELECTRIC COMPANY, 186 Fifth avenue, Chicago, are selling an automatic pressure oil filter for $25, with discounts to the trade. Their catalogue containing 775 pages will be sent on receipt of 50 cents to cover expressage or will be included in a small order.

THE C. & C. ELECTRIC COMPANY, 143 Liberty street, New York, have brought out a motor (type 4P) for direct-connected elevator work and printing press driving. Some of its strong points are slow speed, efficient and rugged motive power and its adaptability whenever counter-shafting and belting are objectionable.

THE WARD-LEONARD ELECTRIC COMPANY. Hoboken, N. J., invite bids before purchasing theatre dimmers.

THE CONSOLIDATED INSULATED TUBE COMPANY John Hancock Building, Boston, Mass., invite prospective buyers to write for prices on their brass and iron armored conduit.

W. R. BRIXEY, 203 Broadway, New York, pronounces "Kerite" wires and cables the standard for all circuits.

WM. TAYLOR, 203 Broadway, New York, is ready to supply a full line of electrical goods, including lamps, incandescent and arc, switches, slate for switchboards, etc.

WILSON & WINKLER COMPANY, 779 Greenwich street, New York, do all sorts of repair work.

THE PERKINS ELECTRIC SWITCH AND MANUFACTURING COMPANY, Hartford, Conn., have brought out a new solid plate flush switch which is shown in exact size in their "ad" in this issue.

NEW YORK NOTES.

THE AMERICAN WAX AND PAPER MANUFACTURING COMPANY, 199 Franklin street, New York, are importers and dealers in pure ozokerite, carnauba and paraffine wax, etc., for insulating purposes. They guarantee their goods free from adulterations and will be pleased to mail samples and prices to any address on application.

JOHN SIMMONS CO., 106-110 Center street, New York, are headquarters for wrought and cast iron pipe, fittings, valves and supplies for steam, water and electrical engineering. Their establishment is one of the largest of its kind in this country. The John Simmons Co., are sole manufacturers of the Excelsior railway bracket, now one of the best and cheapest on the market for trolley use, etc.

THE BRISTOL RECORDING INSTRUMENTS.—We have received a circular from the Bristol Company, of Waterbury, Conn., giving the sizes of their well known and highly useful recording volt, ampere and wattmeters, giving detail information and dimensions which will assist in laying ont and designing switchboards where the Bristol instruments are to be used. The circular also gives excellent illustrations of the styles of terminals employed on instruments for heavy current. The demand for the Bristol recording instruments is so steadily on the increase as to make it necessary to send out this circular in anticipation of the needs of their customers. The company will be pleased to forward a copy of the circular with their catalogue to all applicants for the same.

NEW YORK STENCIL WORKS, 100 Nassau street, New York, solicit the electric trade for name plates. They are one of the oldest New York concerns in this line and do also model and experimental work, die sinking and general engraving.

THE ELECTRO-CHEMICAL STORAGE BATTERY CO., 34 Broad street, New York, report a steady and satisfactory growing business. Their storage batteries are giving perfect satisfaction. Prospects for business for 1897 are very promising indeed.

HAMERSCHLAG & CO., 26 Liberty street, New York, report business quite brisk. They are receiving orders along the entire line of their specialties, such as X-ray apparatus, small size motor transformers for charging batteries, dynamo brushes, etc.

ZIMDARS & HUNT, No. 127 Fifth avenue, New York, report selling a large number of their patent automatic switches for electric motors specially adapted for operating electric pumps. The price charged for this ingenious device is very inviting.

GOLDMARK & WALLACE, 29 Chambers street, New York, report business very satisfactory. They are offering a thoroughly reliable and well-made fan motor outfit and will take pleasure in mailing catalogue of same as well as of the "Eck" dynamos and motors for which they are the agents. Messrs. Goldmark & Wallace are also the United States agents for the well-known Koch woven wire brush, the popularity of which is growing very fast.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, carry a large and complete line of tools for electrical machinsts, also steel wire suitable for springs, switches, etc. Their patent steel wire is probably the best of its kind now on the market, well tempered and of extremely high tensile strength.

THE MENLO PARK MANUFACTURING COMPANY manufacture a superior medical battery in conjunction with their "Leader" dry cell, one of the most powerful and long-lived dry batteries known; the latter never burst or leak. These medical batteries, it is claimed, can be depended upon at all times and have been specifically prescribed by physicians of note. The Menlo Park Manufacturing Company manufacture also push buttons and binding posts. Their works are located at Menlo Park, N. J., with office at 631 Broad street, Newark, N. J., New York office 61 Fifth avenue. A catalogue will be mailed to any address on application.

THE STORAGE BATTERY SUPPLY COMPANY, T. D. Bunce, proprietor, 239 East Twenty-seventh street, New York, have recently fitted up several wagons of B. Altman & Co., Sixth avenue, New York, with their electric carriage lamps; they are giving first-class satisfaction.

THE FACTORY OF C. A. ECK, 157-161 Oraton street, Newark, N. J., is running busy on orders for his latest make of dynamos and motors. These are of Mr. Eck's own design and are of high efficiency. Catalogue mailed to any address on application.

THE GOODYEAR VULCANITE COMPANY, of 353 Broadway, New York, have long made a specialty of hard rubber goods for electrical and mechanical purposes. They have devoted particular attention to the manufacture of the long-handle and watch-case telephone receiver and their products also embrace phonograph tubes, hook insulators, magnet heads, battery cells, sounder and relay covers, cord adjusters, switch handles, and, in short, everything in electrical rubber. The company will be pleased to quote prices.

C. W. HUNT COMPANY, 45 Broadway, New York, issue an exhaustive catalogue on their coal conveying system suitable for electric light and electric railway stations. The "Hunt" conveyor system is widely known and is in use throughout the entire country. It is a thoroughly up-to-date mechanism. The C. W. Hunt Co.'s estimates and plans for their specialty embody the experience of 23 years of this work.

PATTERSON GOTTFRIED & HUNTER, LTD., 146 Center street, New York, have agents in all the principal cities of the United States for the sale of a general line of machinery, metals, tools, hardware and supplies which they carry. They are also agents for the Shaw patent compression flange coupling. Catalogues will cheerfully be mailed to any address on application.

E. H. KELLOGG & CO., 243-244 South street, New York, furnish oil and lubricants to a large number of electric plants in this and foreign countries. They are one of the oldest and largest oil house in existence, and have branches in London, Liverpool, Bremen, Hamburg, Bombay and Calcutta.

D. S. PLUMB, 24 Boudinot street, Newark, N. J., is busy on clock work mechanical movements and recording devices used in the electrical and other lines. He manufactures counters for water, gas and electric meters and will be pleased to make estimates from models or drawings.

UHLING, STEINBART & CO., LTD., 63 Mulberry street, Newark, N. J., report a good trade in their pneumatic pyrometers. These instruments record up to 3,000 degs., and are now being used in the largest plants in the country.

KEUFFEL & ESSER COMPANY, 127 Fulton street, New York, will be pleased to mail an exhaustive catalogue to any address on application. They are the largest house in this country importing, dealing in and manufacturing drawing materials and surveying instruments.

JOHN W. FERGUSON, builder and general contractor, 253 Broadway, New York, is open to undertake the erection of electric light and railway plants or any class of buildings. Mr. Ferguson is busy with large contracts at the present time. In the electrical industry he can refer to his work for the Edison Electric Illuminating Company, Paterson, N. J.; the Steinway Railway Company, Astoria, L. I.; the Bergen County Traction Company, Fort Lee, N. J., and many more, the result of his labors.

MR. ELMER P. MORRIS, whom everybody in the electric railway field knows and who knows everybody, has been appointed Eastern agent for the McGuire Manufacturing Company, of Chicago, Ill., whose trucks for electric cars—and any others, if such now exist,—he will be glad to furnish or to answer inquiries about.

MESSRS. WM. BROWNE & SON, Bank street, Newark, N. J., have contracts to wire the Camden (N. J.) armory, the Lang Company's tannery, the Newark City National Bank, Roe & Conover's warehouse, Senator Smith and Chas. H. Case's residence at Newark. The Consolidated Electric Supply Company have the contract for all the supplies used for the above work.

THE LATE HARVEY L. LUFKIN. The directors of the Crocker-Wheeler Electric Company have adopted a set of resolutions in regard to their late Manager of Sales, Mr. H. L. Lufkin, expressing deep regret at their loss and a high appreciation of him personally and in his business capacity.

WESTERN NOTES

ARMORITE.—The Armorite Interior Conduit Company, of Detroit, Mich., write us that they are very busy and have all they can do to keep up with orders. Among recent orders reported by Mr. J. F. Cummings, general manager, is a large one for the Hotel Henry, Pittsburg, a magnificent new building, which is to be tubed throughout with Armorite, and for which the material is now being shipped.

THE ELECTRIC APPLIANCE COMPANY look back on the Christmas season just passed, as a particularly satisfactory one, not only for the reason that it represents the beginning of their sixth business year, but also on account of the very satisfactory way in which the orders came in during the month of December, at which time they report that business seemed to take quite a jump.

AS AN INVESTMENT.—Under this title, the Garton-Daniels Electric Company, Keokuk, Ia., have issued a dainty little brochure which demonstrates the economy derivable from the use of their lightning arresters. It gives a list of several street railway and lighting companies that use this excellent appliance.

K. McLENNAN & CO., of Chicago, Ill., the sole manufacturers of the celebrated "Gale's Commutator Compound," stated to a representative of this paper that the sales of their compound during the past year have more than trebled those of any previous year; that wherever "Gale's" has been tried it becomes readily adopted. At this time more than three-fourths of the power plants and central stations have adopted its use; and it is now universally conceded to be a "dynamo necessity." To the isolated plants as well as the central stations and power plants, which have not already tried this compound, they will continue to send upon request a free sample stick. They state further that this compound has been equally well received in Canada and Mexico as well as in Europe, whither recent large shipments have been made, and that requests for samples have been received from nearly every section of the civilized world.

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The Electrical Engineer.

Vol. XXIII. JANUARY 13, 1897. No. 454.

ELECTRIC LIGHTING

THE LAUNCESTON, TASMANIA, ELECTRICITY SUPPLY WORKS.—A WATER POWER PLANT.

It was nearly ten yeas ago that the project of supplying electricity to the town of Launceston, Tasmania, was first broached, but it was not until 1889 that the project took definite shape. It was then decided by the City Council, on the advice of their engineer, to utilize the power of the South Esk River, a stream which rushes in a series of cataracts for miles above the gorge, where it joins its waters with those of the North Esk, to form the River Tamar.

THE HYDRAULIC WORK.

Various schemes were proposed for bringing the water from the upper level to the wheels, and the engineers finally decided on boring a tunnel in lieu of iron pipes, as at first proposed.

The grade of the tunnel is 1 in 110, calculated to give a velocity of about 10 feet per second, and therefore a discharge of about 11,780 cubic feet per minute; but as by Parliamentary restrictions only two-thirds of the water flowing in the river is to be made use of, that quantity, equal to 10,000 cubic feet per minute, is all that can be depended on during dry summer weather. The resulting horse-power, taking 10,000 cubic feet per minute as a basis, is 1,562, at 75 per cent. efficiency of turbine, and costs therefore £8 10s. per horse-power, a rate which compares very favorably with work in any part of the world.

From the screening chamber the water, after straining, flows through a wrought-iron sluice gate opening, and by a pipe line is conveyed to the power station, as shown in plan and elevation in Fig. 1. The pipe is of wrought iron with flanged joints, is ¼ inch thick, and for the first 82 feet is 5 feet in diameter, the remaining 121 feet being 4 feet in diameter. The lower end is expanded into a bell mouth, 6 feet by 2 feet 6 inches. The latter conveys the water to a wrought-iron receiver 80 feet long, which extends along the back of the power house, and is supported in similar manner to the pipes. The central portion, 41 feet in length, is 6 feet in diameter, and is of wrought iron ⅜ inch thick; the two end portions being 3 feet in diameter and ¼ inch thick, all being held back by 1½-inch anchor bars. The receiver is fitted with four 4-inch dead weight safety valves.

From the 6-feet section the water is led into the building by means of four 2 feet 4-inch pipes, and from the 3-feet sections by six 12-inch pipes, though only three of the former and five of the latter are at present in use, one of each being left for future extensions. The water from these pipes is taken directly to the turbines, draft tubes being made use of to ensure at least 110 feet of working head.

THE POWER HOUSE.

The power house, shown in Fig. 2, is situated above highest known flood mark on the river bank. It is built of the local basalt on concrete foundations, and with galvanized iron roof; is 105 feet by 24 feet in the clear, with a central bay of 40 feet, which is 6 feet wider. The height of the wings is 15 feet, and of the center, 22 feet; to the wall plate in each case. The tail race extends nearly the entire length of the building, is 9 feet wide and 12 feet deep, and was excavated in the solid basalt. It is arched over with concrete, on which are bedded the girders to which the turbines and other machinery are bolted.

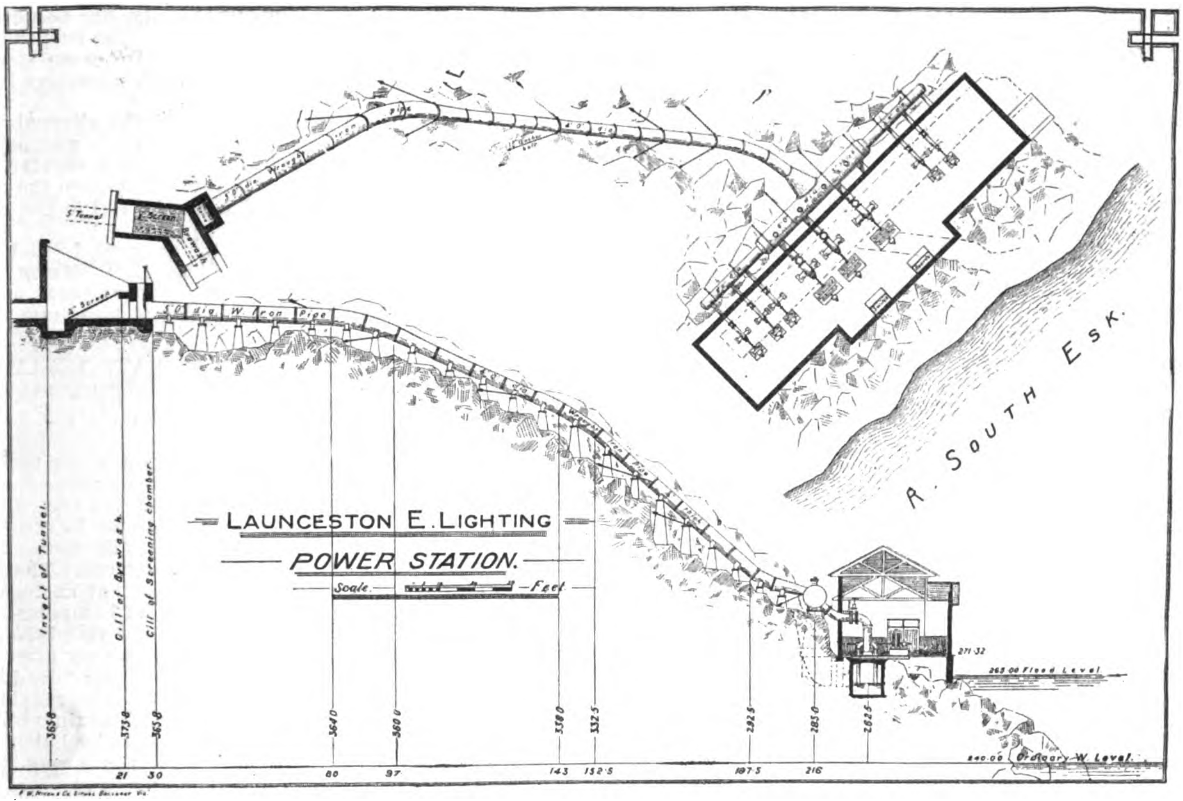


Fig. 1.—The Launceston, Tasmania, Electric Light Station.

TURBINES AND DYNAMOS.

There are eight turbines fixed and at work, all of the Thomson vortex type, fitted with the Murray hydraulic governor. They are adapted for a fall of 110 feet, and arranged for coupling direct to the dynamos. The outer case of these turbines is of cast iron, and the revolving blades are of brass. The fixed guide blades are of Delta metal, and are movable for adapting the entrance orifices to any quantity of water below the full supply. The wheels work vertically, and the draft pipes are fixed so that part of the fall acts by suction. They were made by Messrs Gilbert Gilkes & Co., of Kendal, England. Five of the turbines drive arc light dynamos at 800 revolutions a minute, at which speed they each give 21 horse-power. The other three drive alternators at 460 revolutions a minute, and each gives 158 horse-power.

The arc light dynamos are of Siemens Bros.' manufacture (their H. H. D. type), and give a constant current of seven amperes, and an e. m. f. of 1,750 volts when running at 800 revolutions a minute. They are driven direct by the turbines.

The alternators used are of the Siemens' W type, having revolving disc armatures, each of which has 24 coils, and revolves at a speed of 460 revolutions per minute, when the output from the alternator is 100 kilowatts at 2,000 volts. The alternators are connected directly to the turbines by means of a flexible coupling.

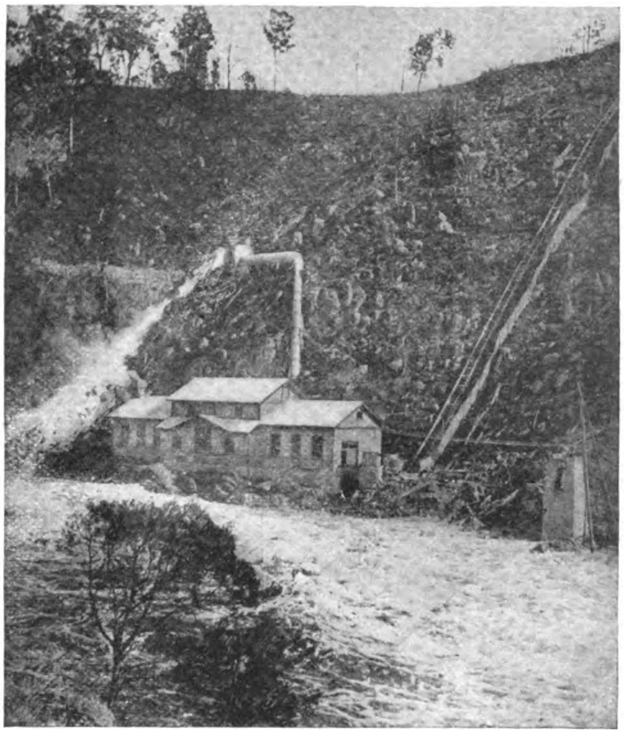


Fig. 2.—View of Launceston Electric Light Station.

DISTRIBUTION.

The engineer's plan was to distribute the electricity from a station conveniently situated for the purpose in the city, bringing the energy from the generating station by means of insulated cables suspended to poles, in as direct a line as possible. This line was the first work undertaken by the contractors. Substantial towers were constructed at both sides of the river, between them the leads were carried across the river, and on to the distributing station, a distance of about two miles; there they were connected through lightning arresters, and other apparatus, to the switchboards. From these switchboards the distributing mains pass out and along the streets in all directions over the city, the leads carrying the continuous current to the arc lamps which illuminate the streets, and those carrying the alternating current to transformers, where the current is reduced to the low voltage necessary for use in the incandescent street lamps, as well as those which light up public and private buildings.

Another peculiarity appears in the arrangement of the mains carrying the alternating high tension current. As this current was to be used for two purposes—street lighting in the outlying parts, and private lighting and power work, each of which might be used at times the other was not required—the leads from one pole of the alternator, instead of being one wire, are of two separate wires insulated from each other; the two being equal in conductivity to the one wire which forms the return to the alternator. Then the transformers for the street lamps are fitted between the return wire and one of the two leads, the transformers for private lamps being between the return and the other of the two leads. By this means, only the energy required for the street lamps, when they alone are wanted, and for private lighting when the street lights are not required, will flow from the alternators. By this means too, the very important desideratum, the being able from one point in the city to light up and turn out all the street lamps, is secured. Switches for accomplishing this are provided at the distributing station.

The transformers used about the city are of capacities varying from one to eight kilowatts. They are of the Siemens' double magnetic circuit type, consisting of Siemens' special stamped core plates slipped into a bobbin, on which the two coils are wound. They are arranged to transform from 1,900 to 112 volts at a frequency of 92, and at full load have an efficiency of over 98 per cent. They are enclosed in iron watertight cases.

The arc lamps, of which there are 120 fitted about the streets, are of the Siemens' "band" type, take seven amperes of current, and burn for sixteen hours without being re-carboned. They are placed inside lanterns fixed on top of poles which stand in the middle of the streets. The lanterns were made by the contractors to the superintending engineer's design, and are glazed with special dioptrical glass, which, while diffusing the light without any considerable loss, makes the lamps pleasant to look at, being free from that glare so frequently present with arc lamps. The incandescent street lamps, which are nearly all of 50 candle-power, are suspended under iron enamelled reflectors fixed to iron brackets screwed to the poles.

The distributing station stands on a block of ground at the intersection of Bourke and Canning streets. It is a neat brick building with central wooden tower, to which the wires are brought, and from which they pass down to the switching apparatus below. The building is divided into a switching and testing room, a workshop and a store-room. There is also provision for a set of arc-lamp regulating stands, fitted with ruby-glass doors.

The heavy leads from the generating station, as well as those carrying alternate current about the city, are suspended from steel wire tied to porcelain insulators. The suspending clips, which attach the cables to the steel wire, were specially designed for this work, and made by the contractors in Launceston.

Within five months of the starting of the alternators, nearly 5,000 incandescent lamps had been installed, and applications for the light were being received with such regularity that it seems clear that no long time will elapse before the additional alternator and turbine, for which room is left in the generating station, will be required.

The entire electrical equipment was carried out by Messrs. Siemens Bros. & Co., of London. Mr. K. L. Murray acted as superintending engineeer for the electrical plant and Mr. C. St. John David for the tunnel, pipes and buildings.

THE EVOLUTION OF THE ISOLATED ELECTRICAL PLANT DURING THE LAST FIFTEEN YEARS.—II.

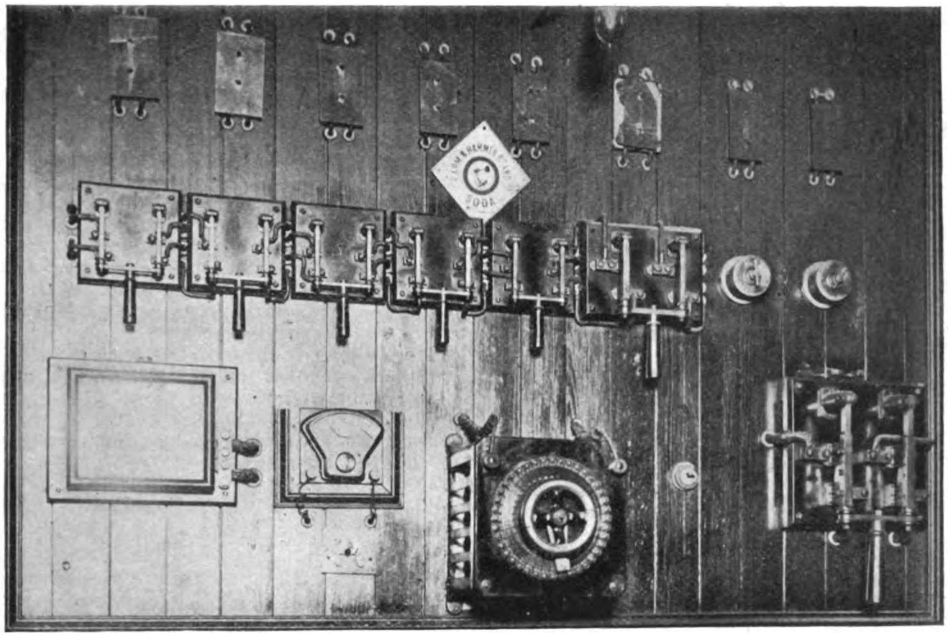
BY CHARLES HENRY DAVIS, C. E.

SWITCHBOARDS.

These were practically unknown when the rheostat was placed on the machine itself and later was hung on the wall, while the voltmeter rested on a wooden shelf and the ammeter was placed where the main circuit left the dynamo room; these latter instruments were little more than indicative of a rise or fall in pressure or current. The writer remembers testing some old ammeters somewhat as follows: Current was started from zero, increased to 25 amperes and multiples thereof, according to the laboratory standards; at each point of rest (which was reached at times only after considerable delay, the instruments not being of the "dead beat" variety), a pencil mark was made; when the maximum was reached the operation was reversed and again pencil marks made, these often varying from the others by half an inch on a total scale of eight or ten inches; the mean was struck and the scale scratched ready for shipment.

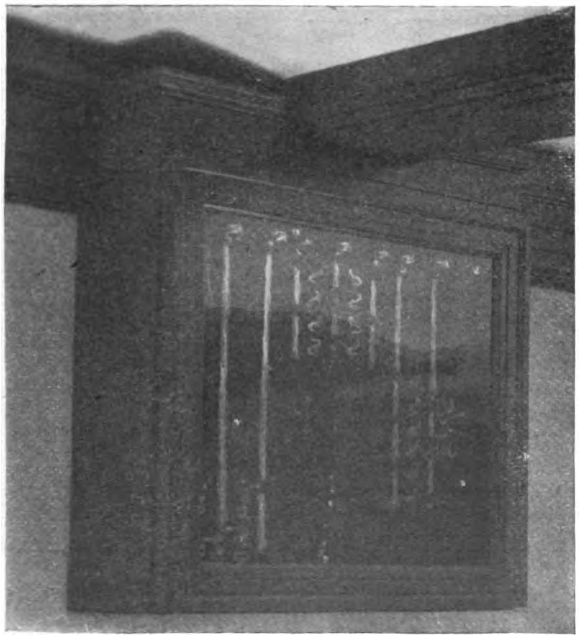
The switchboard of to-day was due to the development in methods of wiring; at first only one or two circuits ran from the dynamo room while now the entire system is controlled from this point by the use of elaborate switchboards of slate or marble set in wood or iron frames. The first step was to use wooden boards upon which were mounted, on their own wooden bases, switches, voltmeters, ammeters, rheostats, etc. These boards were often made skeleton and their liability to catch fire was great; from this risk grew the method of mounting rheostats in iron boxes and switches on slate bases, the next step being the placing of these directly upon the slate switchboard specially drilled for the purpose. The old boards were small affairs while those of to-day are often 20 feet long with great skill shown in their arrangement, design and workmanship; these boards are often arranged to take current from the street on a three-wire system and from the dynamo on a two-wire system.

The old rheostats were very large, clumsy arrangements mounted on wood and made of iron wire, later of German silver, while those of to-day are small compact iron boxes or plates of porcelain and are fireproof. Old time switchboard connections were made of insulated wire run in a promiscuous manner; later copper rods were used and to-day a combination of these with brass or copper bars mounted on hard rubber.



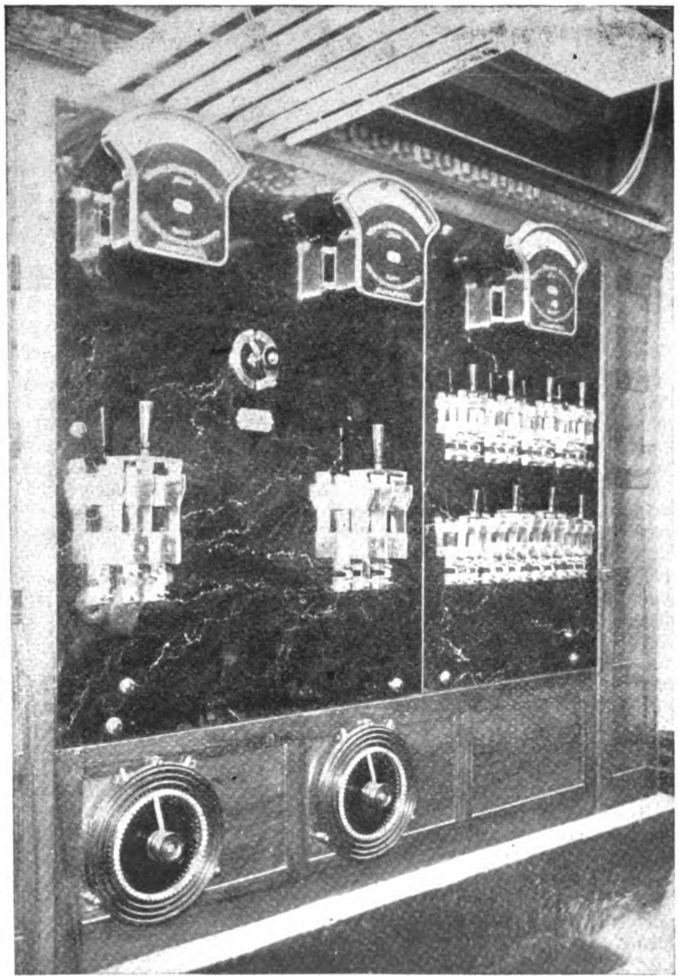
Old Style Switchboard.

In switches and their uses we see the change from vertical and single pole side throw and plug switches to the double and three pole knife blade switches such as those for dynamos and their equalizing connections or to break their fields; double throw switches to change dynamos, or circuits, or from two to three wire systems; from front to back connected switches and all the other endless varieties.



Old Style Panel Board.

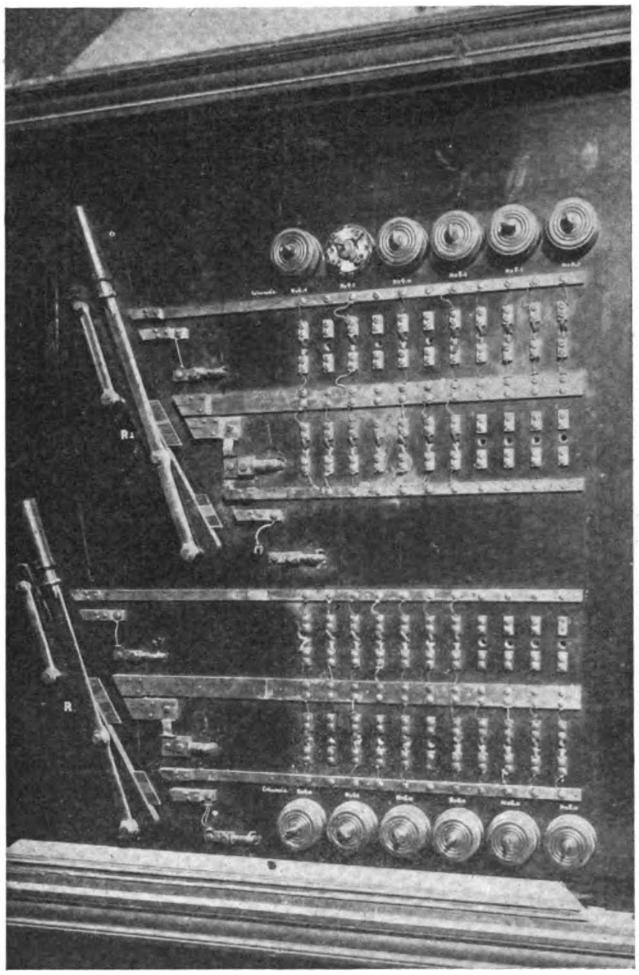
In indicating and recording devices we have passed through the various stages of instruments with angles marked on the scales to be figured, by a table, into volts and amperes; instruments that took a minute or more to come to rest, to those that are "dead beat;" instruments wherein the heating effect prevented their constant connection to the circuit, to those that are in shunt and have illuminated dials and artistic design; while the recording wattmeter keeps a constant record of the power developed which was formerly only obtained by frequent readings of inaccurate volt and ammeters. The engravings give some views of old and new boards.



Modern Switchboard.

WIRING.

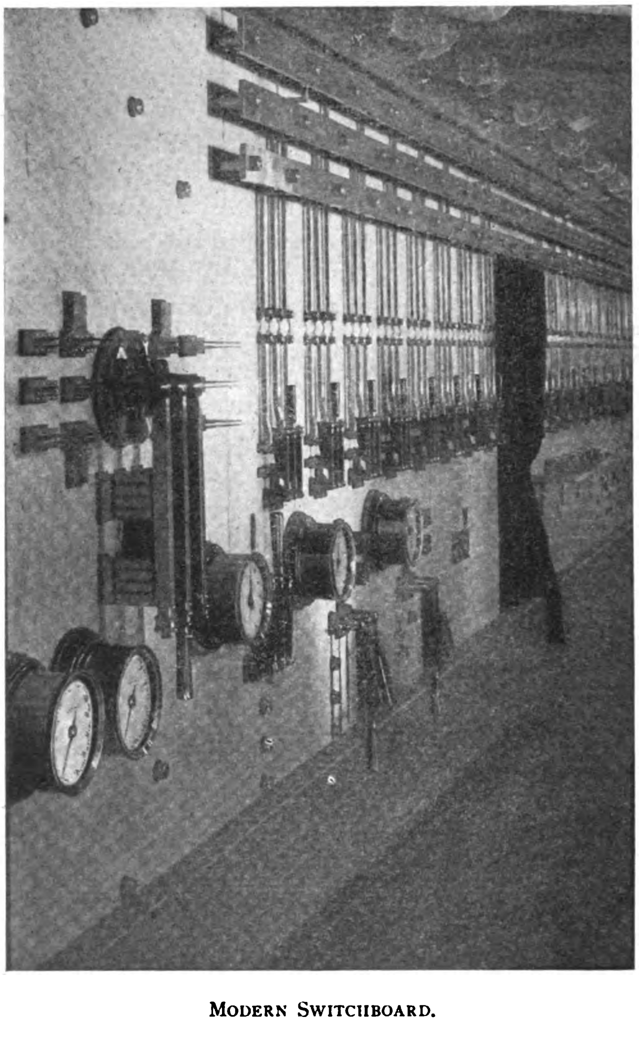
The changes and developments in our wiring systems have mostly come from increase in the size of the plants installed and the greater care required in reducing the fire risks. Wires were first run exposed and supported on wooden cleats, iron hooks, etc.; then in mouldings and on glass or porcelain. These wires were the famous and later "deadly" "underwriters," which are discarded but now on the high road to being again required by our insurance boards. When wires were to be concealed they were lead incased and run in plaster under tile floors, etc., with the result of perpetual grounds and recurring burn-outs. Later wires were covered with rubber or compounds of gutta-percha, some taped, some braided and these were imbedded in plaster walls with but little better results. When "underwriters" wire was condemned for concealed work and mouldings the manufacturers placed upon the market the so-called "weather-proof" and "weather and fireproof" which only differed in the compound being a hydro-carbon product and more easily burned in the first case, and in the second, the inside was weather-proof and the outside fireproof, substantially another name for "Underwriters." The next step was paper, canvass or composition tubes through which the wires were drawn for all concealed work, while the final step has been the use of gas piping lined with paper or composition as an insulating material with some talk of using plain iron piping. The use of tubes has brought with it the placing of positive and negative wires together; in the case of paper tubes, for branch circuits carrying a small current, while with iron armored tubing both polarities are run together up to 100 amperes.



Model Panel Board.

In the distribution of current the old time method was to run a main wire from the dynamo, reducing it in size at various points; then a feeder to the center of distribution with mains the same size their entire length. As control from the dynamo room was developed, partly due to increase in the size of plants, separate mains were run to each floor, or group of floors, the same size over their entire length. To-day combinations of all are used according as they produce the most uniform potential at the lamps. In the distribution wooden cut-outs were employed entirely until earthenware and procelain forced their way into use owing to superior protection against fire; these were placed along the feeders, mains or branches, as circumstances required, and were at first uncovered and exposed; later they had mica or porcelain covers and were grouped together. This grouping or "pocket system" led to the use of slate distribution boards which are now universally used in the best construction and are similar to small switchboards, with or without switches; these are often enclosed in slate-lined boxes. The writer believes that these slate distribution boards or "panel boards" were first used as a system in the Pennsylvania Mutual Life Insurance Building, Philadelphia. One of the engravings shows these crude panels as they were then made, while some of the latest are shown in the other engravings; the writer also believes that the slate-lined box was first suggested and called for in specifications prepared for the Hon. Whitelaw Reid's house in Westchester County in the winter of 1889-90; this plan, however, was never carried out.

The change from switches with wooden bases, poor contact and lack of quick make and break, single pole and light mechanical construction, to those which are fireproof, substantially and electrically first-class, is well known. Porcelain cleats, the running of wires between insulators without tie wires, the avoiding of all soldered joints in runs, the use of junction boxes and tubes are some of many improvements in our wiring systems. A marked change has taken place in the manufacture and use of fuses, the tendency now being to avoid their use whenever possible, to have them with metal terminals and standardized and in many cases displaced by circuit breakers.



Modern Switchboard.

ELECTRIC TOWING IN GERMANY.—It is stated that electric tow-boats are about to be placed on the River Spree, near Berlin, where for a distance of eight miles the ordinary barges cannot use sails, owing to a large number of low bridges. The trolley system will be used.

POWER TRANSMISSION

A CROCKER-WHEELER ELECTRIC DERRICK IN BROOKLYN, N. Y.

An illustration, Fig. 1, is shown herewith of a very interesting and effective derrick and hoist installed by the Crocker-Wheeler Electric Company, at Ampere, N. J., in the yards of Post & McCord, building contractors, etc., Newtown Creek, Brooklyn, N. Y., who have a large plant of their own for electric light and power. From that plant the derrick is supplied with current by means of a long run of underground lead covered cable, which leads into the derrick or crane. There is an ingenious contacting arrangement by means of which the derrick as it swings around gets its current without interruption. This device is placed under the power house shown in the cut. This house contains a 10 horse-power Crocker-Wheeler motor, with their automatic electric strap brake of the pivoted field type familiar to our readers. The arrangement is shown in Fig. 2. The little house above the larger one contains a 3 horse-power motor also fitted with automatic electric brake. The lower motor does the hoisting; the upper motor runs the rack, or trolley travel. A motor of from 3 to 5 horse-power is now to be installed to turn the crane around, that having been done hitherto by hand. In the lower house there are two controllers of mill or street car type, one for each motor. One man manipulates the entire combination, standing between the two controllers, one being held in his left hand and the other by his right.

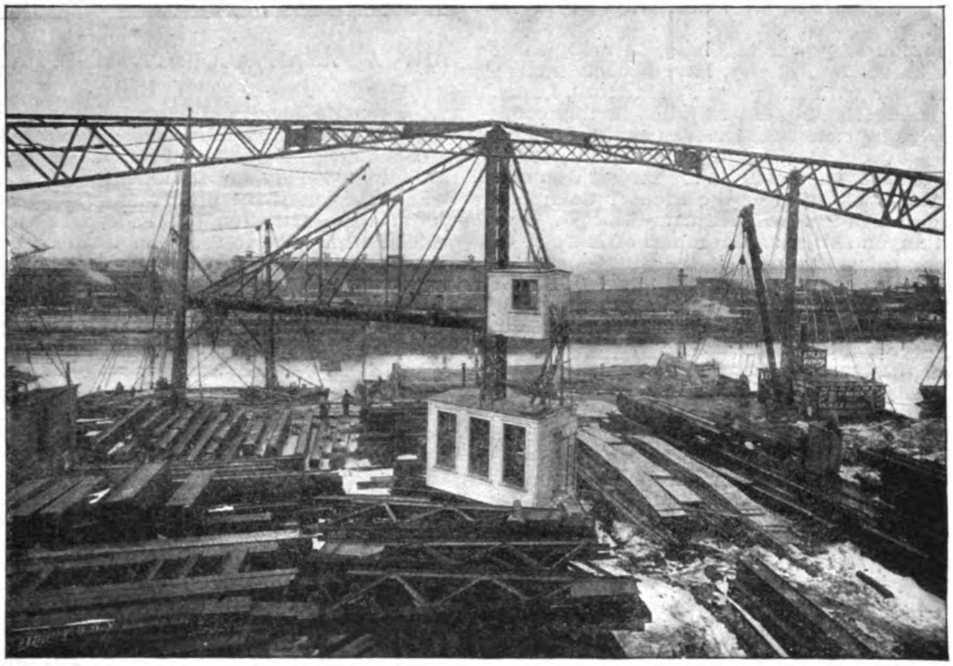


FIG. 1.—10-TON DERRICK CRANE AT IRON WORKS OF MESSRS. POST & McCORD, BROOKLYN, N. Y.

One Size 10 C.-W. Single-Reduction Motor on Hoist and One Size 3 C.-W. Motor on Trolley Travel.

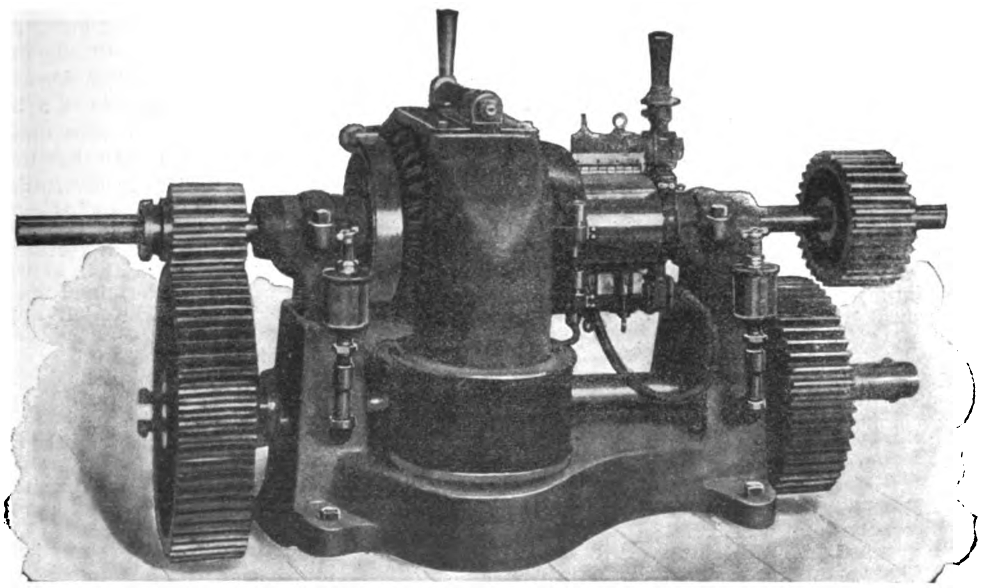


FIG. 2.—SIZE 10 C.-W. AUTOMATIC BRAKE MOTOR.

With Countershaft Through Base of Pedestals with Changeable Gears to Give Two Speeds.

This appliance has been in constant and successful use at Newtown Creek for two years loading lighters on the creek with building material. There is also a similar outfit at the entrance of the works, this being used for loading trucks.

The voltage of the system is 230. The generating plant is of Crocker-Wheeler make, consisting of one 80 kilowatt and one 60 kilowatt generator, for light and power purposes.

RECENT ADVANCES IN POWER TRANSMISSION.

By JOHN McGHIE.

THE long-distance transmission of power was seriously handicapped by the unavailability of the direct current as far as generation was concerned, and equally by that of the alternating current at the motor end. And not until the development of the alternating current multiphase system and the creation of the induction motor had become an actual fact did long distance power-transmission really rise above the horizon of the practicable. From the moment we became familiar with the multiphase system, the work of introduction became child's play in comparison with that with which we had struggled before.

Since 1892, transmission of power involving in many cases outlays of very large amounts of money, have become numerous. Starting in that year with the plant at Hartford, Conn., the first multiphase transmission plant installed in this country, in which the power is transmitted eleven miles, I find a succession, steadily growing in number and capacity each year, until we reach, in 1896, what will be the largest commercial transmission in the world, that of the Pioneer Company, at Ogden, Utah, which when finished will carry the power of the water of Ogden Canyon as far as the mines of Mercur, 60 miles distant. The great developments of the past four years in the electrical field, both from the commercial as well as the technical standpoint, have nearly all been made with a view to meet the demand which an earnest campaign of education has raised in the power transmission field. We have seen brought into existence the increasing and reducing transformer of very large capacity, cooled by air currents; the rotary converter, which converts alternating current into direct and which has given to our present street railway systems a means of economically feeding current to their most distant sections; the lightning arrester for high-tension work; the multiphase generator of which examples exist which deliver current direct to the wires at high voltages only a few years back deemed impossible; and lastly the induction motor, that beautiful creation which does its work with all the precision of the direct current motor, while having no commutator, no brushes, no moving contacts, nothing, indeed, but three wires attached to the binding screws.

But the transmission of power by no means implies the necessity of long distance. In mill and mine practice, while the direct current system is by no means discarded, the multiphase system is finding a large place. The equipment of a transmission plant for mine or mill, distance being slight, differs in no way from the long distance plant, excepting in the absence of the raising and reducing transformers, and in the modified subsidiary apparatus. The same advantages are present.

At Columbia, S. C., the entire machinery for a huge cotton mill is driven by multiphase apparatus; similarly at Taftville, Conn., and instances are multiplying fast all through the country. In mine work, the multiphase system has only recently been introduced, yet it is receiving a gratifying reception, thanks to the propaganda, which, let me not omit to say, has been very largely carried on by the electro-technical papers, The Electrical Engineer by no means the least prominent.

The benefits which the employment of electricity as a motive power confers upon mine and mill operation, have been too frequently set forth in your columns, to warrant digression now. Suffice it to say that it may be epitomized in increased and improved output; reduction in cost of operation and maintenance expense; better physique and morale of operatives, and a general pervasive satisfaction.

Some idea may be gathered of the growth of the power branch of the great electrical industry by an examination of the following figures, given in horse-power instead of in dollars, to avoid erroneous comparison. They are taken from the published figures of only one of our largest companies. Up to 1892 the total horse-power of the apparatus for purely power purposes sold by this company, amounted only to 13,719 horse-power. In 1893, the total sold exceeded that of all years previous by 5,000 horse-power, the total reaching 18,762; in 1894, the total for that year reached 42,379 horse-power, while in 1895, not less than 46,727 horse-power had been called for. The year 1896 has been universally conceded the nadir of business depression, yet I feel warranted in saying that if the outside observer had been limited to conclusions drawn from the amount of power apparatus sold he would have classed it as a fat year among fat years. Between Jan. 1 and Dec. 31, quoting from the same source, the apparatus sold for power transmission and power utilization purposes, amounted to the very respectable total of 75,000 horse-power.

Nothing further than the foregoing need be said to show the important place now occupied by electric power in the industry. If to the above figures could be added the results of the work of the other concerns manufacturing electric power apparatus, the total would probably assume proportions likely to tax the credibility of your readers. Meanwhile, all the signs point to a still larger extension in this branch of the business, and they are of the character that augurs realization.

MISCELLANEOUS

HOW A FATAL ACCIDENT HAPPENED IN PHILADELPHIA.

A coroner's jury in Philadelphia has rendered a verdict of accidental death in the case of Joseph Muchenrider, the 15-year-old lad who was killed by touching an electric wire in the fire box at Second and Callowhill streets. Andrew Gallagher, the companion of the unfortunate lad, stated that he and the victim were attracted by the sparks coming from the box, which had set fire to the pole. Some one in the crowd of bystanders suggested that one of the boys turn in an alarm. Joseph stepped up to the box and touched the handle and instantly fell lifeless to the sidewalk.

Lineman McDugal, of the Electrical Bureau, said that the trouble was caused by two electric light wires coming in contact with a guy wire, which was fastened to the pole on which the fire box was placed, and to another pole on the opposite side of the street. The insulation on the electric light wires was worn off and the current was conducted to the guy wire and through that reached the metal tubing in which the alarm box wires are incased. In this manner the box became charged.

Several expert witnesses testified that the only way in which electric wires could be placed to insure safety is to have them placed underground. The jury recommended that the city councils pass an ordinance compelling all electric lights and telegraph companies to place their wires underground.

ELECTRICITY IN NAVAL LIFE.—XIII.

BY LIEUT. B. A. FISKE, U. S. N.

HORZIONTAL BASE POSITION FINDER.

IF the ground in the vicinity of the water is not high enough to offer a sufficiently long vertical base line for a depression finder, it becomes necessary to use a horizontal base. The solution of the problem of so employing a horizontal base has been attempted during many years, but, so far as the writer has been able to ascertain, the only system that has done it successfully is the one here described, in which telescopes located at the opposite ends of a base line carry contacts which sweep over arcs of wire that are connected together in the same way as in the range finder just described. The position finder referred to in the Italian report, of which an extract has just been given, is of this character. Another form is shown diagrammatically in Fig. 40, in which—

A B represents the parapet of a fortification. The distant object is supposed to be located at C, and it is the position of this object which is to be determined upon a suitable chart, D, on which the fortification line A' B' appears on a reduced scale.

E is an arc of conducting material.

F is a telescope or alidade arm pivoted at one end at F', with its free extremity moving over and making contact with the arc E.

G is an arc similar in all respects to the arc E and located in suitable proximity to the chart D.

H is an arm pivoted at H' and having its free end sweeping over and making contact with the arc G and carrying a pointer I.

a b c d are members of a Wheatstone bridge connecting the arcs E and G.

e is a loop including the battery, and f the loop including the galvanometer g.

It will be obvious that when the arm H is set upon its arc G at the same angle to the line H' F' as the arm F upon the arc E, then the bridge will balance, and the galvanometer will indicate zero, and hence, inasmuch as the telescope F points to

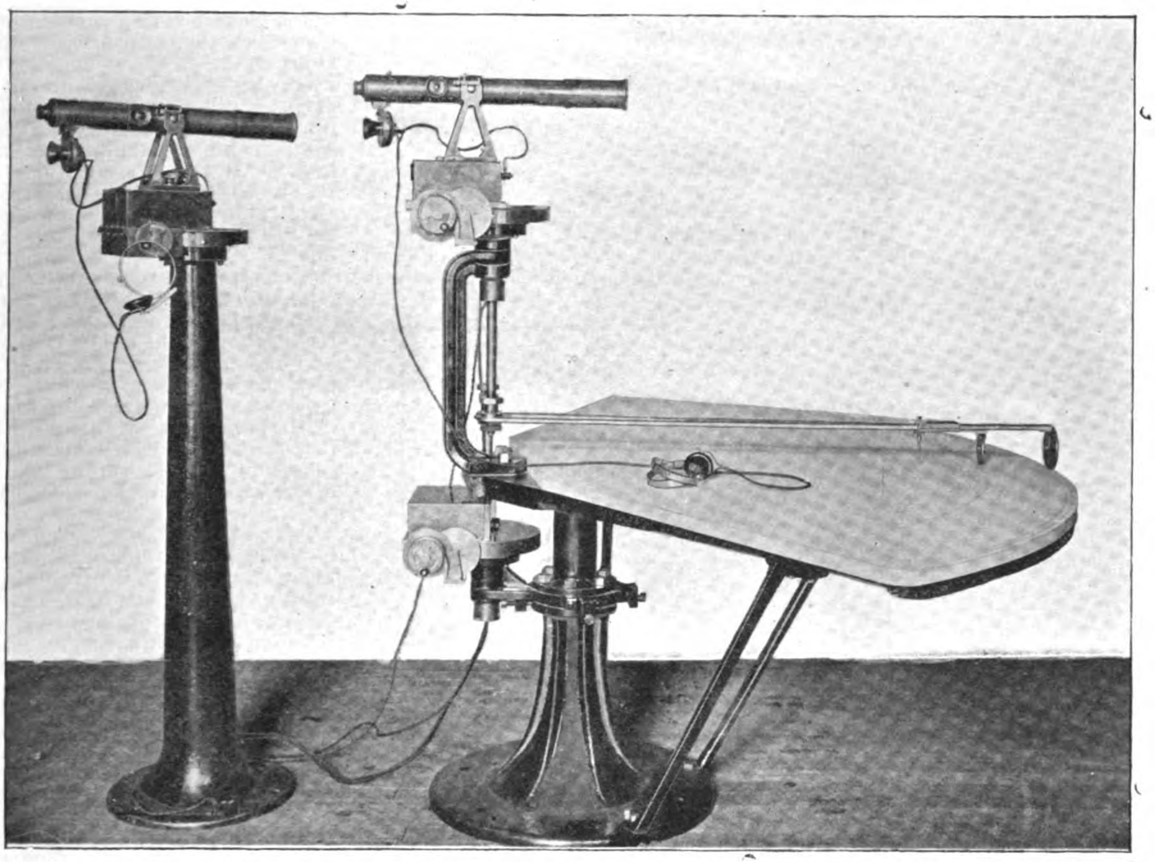


FIG. 41.—POSITION FINDER.

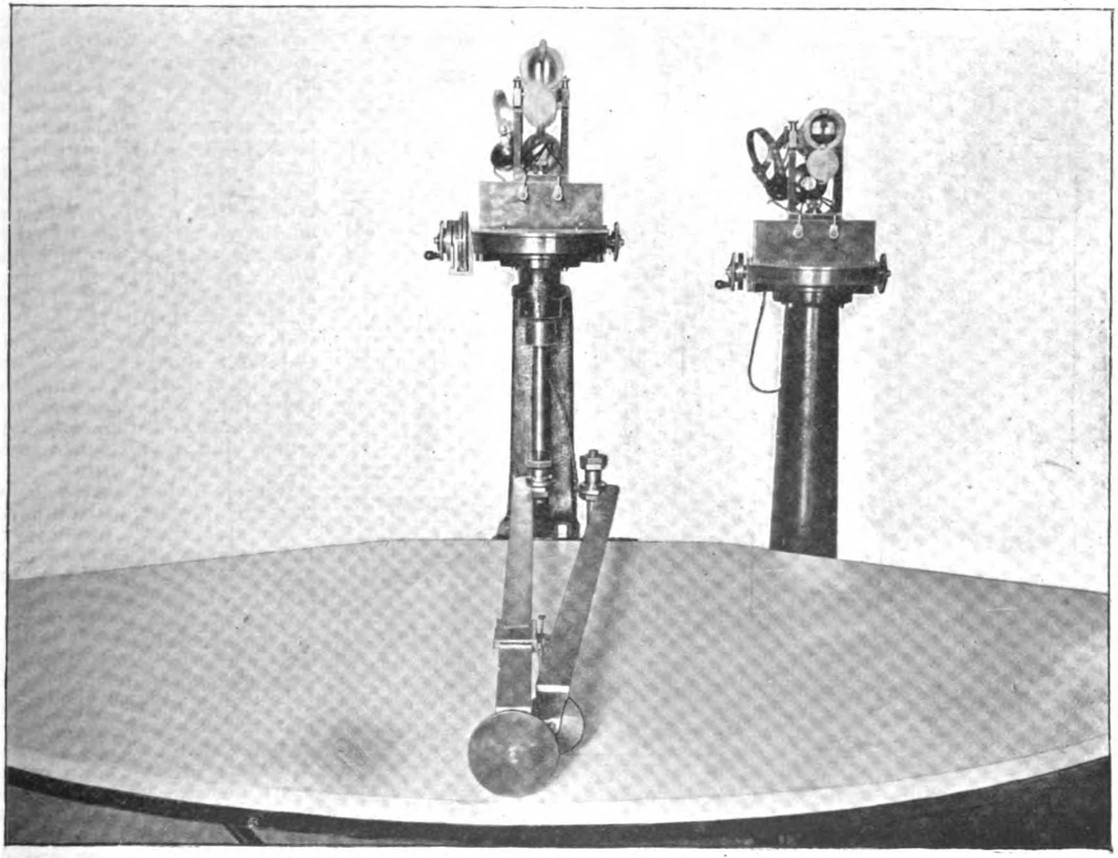


FIG. 42.--POSITION FINDER.

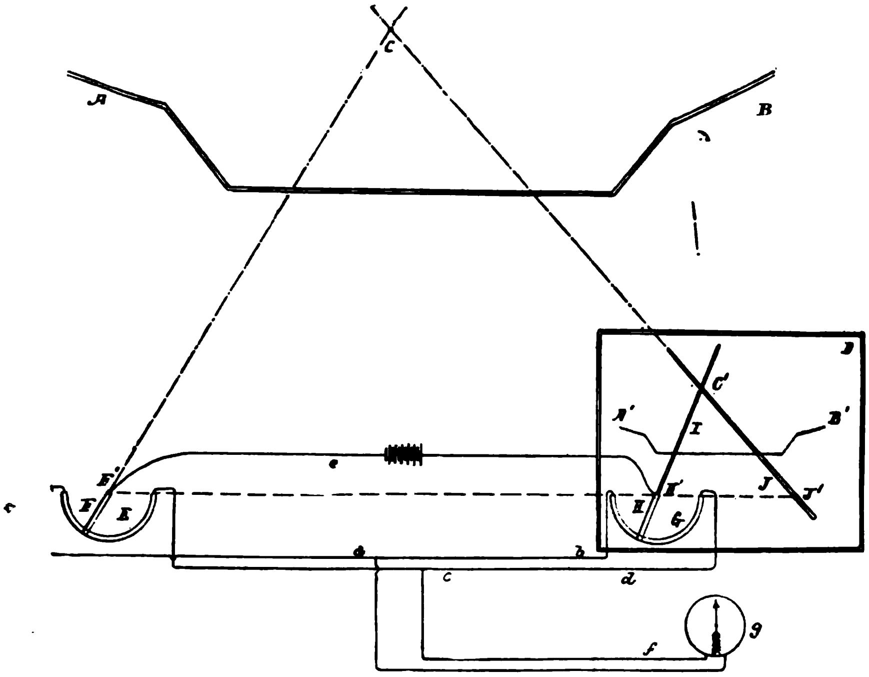


FIG. 40.—POSITION FINDER.

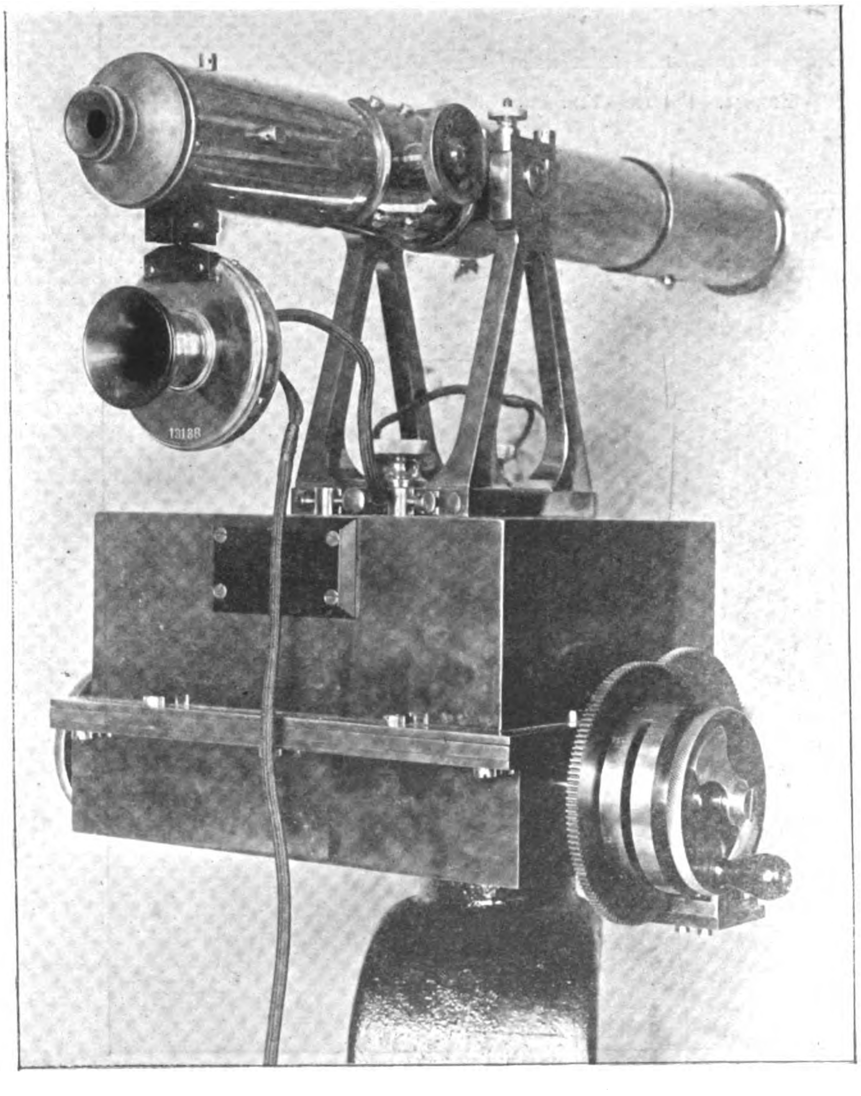


FIG. 43.—POSITION FINDER.

the actual object C, the arm H will point to the corresponding position of the object C or C' on the chart D. Pivoted upon the chart D at J' is an arm J, which arm may be provided with a telescope or alidade so that it may be directed upon the object C. The arm J is long enough to make intersection with the arm I. If then the arm J is trained directly on the object, inasmuch as the line H' J' joining the pivots of the arms I, J on the chart D corresponds to the base line F' J', extending between the distant stations, and as the angle C' H' J' equals the angle C F' J', it follows that the intersection of the arms I and J at C' indicates the position of the object C upon the chart D. The chart being drawn to scale, it is easy to recognize at a glance both the direction and the distance of the object C.

The latest form of this position finder is that installed at Fort Hamilton, and represented in Figs. 41, 42 and 43. The larger of the instruments is fitted with a plotting table as well as a telescope.

The resistance wire for each instrument is wrapped in a spiral around an insulating cylinder instead of being laid in the form of an arc, and differs from the new form of range finder principally in the addition of the plotting table. The operation of using it is much the same as the operation of using the earlier form of position finder just described. The observers point their telescopes so that the cross wires rest on the mast or funnel of the enemy's ship above the smoke. The reader at the plotting table, usually an officer, keeps moving the electrical contact of his instrument so as to keep the galvanometer needle always at zero, thus maintaining the corresponding pointer always in parallelism with the telescope at the distant station. The reader and the observers have telephone receivers on their heads and long distance transmitters on the telescopes; so that they are in constant communication. As soon as each observation is made the officer orders "rest," and both observers cease observing for awhile. At the end of twenty seconds the officer orders "mark." The observers again sight their telescopes on the target and keep the cross hairs exactly on the mast until the officer, at the end of ten seconds, again orders "rest." The officer now notes the intersection of the pointers and marks it on the chart by a spring pencil, connects it to the position just preceding by a short line, and prolongs this line to an equal distance beyond the last point. The end of this line is clearly the position which the ship will probably occupy at the end of the next thirty seconds, and it is this "predicted position" which is signaled to the guns. But the frequency of the observations and the length of time over which the prediction extends, may be made to vary at will.

With a little practice the work of plotting and predicting positions occupies but a few seconds. To facilitate the operation, the apparatus has been given the form shown in Figs. 41, 42 and 43. The pointers are heavy steel bars graduated every ten yards up to 10,000 yards and supported at their outer ends on light brass rollers. The spring pencil fits in a slider that moves along one of the pointers. When the slider is pushed along its pointer until its edge rests against the other pointer, the middle of the spring pencil is exactly at the point of intersection of two lines drawn from the centers of the pivots of the pointers; so that to mark the position on the chart of the enemy upon whom the telescopes are directed it is merely necessary to push down the spring pencil with the finger. The distance of the position from this instrument can be read at once from the graduated pointer through an opening in the slider, and the direction can be read at once from the graduated disks shown on the right of Fig. 43.

As installed at Fort Hamilton, the base line is 985 yards. In "tracking" moving vessels and in plotting the positions of known objects situated in different parts of the lower bay, some as distant as 9,000 yards, no error as great as 1 per cent. was discovered on the official or the preliminary trials.

THE BALTIMORE ELECTRIC SUBWAY SYSTEM.

THE increasing number of overhead electric pole lines in the city of Baltimore, Md., carrying not only telegraph and telephone, but electric light wires at high tensions, made it long ago apparent that some system of burying the wires in the streets was desirable. It was not, however, until June, 1895, that any decisive action was taken, when the city council passed an ordinance creating an electrical commission to inquire into the question and to submit a plan for the construction of a system of conduits for the accommodation of all the overhead lines within the city, except the trolley lines.

This commission has just handed in its voluminous and exhaustive report which consists substantially of the report of its engineer, Mr. Nicholas S. Hill, Jr., whose plans the commission recommends for adoption by the city council.

Mr. Hill in his report first points out the necessity for the creation of a department or bureau which shall have full charge of all electrical construction in Baltimore, with power to formulate rules for installing wires, to inspect all wiring work, etc.

As regards municipal control, Mr. Hill is unreservedly in favor of the municipality building and controlling the subways absolutely, the people at the last election having authorized the expenditure of $1,000,000 for an electrical subway system.

The map, Fig. 1, indicates the area within which the wires are recommended for placing underground; beyond these limits pole lines are to be used, erected and maintained under certain specifications and rules.

The method of subway construction recommended is that of the "drawing in" system, consisting of ducts or tubes for trunk lines. Mr. Hill describes and discusses four types of conduit for this purpose, namely: 1. Cement lined pipe of the National Conduit Manufacturing Company. 2. Wrought iron pipe. 3. Camp terra cotta conduit. 4. McRoy terra cotta conduit.

As regards the cost of the trunk line construction, the curves, Fig. 2, show the cost per foot per duct of the four types of conduits mentioned above, when laid under Belgian blocks; the report also gives similar curves for cobble and asphalt pavements. In Mr. Hill's opinion the cost of wrought iron pipe construction would be prohibitive, and while stating that each of the remaining types will give good results recommends the adoption of either the Camp or the McRoy terra cotta conduits for trunk lines.

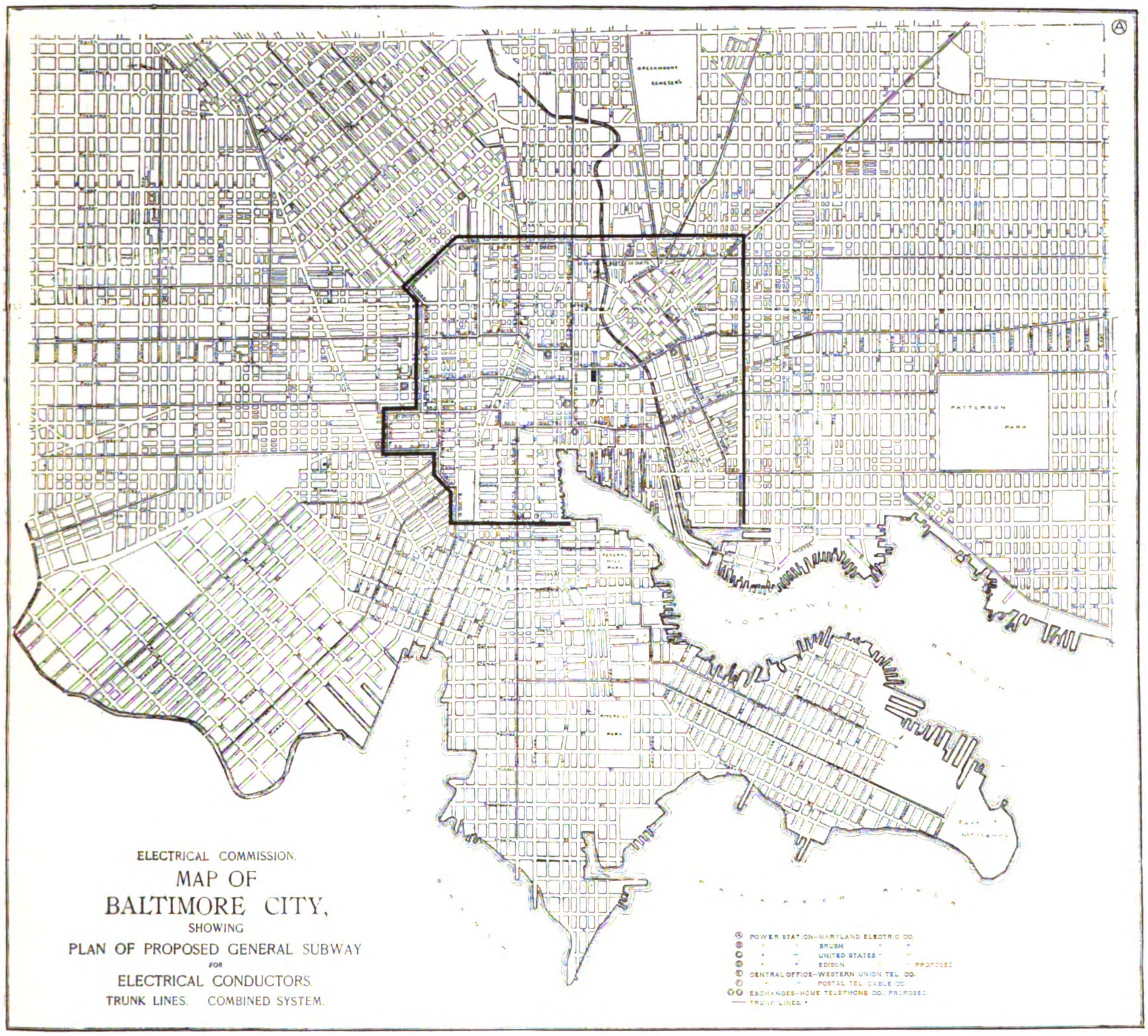

ELECTRICAL COMMISSION.
MAP OF
BALTIMORE CITY,
SHOWING
PLAN OF PROPOSED GENERAL SUBWAY
FOR
ELECTRICAL CONDUCTORS.
TRUNK LINES. COMBINED SYSTEM.
PATTERSON PARK
POWER STATION—MARYLAND ELECTRIC CO.
" " BRUSH " "
" " UNITED STATES " "
" " EDISON " " PROPOSED
CENTRAL OFFICE—WESTERN UNION TEL. CO.
" " POSTAL TEL. CABLE CO.
EXCHANGES—HOME TELEPHONE CO. PROPOSED
TRUNK LINES.

FIG. 1.—PLAN OF PROPOSED GENERAL SUBWAY FOR ELECTRICAL CONDUCTORS, BALTIMORE, MD.

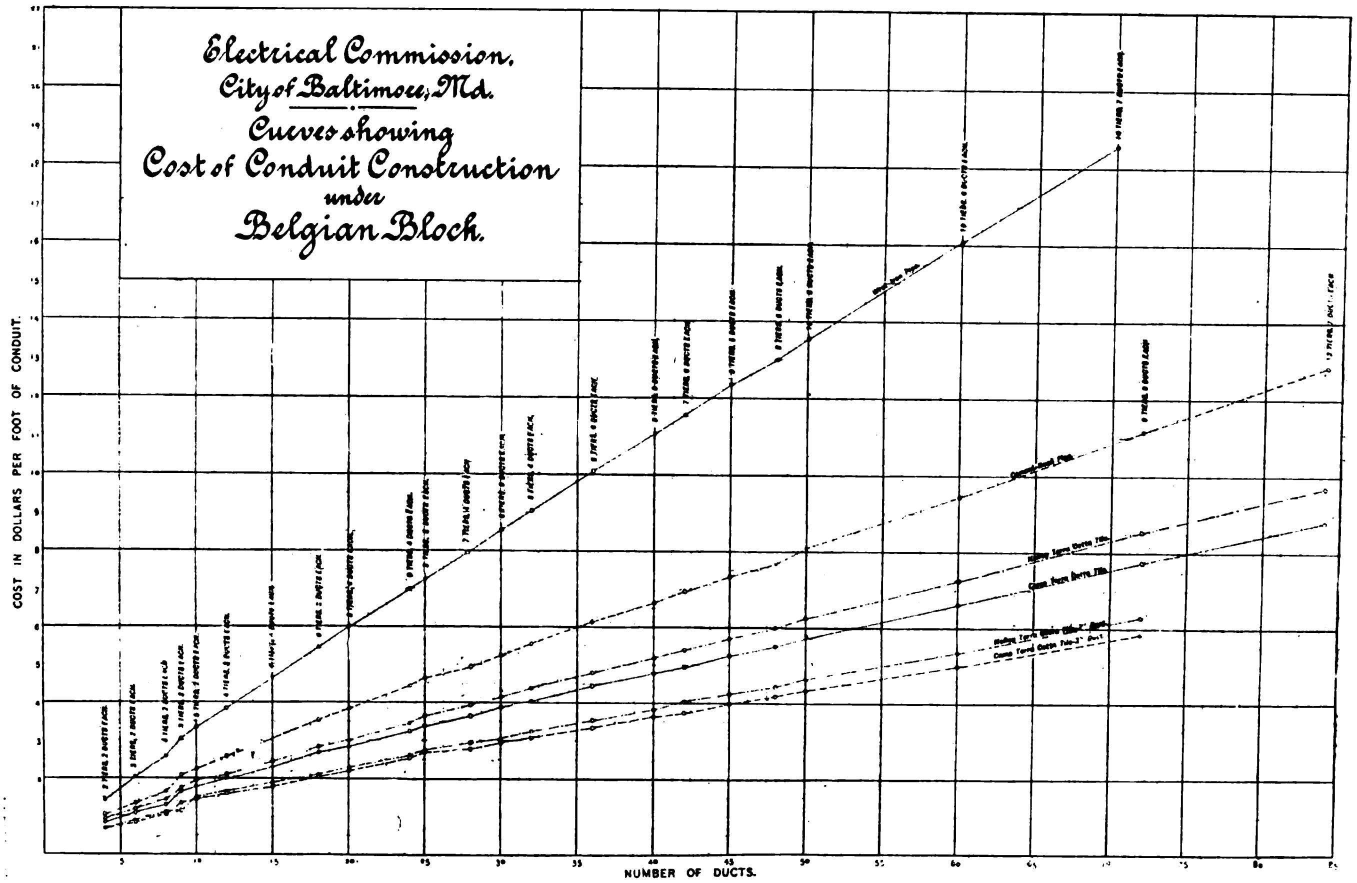


FIG. 2.—CURVES SHOWING COST OF CONSTRUCTION UNDER BELGIAN BLOCK, BALTIMORE ELECTRIC SUBWAY.

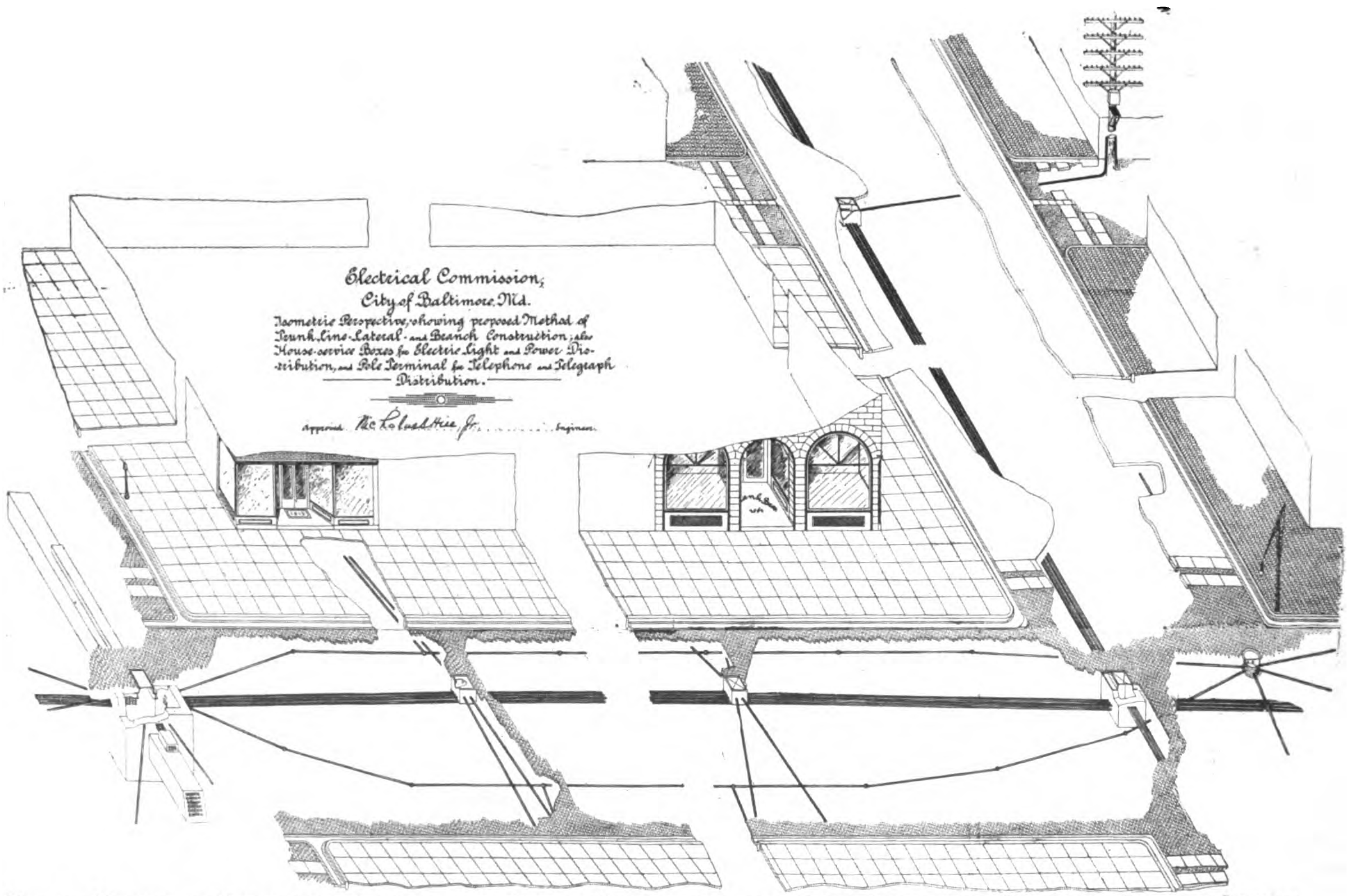

Electrical Commission;
City of Baltimore. Md.
Isometric Perspective, showing proposed Method of
Trunk line-Lateral- and Branch Construction; also
House-service Boxes for Electric Light and Power Dis-
-tribution, and Pole Terminal for Telephone and Telegraph
Distribution.
Approved Mc Lolwell Hie, Jr. Engineer.

FIG. 3.—METHOD OF TRUNK LINE, LATERAL AND BRANCH CONSTRUCTION AND HOUSE CONNECTION, BALTIMORE ELECTRIC SUBWAY.

It having been proposed to run the telegraph and telephone wires in ducts separate from those carrying high tension currents, a plan has been elaborated with that end in view, although Mr. Hill's personal observation leads him to the belief that there is no real reason why all classes of service should not be placed in the same conduits. In substantiation of his position he refers to the report of the Electrical Commission of Washington, D. C., and letters received from various sources by that commission. For the combined system of conduits there is recommended a combination of two and three-inch ducts. If the separate system of ducts is decided upon, all 3-inch ducts are recommended for telegraph, telephone and other low potential circuits, and the combination of two and three-inch ducts for the electric light and other high potential circuits.

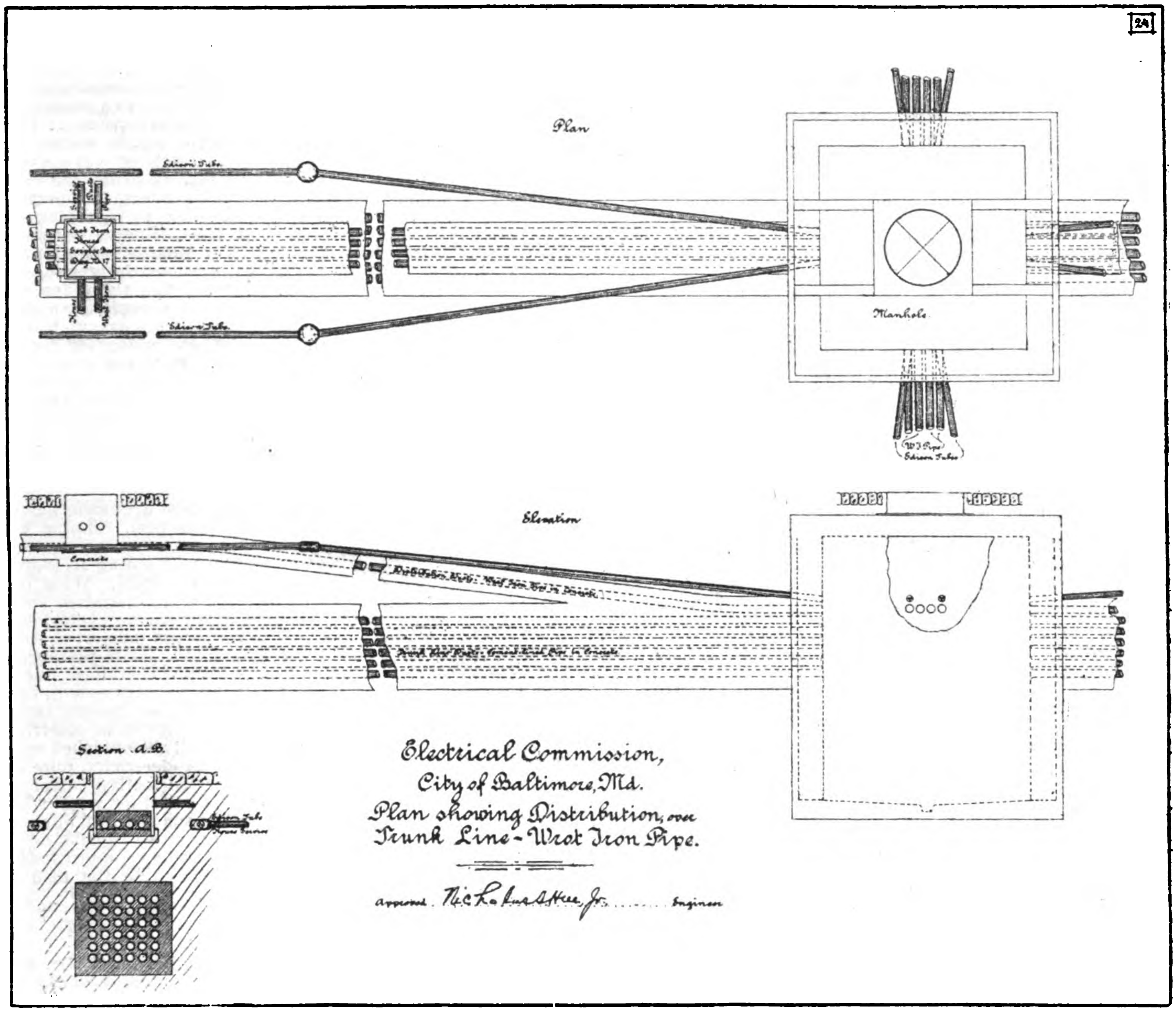

2A
Plan
Edison Tube.
Edison Tube.
Cast Iron House Service Box Dwg. No. 17
Manhole.
W.I. Pipe
Edison Tube
Elevation
Concrete
Section A.B.
Electrical Commission,
City of Baltimore, Md.
Plan showing Distribution, over
Trunk Line - Wrot Iron Pipe.
approved. Nicholas Hill, Jr. ...... Engineer

FIG. 4.—PLAN OF DISTRIBUTION OVER TRUNK LINES, BALTIMORE ELECTRIC SUBWAY.

The house service distribution recommended for the two classes of wires is illustrated in Fig. 3. For telegraph and telephone distribution, it is as follows: Through wrought iron, cement lined tubes, or terra cotta pipe, to pole terminals situate in each block, and from thence overhead to each subscriber. For electric light and other high potential distribution, through wrought iron pipe and house service boxes to consumer, as shown in Figs. 3 and 4.

After discussing various methods of ventilating conduits, Mr. Hill recommends the delivery of fresh air to the manholes by compressed air or blowers operated from a central station, notwithstanding the initial cost which such an installation and its maintenance entails.

The rentals for ducts in the Baltimore conduits are calculated to vary for a separate system, from 15 cents per foot for wrought iron tube construction, to 9¼ cents for the McRoy tile construction, both being 3-inch ducts; the cement lined tube figures at 12¼ cents. For two-inch ducts the rental is calculated at 7 cents for the McCoy and 6¾ cents for the Camp tile.

The rentals to be charged are intended to pay the interest on the amount of stock issued, to refund the sinking fund, so as to redeem the stock at maturity, and to cover the cost of depreciation, superintendence and maintenance. It is proposed to build the subways at least 50 per cent. larger in capacity than the present service requires.

The report contains a number of valuable tables and other statistics relating to underground and overhead wire construction, and altogether is one of the best documents of its kind which has come under our notice.

COMMERCIAL CABLE COMPANY MORTGAGE.

A mortgage has been filed with Register Sohmer for $20,000,000, given to the Farmers' Loan and Trust Company by the Commercial Cable Company, pledging all its telegraph properties, rights, privileges, and franchises, including those of the Postal Telegraph Company. The mortgage is given to secure an issue of 500 4 per cent. gold bonds and debenture stocks, which aggregates the sum of the mortgage.

HARTFORD, CONN.—A joint special committee of the Hartford City Council has reported against the necessity of a municipal plant. The cost would be $400,000, and there would be no saving over the rates of the Hartford Electric Light Co., which for a ten year contract would make even better terms with the city.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - -	per year.	$3.00
Four or more Copies in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, JANUARY 13, 1897. No. 454.

MAKING OR BUYING ELECTRIC CURRENT.

OUR columns have recently contained various articles on the relative economy of current generated in so-called block stations, and that distributed from central stations. Thus far it may be fairly considered that the central station has come off best, and that its predicted "doom" need not scare electric light stockholders into sale of their holdings. It seems that our friends across the sea have had a somewhat similar question put before them, but rather more in the form of a comparison between the cost of isolated plant and central station lighting. Our contemporary, the London "Electrical Review," in a recent number publishes a number of letters from engineers in reply to the query: At what point does it become cheaper to make one's own supply of the current than to buy it? As might have been expected, the majority of opinions amount to saying that it all depends, and that to answer the question intelligently one would have to go into details of every case. One writer appears to take 400 16-candle-power lamps as the point where an isolated plant can be profitably operated, while another puts it at 400 8-candle-power lamps. Neither of these estimates can, of course, be taken as a criterion for the United States, owing to the disparity in the cost of gas for driving the gas engines, or lighting direct. One correspondent of our contemporary touches upon a question which has already on numerous occasions cropped up in experience on this side and that is, the connecting of the isolated plant circuits to the central station mains when the load becomes so light that it no longer pays to run the isolated generating plant. The English engineer doubts whether a central station has the power to refuse the demand for occasional current; from which it would appear that the question has not been brought to an issue there, as it has with us. We believe that enough judicial decisions have established the obligation of the central station to supply current to all who apply for it along the line of the conductors. Even if such were not the case, we believe it is good policy to give connection to all isolated plants. As a rule, current would only be called for during hours of light load at the station and would therefore help to maintain the load curve. But on the other hand the fact of a street connection being available always acts as an incentive to make use of it. Of course, the rates to be charged for current would have to be graded in proportion to the quantity called for, and when this is done we can see no hardship in the arrangement. Besides, an isolated plant with a street connection may make the owner more open to argument as to the greater economy of the central station current than a plant not so connected. This whole question of the central station versus the isolated or block plant is slowly but surely working itself out towards a natural solution. As a matter of fact, humiliating as the confession may be, we have but just begun to generate and distribute current on anything like an economical basis, and there is still plenty of margin for improvement in sight. From what we know and what can reasonably be hoped for, we do not hesitate to say that in large units the electric incandescent light will be furnished cheaper than gas light at no very distant day, under all ordinary conditions of service.

THE LATEST "YOUNG GIANT" IN THE ARTS.

ELECTRICAL engineers have so long and so patiently endured the reference to the "infancy of electricity" by popular writers and speakers, that they have become thoroughly reconciled to their misery. But we are glad to believe that the title to infancy is now to be transferred to another type of motive power, to which it will be applicable with even less propriety than it was to electricity. An indication of this transfer of juvenile honors is observable in an article by Mr. C. W. Shields in the "Engineering Magazine," entitled "The Rise of the Young Giant, Compressed Air." Considering that compressed air was practically applied as a motive power, years and years before electric motive power was thought of, the infant seems to have remained somewhat stunted. However, a glance at Mr. Shield's interesting article shows that compressed air is being employed in a variety of ways, among which may be mentioned the driving of rock drills, the cleaning of car cushions, for pneumatic track sanders, for operating sand paper machines, pneumatic ditching and grading machines and for compressed air locomotives, together with a variety of other works, such as caisson-sinking. One cannot deny that the record here presented is a most interesting and encouraging one, and that a good future lies ahead for compressed air, but we fail to see that this expansion can lie in any other direction than in special applications, while as a motive power, pure and simple, its sphere is sharply circumscribed by the new comer, electricity. Take the case of the compressed air street car. From what one reads and hears on the subject nowadays, one might be led to believe that here was an entirely new departure, something that had never been thought of, let alone tried, before. Yet nothing could be farther from the truth. As a matter of fact compressed air cars have been in actual operation for years past in Europe and we take it that this very fact, made so much of by the advocates of compressed air, constitutes the best argument against them. Surely these European roads have been running long enough to make their cost of operation a known factor, yet in spite of this the extension of electric railroading in Europe bids fair to match our own activity in this field. What does this indicate? Simply that neither in cost of operation nor in ease of handling, can the compressed air car be ranked with the electric. We need not here refer to the danger of transporting vessels on each car carrying 2,000 pounds pressure to the square inch, though an unpleasant experience due to this fact made itself manifest on one of the cars now in operation in New York quite recently. Nor can we assume that it was fashion or a fad that dictated the adoption of electricity with such spontaneity. After weighing all the evidence one is forced to the conclusion that the merits of electricity, pure and simple, have made it in many respects the motive power par excellence, not only for railway but for all other work where power is applied, either directly or transmitted. If our compressed air friends are open to argument we would advise them to concentrate their energies on special applications of which some have already been developed and the field for which is practically a virgin one as yet.

WIRE *vs.* SHAFT.

THE pithy and epigrammatic article with which Dr. S. S. Wheeler favored us last week on the passing of the pulley went right to the heart of a great matter. One does not realize how great are the advances being made in power transmission until one studies Dr. Wheeler's own work and views, or connotes, such data as that furnished us this week in Mr. John McGhie's striking communication. It is evident that whereas a mill or mine owner once looked upon electric power as a kind of last resort to be tried only if the work was abnormally difficult, electricity has now to be taken into consideration first and foremost. The report that coal operators in the Hocking Valley are proposing a wholesale adoption of electric power because strikes have been crippling their productive capacity, and because they can get light, power, traction and ventilation all from one source, is simply another indication of the way the industrial wind is blowing.

Returning to Dr. Wheeler's points in favor of direct driven apparatus, where the power is put directly in the tool or machine, we may say that his terse arguments find remarkable proof in the figures of the recent tests submitted to the American Society of Mechanical Engineers by Prof. C. H. Benjamin, of the Case School of Applied Science, Cleveland, O. He made these tests of shafting in 16 different establishments, comprising rolling mills and stamping mills, bridge works, general machine works and screw shops. In each establishment indicator cards were taken every hour during the day, and their average was taken as showing the total amount of power needed to run the mill or shop. During the noon hour or at night cards were taken from the same engine while it was driving the shafting only, and the average of these cards was taken to represent the power necessary to overcome the friction of the shafting. The percentage of power necessary to run the shafting was the smallest in the case of a shop making steel wood screws, where it was 14.5 per cent. There were 14 men employed here and 117 horse-power was required to run the works. The greatest ratio, 80.7 per cent., was in a bridge shop employing 80 men, and where there was an unusually large amount of shafting for the number of machines used, only 59.2 horse-power, all told, being employed. In a heavy machine shop employing 225 men and requiring 168 horse-power, 54.2 per cent. was used on the shafting, and in another plant about the same size and character, 57 per cent. was needed. Prof. Benjamin's investigations may be summarized by stating that in the sixteen establishments visited there were 15,897 feet of shafting, 1,808 horse-power was employed in running the entire series of works, and 979 horse-power, or 51 per cent. of the whole, was spent in driving the shafts, main belts and counter shafts. These figures are startling and show how wasteful some of the methods must be even in places where ordinary care and average mechanical knowledge are certainly not lacking. Admitting that in the electric system, there are offsetting losses in the conversions of the power, the line resistance, the rheostats, etc., it is obvious that the new method has advantages. Indeed it is hard to believe that today any new mill or factory will equip without having investigated the use of electricity, or that, with rare exceptions, it will not be found best to put in a combination lighting and power plant, with the alternative or adjunct of connection to the lighting mains of the locality.

BETTER ELECTRICAL PROSPECTS.

THERE can be no question as to the fact that there is a general improvement in electrical trade. Wherever one looks throughout the country, new work is in hand, or about to begin, on lighting plants, electric roads, telegraph offices, telephone exchanges, power equipments, and the various other branches of the industry. In the bulk and aggregate, this work far exceeds that of any recent year, and has already stimulated production. At the same time, while prices remain low, and will probably never attain old levels again, better rates are being secured, and a closer agreement among the manufacturers tends to keep them up. There is not a great deal of débris now lying around to tempt the consumer because it is cheap, and to harass and check the efforts of those introducing new and improved apparatus.

The stock market is still limp and apathetic, not knowing exactly what is the matter with itself, "letting, I dare not wait upon I would." In electrical securities, not a great deal was done last week. G. E. was sold to the tune of 18,581 shares at from 34⅝ down to 32¾, closing at 33½. Of W. U., 6,958 shares were sold, down to 82¾ and closing at 84⅛. Erie Telephone and Telegraph sold at 64½, American Cable at 90¼, Edison New York Electric Illuminating Company at 103¾. The bond market was slow and dull, and sales so small as not to be worth mentioning—little lots of 10 and 20. On the Boston market, American Bell Telephone reached 210. In Philadelphia, Electric Storage Company reached 28⅜.

ELECTRIC TRACTION IN EUROPE.

MR. E. H. JOHNSON has recently returned from Europe, and having spent some six months in wide travel, his shrewd observations are, as usual, full of interest and importance. It is well understood also that he has done some good work for the introduction of new American electrical apparatus, thus supplementing the pioneer work of earlier years with other important innovations and novelties. His comments on the electric railway situation are very interesting, and tend to confirm the current idea that England is going into an electric railway regime, largely on American lines. But with some noteworthy differences. Mr. Johnson expects to see the trolley limited to the outer circles of large cities. In the denser areas, he looks for a large adoption of the conduit system, not of the open type, but particularly of the closed conduit sectional type, in which field his efforts are well known to have been concentrated for some time past. In England, for example, conduits must be shallow, pipes must not be diverted or disturbed as here, and the public knows that the day of the cable conduit has gone by. Therefore, in turning to electricity, it would prefer a closed conduit as being the shallowest of all in its disturbance of the street, and as not being an open sewer. As to automobile cars of the air and gas types, Mr. Johnson finds them "exploded" in more senses than one. Both the open electric conduit and the storage battery cars are also, to his way of thinking, falling rapidly out of favor in Europe. This summing up of the situation at a moment of new departure by a close and highly competent observer is unusually worthy of note.

PATENT PROTECTION.

SOME of our American patent companies carry their patents on the property account for a good many million dollars. The Allgemeine Electricitaets Gesellschaft, of Germany, which probably stands second to none in respect of variety of work, holds its patents to be worth one mark. When one figures how much these patents cost to defend, making them a source of outgo rather than of income, the lower valuation seems reasonable. The Tesla phase patents have just been revoked in Germany, as we announced last week, on some technical ground. They are of great, undoubted value, but thus figure as a cost and loss. Speaking of rotary engines, the "American Machinist" says that 1,370 patents on them have been taken out in this country, and that most engineers would value the lot at about 10 cents. Granting, as we all must, the desirability of patent protection, it would seem that the protection lies less in the patent than in the intrinsic merit of the apparatus made under it.

OUR NEW YEAR NUMBER.

IT is literally impossible to reply individually to all the congratulations upon our New Year Number—its size, style, contents and other features. We are glad to have done so well. We feel we could have done much better, and that if we did not, the fault is all our own. A few contributions were belated. Up to the present time, advertisements have not ceased to come in, and but for our determination to have the paper out in its regular week of issue, it might perhaps have been 264 pages instead of 132. Our regular day of publication is Wednesday, and this issue was distributed Friday. A snowball once it gets rolling has the property of rapid growth, and our New Year snowball got rolling at such a pace, it soon flattened out all our ordinary facilities, and threatened to become a devastating avalanche. However, we survive for further effort, and it looks as though we still had our friends with us. It is not an easy task to print over 15,000 copies of a paper of 132 pages, but we trust all our obligations to readers and advertisers have been discharged by this time and that we are in line for duties and favors to come.

THE South has been a storm center of "independent telephone" fighting and some of the newcomers have stirred things up considerably. But the old occupants of the territory are in nowise dismayed. In fact, they report large accretions of business, and have gone in for new exchanges. The latest is that going up in Savannah and illustrated in this issue of the Engineer. It will embody all that is latest, costliest and best in modern telephonic work.

THE shutting down of central stations by accident or fire becomes rarer and rarer, and the recent destruction of the plant of the Newark, N. J., Electric Light and Power Company is therefore a mysterious affair, as there seems to be nothing but incendiarism to explain it. We are glad to note that large rewards have been offered, but what pleases us most is the celerity which President P. N. Jackson displayed in renewing the plant. We made note last week of the rushing through of some apparatus from Cleveland, and like dispatch was shown in regard to machinery from Pittsfield, Mass. Moreover, all available plants in the vicinity were looped in or switched on, and for some days past the station has been running as though the disaster had never happened. If such interruptions must come, it is encouraging to see them met with so much promptness and energy.

DR. D'ASONVAL writes to the New York "World" that he is a "great admirer of the bold work of the American electricians," and that he wants them to attack as their next problem for solution the cure of tuberculosis. He believes it to be well within possibility, and says truly that it is far more worthy of the effort of great philanthropists than electrocution. All will agree with him. Electrocution is a base method of employing a noble agent. To cure tuberculosis might well occupy the lifetime of the greatest electrical discoverer. There have been hints of a near approach to the goal named.

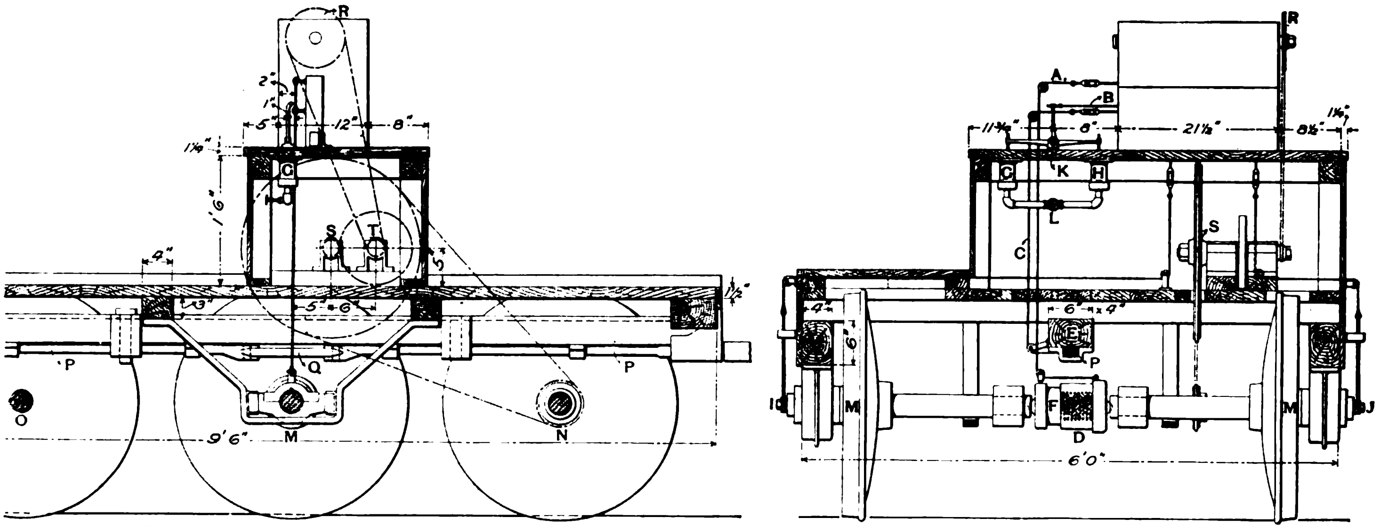
A well informed mechanical engineer of high standing, remarked in conversation the other day, that the sharp competition in the late hard times had in many instances lowered the quality of the raw material so that analysis had been more than ever necessary, and if not resorted to rigorously had led to many subsequent failures of apparatus. Perhaps this is true to some extent in some electrical lines. Mere cheapness does not promote high quality, and it is to be hoped that all lines may now move back quickly to the point at which a decent profit can be made without the straining of recent years.

ELECTRIC TRANSPORTATION

THE BOWEN DYNAGRAPH CAR.

IN his paper on "Track and Track Joints"[1], read at the meeting of the American Street Railway Association last October Mr. M. K. Bowen, superintendent of the Chicago City Railroad, described a dynagraph car whose indications show graphically the condition of the track and which gives an accurate index of the amount of money which can profitably be spent upon it.

The car weighs 3,865 lbs., and when the records are being made it is fastened to any ordinary car which is drawn over the track at a uniform speed. It has a platform 8 ft.x 10 ft., mounted on a single truck. The dynagraph automatically records the conditions of the track, and Mr. Bowen's original idea was to make the records show the excess of power which is required to draw the car, because of the faults, in dollars and cents per ton of load when capitalized. This result multiplied by the ton miles on any road tested would show accurately the amount which should be expended on track reconstruction and put a stop to expensive guessing. In regard to the above plan, Mr. Bowen writes, as follows:



FIGS. 1 AND 2.—THE BOWEN DYNAGRAPH FOR STREET RAILROADS.—LONGITUDINAL AND TRANSVERSE SECTIONS.

"It was our original idea to rule off paper which would express in dollars and cents this dynamometer pull for a ton mile, but experience has demonstrated that it is unnecessary, as any intelligent man using the instrument for a short time is able to make a deduction from the dynamometer pull, express it in dollars and cents per ton mile, which multiplied by the ton miles on that particular road for one year will give you, capitalized, the amount that you could, with judgment, spend upon the repairs to tracks."

"Anyone using the car for a short time, making a few calculations from the profiles, reducing the excess horse-power for poor joints, etc., from the dynamometer pull to the cost in dollars and cents for this excess pull, will be enabled in a short time to tell by simply looking at the dynamometer pull the cost per ton-mile of excess horse-power expressed in dollars and cents.

The records show high and low rails, low joints, gauge, drawbar pull and variations of track level. The records are plotted on a paper 18 inches wide, which unwinds from the drum R, Figs. 1 and 2, at the uniform speed of 1 foot for every 1,000 feet of track.

The dynamometer consists of two drawbars, P, Fig. 1, one at each end of the car and extending beneath the platform to a distance of about 1 foot, from each other. Between the two adjacent ends a spring is placed, and a movement of this spring changes the relative length of the wire C and moves the recording arm, which makes a trace on the drum R. The apparatus for showing the difference in level of the rails is mounted on the platform and consists of two cups of mercury, G and H, Fig. 2, into which dip two plungers connected to a recording arm by means of the wire B.

The records showing the high and low joints, or other variations in surface, and the changes in gauge are accomplished by means of the midway wheels M, which rise and fall as the surface of the track varies, and also move apart and approach each other as the alignment changes. The journals allow a free vertical and longitudinal movement of the midway axles. The car rests directly on the other axle bearings, N and O, Fig. 1, so that the vertical movements of the midway wheels give an accurate measure of the low places. As the forward wheel passes over a low joint it drops down into it, and this causes a relative rise in the midway wheels, which is recorded on the paper in one direction from the normal line; and then the rear wheel drops into the low joint, which is recorded in the same manner as when the front wheel passed the low joint. The passing of the three wheels over a low joint causes the glass pen to make two short deflections in one direction and a much longer deflection between the other two and in the opposite direction. Only the middle deflection is used in determining how low the joint is.

The manner in which the differences of the gauge is recorded by means of the longitudinal movement of the wheel on the midway axle will be seen by referring to Fig. 2. In the middle of the axle is a cylinder D, containing a spring which is compressed or extended as the gage increases or diminishes. Any change in the relative position of F and D will move the wire A which is attached to the recording arm, which marks the gauge.—The "Railroad Gazette."

THE NEW FORM OF ELECTRIC RAILWAY CONDUITS FOR NEW YORK.

AS already announced by us, the Metropolitan Railway Co. has decided to adopt electricity as its motive power on the Fourth, Sixth, Eighth and Madison avenue lines, and has already ordered 300 car equipments.

The details of the underground system have been practically all worked out and we present in the accompanying engraving a sectional view of the conduit which will be installed. As will be noted, the entire depth of the yoke is only 2 feet 6¾ inches so that but a very shallow excavation will be required in marked contrast to the depth demanded by the cable conduit. The yokes will be spaced 5 feet on centers, and the hand holes where the insulators are attached, at 15 feet.

The conducting rails have been the subject of much thought and as a result a special section has been adopted, as shown, being a modified T-section with the edges lapped over, as it were, so as to give additional stiffness, to resist the pressure of the plow contacts. The conducting rails are held in position by fork brackets, which are held firmly by the insulators of porcelain.

In place of the 7-inch rail heretofore employed on the New York cable roads, rails 9 inches high will be used, weighing 106 lbs. to the yard. These are held in position by tie-bars as usual. The 7-inch slot rail is retained. A bed of paving concrete 6 inches thick forms the sides of the conduits and connects the two.

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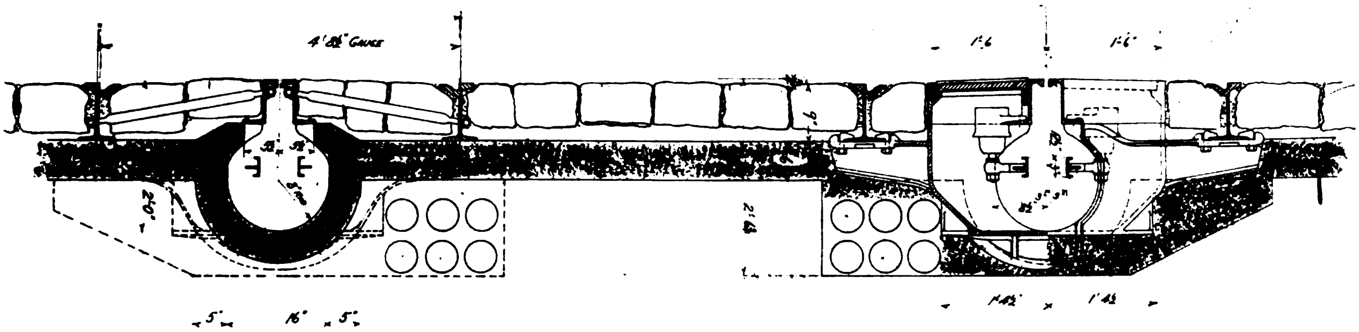
[1] The Electrical Engineer, Oct. 28, 1896.

Our engraving shows a view of the double conduit, the left hand section being taken midway between the hand holes and the right hand at the hand hole.

Work on the underground construction will be begun as soon as the frost is out of the ground. Two electric power plants will be installed, one in the present cable power house at Twenty-fifth street and Lexington avenue, which will contain four 800-kilowatt generators. This station will supply current below Fifty-ninth street. The other station will be built close to the present electric power house now supplying current to the Lenox avenue electric road, at Lenox avenue and One Hundred and Forty-sixth street. This section will supply the lines above Fifty-ninth street. To provide for the feeders, ducts will be laid on the inner side of the conduit, as shown, and in these conductors ranging from 300,000 to 1,000,000 circular mils will be drawn.



Section of Conduit Adopted for the New Electric Roads of the Metropolitan Railway Co., New York.

THE LOVE CONDUIT RAILWAY SYSTEM.

BY M. D. LAW.

It is a well-known fact that electricians in general deny that underground trolleys can be successful, but after nearly four years of practical success with the Love conduit system, I can unhesitatingly say, that it has been an unqualified success, and that all the claims of the Love company can be fulfilled, namely:

First—That it can be kept in operation 365 days in the year.

Second—It is absolutely impossible for any one to be injured by the electric current.

Third—It requires no skilled labor to operate.

Fourth—Cost of maintenance as low as any known power.

Fifth—Does not increase the cost of insurance along the line of the road.

To fulfill the first of these claims, requires a first-class roadbed, and that the electrical equipment be of the very best, thoroughly protected from mechanical injury and easy to repair .

It has been kept constantly before me, that all roads are subject to breakdowns, so the idea has been to reduce these accidents to a minimum, and when they do occur, to be able to repair them without delay to the cars; this has been carried in the Love system to a state of perfection that is surprising.

The shape of the yoke is such that it protects the insulator from all moisture and allows of quick access, to admit of inspection or repairs. The slot rail is of such shape that it thoroughly protects the conductor from all sleet, mud or any conducting material reaching it from the slot. It also protects the conductor from any damage by the trolley from a derailment of the car, so that the line is at all times in a condition for operation. All insulators are so placed that they can be easily reached from the surface, quickly removed and a new one substituted.

The conductor is of copper, made up of short sections, each section having a peculiar expansion joint; this joint has a greater conductivity than the rest of the conductor, and the conditions are such that it is at all times bright, and free from corrosion. Should it become necessary to change any one of these sections, it can be done in four minutes.

The conductor is so arranged that should a ground occur, it can be traced to its exact location and removed in a few minutes, and from the fact that a metallic circuit is used, a ground on one side of the line will cause no trouble in the operation of the cars.

The conductor being supported within a few inches of the surface, with an underbearing trolley, gives successful running, even though the conduit may be full of snow. The trolley has been perfected to such a point that it is extremely simple, and will run 20,000 miles without repair, other than wheels and bushings, and I find that the regular trolley wheels will make more than double the miles of run that they will on the overhead wire.

The second claim is covered by the fact that the conductor is so placed under the protecting slot rail that it is impossible for it to be reached from the surface.

For the third claim, its construction and operation is so simple, that any ordinary trackman can be very soon instructed, how to locate and remove all trouble.

As regards the fourth claim, it is a well-known fact that a street railroad can be operated cheaper by electric than any other known power, and the Love system is nothing more than the overhead trolley, placed beneath the surface, with a metallic circuit. There is no appreciable loss of current in insulation, bad bonding, or loss between wheel and rail, from sand, mud or snow on the rail. There being no current in the rail there is no electrolysis on the surrounding gas or water pipes.

The cost of line maintenance is reduced to a minimum, and has been proved to be much lower than overhead construction.

It does not increase the insurance along the line of the road from the fact that there are no grounded circuits and that there are no wires above the surface of the street.

REPORT OF NEW YORK STATE RAILWAY COMMISSION.

Among other things, the New York State Railway Commission speak in their last report of the dangerous overcrowding of street cars, especially on Sundays and on holiday occasions. Such overcrowding, the report says, can only be prevented by a rigid legislative enactment providing a severe penalty for permitting a greater number of passengers to ride than can be conveniently seated and stand in the aisles. The Commissioners say of the evil of jumping on and off moving trolley or cable cars: "The evil which this recommendation seeks to correct is particularly noticeable in New York City, where dexterous efforts on the part of passengers—the result, no doubt, of constant training in the athletic but dangerous exercise of getting on and off moving cars—alone prevent a large increase in the number of accidents. There is no reason why as courteous treatment should not be accorded the public by street surface railroad employés as is exacted upon the steam surface lines, or why careless and dangerous methods of operation, which would be regarded with horror if practiced upon the latter, should be tolerated upon the former."

The recommendation that a law be passed requiring all street surface cars to be heated is renewed. There is no longer any excuse for electric cars not being heated.

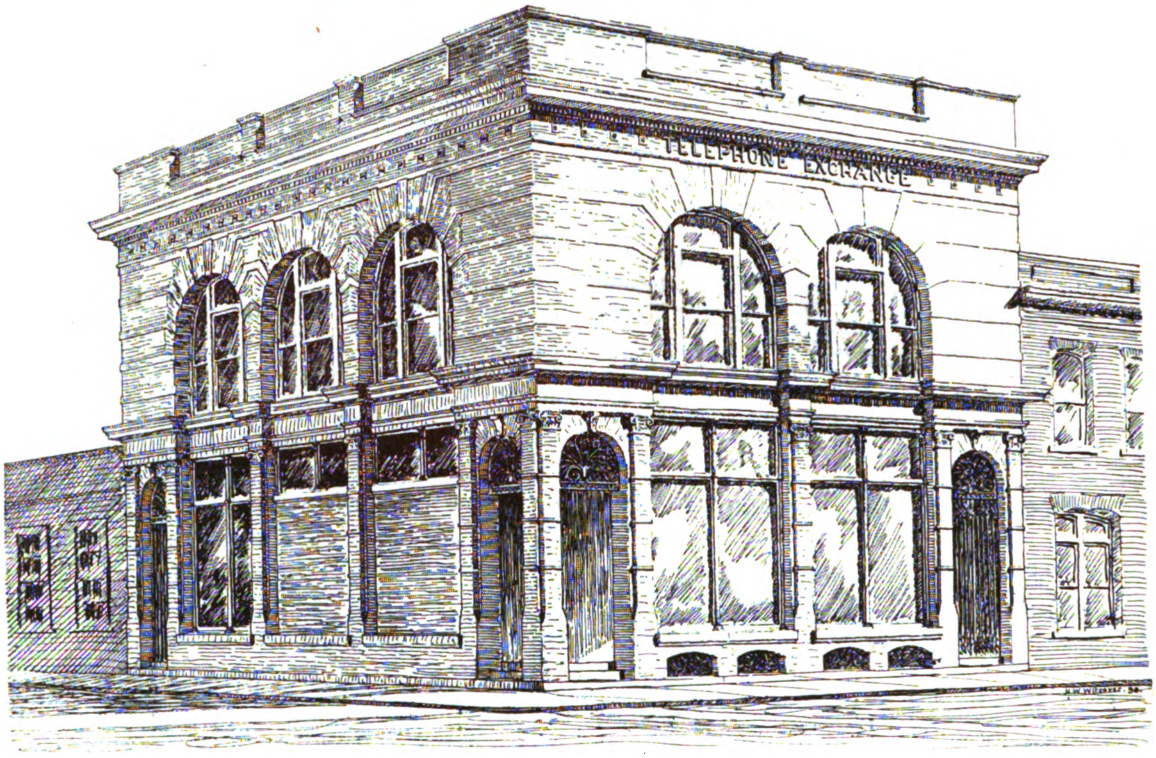
FOUR-CENT FARES IN MILWAUKEE.

A Milwaukee special says: "William Nelson Cromwell, who has been here this week on account of the 4-cent fare litigation, caused a good deal of surprise by his statement that Milwaukee Electric had not been earning running expenses during the past eleven months. Mr. Cromwell assured the court that the New York investors had provided Milwaukee with the finest trolley system in America, and that they had never received a cent in dividends. He added that to enforce the four-cent fare ordinance would mean bankruptcy. The company lost a good deal of money by reason of the strike of last summer, but the general impression has been that it was earning expenses, an impression which was strengthened when Milwaukee Electric recently bought out the power and lighting business of Pabst, the brewer. It is believed that the connection formed with the new interurban line, which is ultimately to extend to Chicago, will be a good thing for Milwaukee Electric, especially in summer. The line is now in regular operation between Milwaukee and Racine."

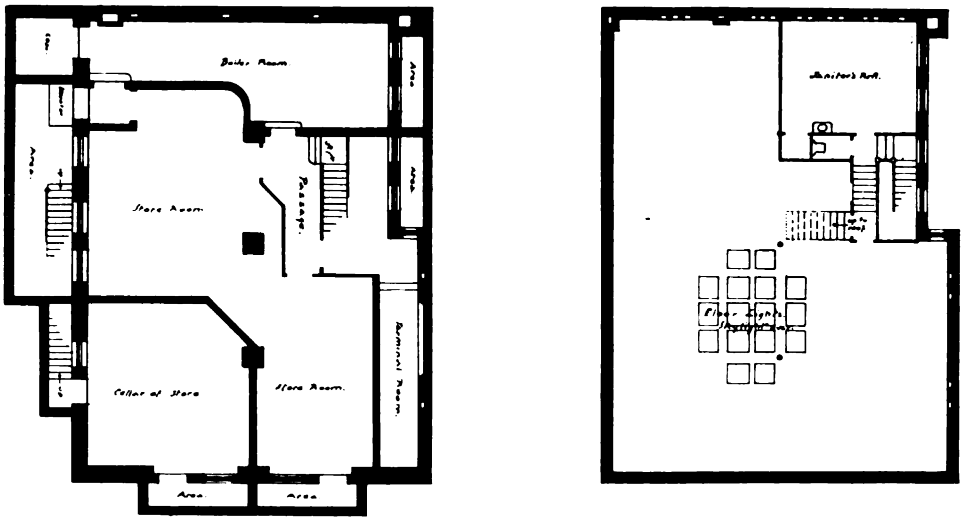
TELEPHONY AND TELEGRAPHY

NEW SOUTHERN BELL TELEPHONE EXCHANGE AT SAVANNAH, GA.

THE South has for some time past been the scene of considerable activity in the telephone field. The work there implies many conditions of difficulty and involves many problems not dealt with elsewhere; offset by the general advantage that the mildness of the climate favors the steady maintenance of regular service. The distances are very great, the centers of population are not large, the easy-going nature of many of the people does not encourage swift communication, and the public is not inclined to pay the high rates which make luxurious refinements in the system possible. Under these conditions, however, the Southern Bell Telephone Company has been persistently developing its exchanges on a modern basis of technical perfection while the growth of the long distance lines in the great Southern States has been remarkable. In those cities where commerce and trade are active, the company has not been slow to enlarge its facilities, and it has now several new and extensive exchanges on its list, comparing favorably with those anywhere else in the country. One of the latest to be designed is that for the bustling, progressive city of Savannah, Ga., which with a population of over 60,000 does a business worthy an even larger community. The building design was made by Mr. A. S. Eichberg, a well-known Southern architect, and consists, as will be noted, of two main floors, with a basement floor and an attic floor. The building is constructed of the handsome, bright tinted "telephone



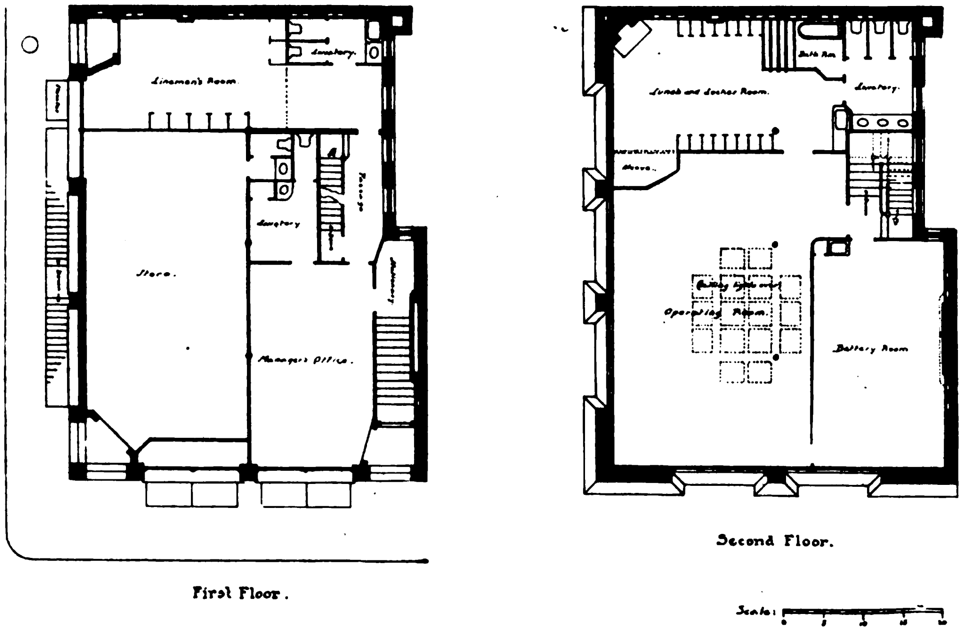
THE NEW SAVANNAH, GA., TELEPHONE EXCHANGE OF THE SOUTHERN BELL TELEPHONE AND TELEGRAPH COMPANY.
(*A. S. Eichberg, Architect.*)



Basement. Attic.

THE NEW SAVANNAH TELEPHONE EXCHANGE BUILDING.

brick," made by the Perth Amboy Terra Cotta Company, a material that has given quite a distinctive and characteristic aspect to several of the finest telephone exchanges in the country and whose beauty no amount of general use and no lapse of time appears to mar in any way. The outside dimensions of the building are 45 feet by 60 feet. On the ground floor a large store has been laid out, which in the long run the company will doubtless need for its own operations. Under it is the basement which extends also under part of the sidewalk. Above it is the main telephone floor devoted to the general uses of the exchange. The operating and battery department, with the area for the cross connection board, occupies a roomy space 40 feet square; and on the same floor are the lunch and dressing rooms, 16 feet by 40.

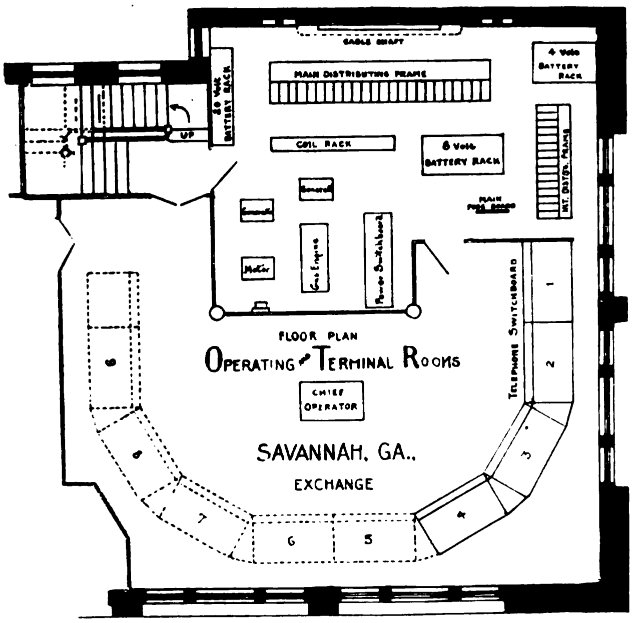


First Floor.

Second Floor.

The New Savannah Telephone Exchange Building.

The plans shown herewith indicate the location of the various rooms. The manager's office is 16 feet by 40 and the linemen's room 14 feet by 40, so that there is not the least cramping in any respect. The cable duct will be noted at the side of the building, a space 8 feet long and 1 foot wide. It connects in the basement with the underground system laid for the company by the National Conduit Manufacturing Company using their cement lined pipes.



Operating and Terminal Rooms, Savannah Telephone Exchange.

The switchboard now being built by the Western Electric Company, will provide for no fewer than 2,000 subscribers, thus taking care of the natural expansion of the company's patronage for some time to come. It will be on the metallic system plan, and will be operated on the now familiar method of visual indication by means of incandescent lamps. It includes all the latest devices of the Western Electric Co. for facilitating the dispatch of business so necessary in a city like Savannah and at periods like the busy cotton shipping season. The arrangements for the operators also comprise everything that could be thought of to increase their comfort; and the whole building, far South as it is, is heated by steam.

The exchange will be self contained as to its generative capacity, current being furnished by means of the equipment shown in the plan of the operating room, a gas engine furnishing power, with electric motor as an adjunct or auxiliary, no chance of breakdown being taken.

Mr. R. H. Polk, the manager of the exchange is an active and successful young telephone man, who began his career very early, and who since his work in Richmond nearly 20 years ago has invented and devised many telephone improvements. He not only has the interests of the exchange to look after, but finds much to occupy his attention in the rapidly extending long distance service which now gives Savannah direct connection with Atlanta and with the whole North.

THE TELEPHONE IN OUR HOMES.

BY W. H. ECKERT.

The editorial entitled "The Telephone in Our Homes," which appears in The Electrical Engineer of Dec. 30, recalls to mind that that which is now cited as a novelty, namely, the transmission of music over the wires to subscribers, was accomplished years ago by the Bell Telephone Companies.

The City & Suburban Telegraph Association (Bell Telephone Exchange), of Cincinnati, O., of which the writer was general manager, placed Blake transmitters in all the principal theatres and concert halls of that city in 1879. Subscribers had music "on tap" at all matinee performances and every evening, and frequently as many as four hundred subscribers were connected on to the music lines. Many of the subscribers, desiring to entertain their friends, applied to the company for additional receivers and often twenty-five or thirty receivers were furnished so that the subscriber and his friends could enjoy the performances.

I call to mind the stand taken by the manager of the Grand Opera House. A subscriber to the telephone system told the manager that he did not intend to go to the theatre because he could sit at his home, hear the orchestra, the songs and even the steps taken by the performers when dancing. A few cases of this kind and the manager ordered the transmitters removed from the theatre. The same may be said to have applied to the concert halls. Then, besides, the American people use the telephone as a business device and the giving of music interfered with the service considerably. It also lost its novelty, and, except in isolated cases, it has been abandoned.

In June, 1880, at the convention of the National Democratic Party, held at Cincinnati, the writer arranged with the chairman for two Blake transmitters to be placed on either side of his desk. Before the convention, score cards, showing the vote of each State, etc., were sent to every subscriber. Each subscriber was given connection, if desired, with the instruments at the convention hall, and during the three days of the session, more than one-half of the subscribers to the system were connected with those wires. People in all parts of the city heard the speeches of the chairman, roll-call and other matters relating to the business of the convention. It may be said that the affair was highly successful, and this, it will be seen, occurred over sixteen years ago.

The transmission of music, speeches, sermons, etc., has been accomplished by the licensees of the American Bell Telephone Company many times since, both for short and long distances.

At Cincinnati, the fire department and police headquarters were operated in connection with the general telephone system, each department having an exchange of its own. The operators kept records of all news items relating to each department for the benefit of the newspapers of the city. Then, besides, each subscriber to the general system could apply to either of the departments for any information relating to fires, arrests, disturbances, etc., at any time during the day or night. Fire alarms were sent in by telephone; officers were sent for in like manner.

The above, in a small way, accomplished nearly the same results as those secured at Buda Pest—it was simply a reversal of the plan followed at that place; instead of having the news sent to the subscriber, the subscriber applied for it. While the telephone may not be exploited to its greatest extent, I do not think that anything has been done in Europe that has not been done here.

THE TELEPHONE BUSINESS IN SYRACUSE, N. Y.

There has been a large increase in the use of the telephone in Syracuse during the last year, the average number of calls having increased from 15,022 to 16,022 a day. At the Syracuse exchange of the Central New York Telephone and Telegraph Company there are employed at the present time fifty-seven persons. Thirty-two of these are day operators, one is a night operator and one is the bookkeeper. The other employés are linemen and messengers. The company has, including wire in cables, 1,741 miles of exchange wire, of which 1,580 miles is strung on 50 miles of poles and 161 miles on buildings. There are 38 aerial cables 28,015 feet in length and made up of 2,045,740 feet of single wire. There are in use 1,621 telephones, of which 1,189 are in business places. During the year the number of telephones in use has been increased by 109. Following is a summary of the business of the year:

Local calls	5,848,000
Daily average of local calls	16.022
Toll messages sent	22,600
Toll messages received	32,000

ENGLAND'S NEW PACIFIC CABLE.

A dispatch from London of Jan. 5, says: It is stated here today that the Pacific Cable Conference has about completed its labors, nothing now remaining to be done except to sign its report, which will be done at a meeting of the conference that will be held a fortnight hence.

It is stated on good authority that the report will show practical unanimity among the delegates in recommending the construction of a cable, the testimony adduced having shown that the scheme is entirely feasible, and that, commercially and politically considered, it is necessary to Great Britain, Australasia and Canada. Some difference of opinion existed as to the relative share of the expense of construction to be borne by the mother country and the colonies, but the matter was adjusted by the delegates agreeing to recommend that, instead of carrying out the original proposition regarding the expense, Great Britain should pay a less sum than was first allotted as her share, the colonies making up the difference.

Drafts of the report, signed by the Canadian and Australian delegates, will soon be sent to their respective governments for their approval.

NEW YORK AND NEW JERSEY TELEPHONE COMPANY has declared its regular dividend of 1½ per cent. and 1 per cent. extra payable Jan. 15.

SOCIETY & CLUB NOTES

ELECTRICAL SOUND MONEY CLUB.

At a special meeting of the officers and committee of the Electrical Sound Money Club, held at the offices of the treasurer, Capt. W. L. Candee, 253 Broadway, New York City, on Friday, Jan. 8, it was voted that in view of the fact that the objects for which the club was formed had been successfully accomplished, the club be dissolved. It was also voted that the treasurer be appointed a committee of one to dispose of to some charitable object the small balance of cash on hand. Those present at the meeting were: Dr. S. S. Wheeler, of the Crocker-Wheeler Electric Company, chairman; Capt. W. L. Candee, of the Okonite Company, treasurer; vice-presidents, J. E. Ham, of W. R. Brixey, and Charles Blizard, of the Electric Storage Battery Company; General C. H. Barney, of the New York Telephone Company, chief marshal; A. C. Shaw, of The Electrical Engineer, and Stephen L. Coles, of the "Electrical Review," secretary.

Resolutions of thanks were passed for favors extended by various corporations and a special vote of thanks was tendered to General Barney for the excellent work he did in organizing and commanding the 1,832 men turned out in the business men's parade by the Electrical Sound Money Club.

NEW YORK ELECTRICAL SOCIETY.

The next meeting of the society will be held at Columbia College, on Thursday, Jan. 4, at 8 P. M. Mr. E. Leavenworth Elliott will give a paper on "Light, Its Distribution and Diffusion as Related to Quality and Efficiency." Mr. Elliott's paper is directed to the discussion of the means for making the light-giving element most effective. It will be illustrated with diagrams and apparatus bearing directly on the question.

LETTERS TO THE EDITOR

ENGLISH CAPTIOUS CRITICISM.

The following admirable letter from Prof. John Trowbridge appears in the London "Electrician" for December 25:

Sir: There is a tendency among critics to condemn a book for not comprising what it was not intended to contain. Such critics have a preconceived notion of what a writer should have included in his treatise; they glance through the pages in a superficial manner for what they think should be there, and not finding such topics expressed to their mind immediately condemn the treatise.

This pernicious habit of critics is well illustrated by recent criticisms[1] of Prof. Bedell's book[2] on the theory of the transformer. A writer in "Nature" sees nothing good in the treatise because it does not enter fully upon the practical details of transformers with iron cores. To do this Prof. Bedell would have been compelled to greatly increase the size and scope of his book. It was plainly his object to outline, so to speak, the scaffolding of the edifice, and to give in a clear manner the fundamental equations upon which the discussions of transformers rest, and to illustrate the use of graphical methods in such discussions.

Before the appearance of Prof. Bedell's treatise the student was compelled to rely upon books which were illogical collections of articles originally published in electrical journals and hastily thrown together in a book form. A just critic should recognize the endeavor of Prof. Bedell to bring order out of chaos in presenting the fundamental equations used in discussions of alternating currents in such a clear and instructive manner.

JOHN TROWBRIDGE.

Harvard University, Cambridge, Mass.

(We regret to note the increasing tendency of captious criticisms of American books by English reviewers, and the magnification of small faults to undue proportions. We will not undertake to seek a cause for this manifestation, but merely ask for American authors, whether of books or of articles, fair play with strict justice.—Eds. E. E.)

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[1] Nature, p. 545, October 8, 1896; The Electrician, p. 637, September 11, 1896.

[2] "The Principles of the Transformer," by Frederick Bedell, 1896.

THE CHICAGO SCHOOL OF ELECTRICITY.

WE notice in your issue of December 30, a letter from Professor Frederick A. C. Perrine, in which he claims that we are using his name in our advertisements, and that such use is not authorized by him. He states, "I have no connection with the Chicago School of Electricity." Will you kindly state in your valuable journal that we have not used and are not using his name in our advertisements, and that we do not purpose to advertise, as Dr. Perrine has no connection with the Chicago School of Electricity whatsoever.

The Lesson Leaves, which were prepared for the National School of Electricity, have come into our control by purchase, and we have published them in book form, giving in the descriptive circular the names of the authors, and stating "published by the Chicago School of Electricity." Dr. Perrine admits in his letter to you that he did assist in preparing the lessons—the only thing we have stated in our advertisements.

No one who was financially interested in the "National School of Electricity" is in any way connected with the Chicago School of Electricity.

There can be no question of bad faith upon the part of the officials of the National School of Electricity, as we, knowing how the lessons were prepared, did not consult them before issuing the Bound Lesson circular. We sent a copy of this circular to Dr. Perrine, but have not heard from him in reply.

We enclose a copy of every circular issued by the Chicago School of Electricity.

Our course consists entirely of laboratory practice. Our instructors are thoroughly competent men. We have plenty of apparatus, of every description necessary, for the purpose of giving our students a competent electrical education, and as they are being promoted in their regular occupations it is sufficient proof that we are giving entire satisfaction to every one of them.

We can refer to every electrical enterprise in this city. We stand entirely upon our own reputation for doing good work, and do not advertise anything that is not strictly correct.

CHICAGO SCHOOL OF ELECTRICITY.
R. A. Bagnell, Manager.

Chicago, January 6, 1897.

MARRIED

MR. HOMER A. WADDELL, general superintendent of the Frick Coal and Coke Company's extensive telephone and telegraph service, at Scottdale, Pa., and Miss May Gertrude Thompson, daughter of J. Wilse Thompson, of Indiana, Pa., were married New Year's eve at the home of the bride.

MR. CLARENCE GAMER, general superintendent of the St. Charles Telephone Company, of St. Charles, Mo., was married to Miss Virginia Miller on Dec. 30, at the home of her parents, Jonesburg, Mo.

OBITUARY

A. LE ROY PAGE.

The death occurred on Jan. 2 at New Haven, Conn., from heart failure, of Mr. A. LeR. Page, manager for the Postal Telegraph Company in that city. Mr. Page was born in New Haven on the 16th of January, 44 years ago. With the exception of a stay of two years in New Rochelle, where he was manager for the telegraph company, he had never spent any considerable time away from his native city. He had been manager of the Postal Telegraph Company ever since it started a branch in New Haven. Previous to that he was operator for the Western Union Company, at the depot, and was at one time manager of the old Rapid Telegraph Company.

He was an active, energetic man, genial, and with qualities that made him many friends. There were few men in the profession in New England who were better known or more popular.

DEATH OF C. E. BALL.—The death was announced in New York City, on Jan. 3, of Charles E. Ball, of appendicitis, after a brief illness, at the age of fifty-one. He was a man with a wide reputation as an electrical inventor. At the outset of his electrical career he had much to contend with, especially in the introduction of his Ball "unipolar" arc lighting system, but he persevered, and after surmounting many obstacles he succeeded in establishing for himself an enviable position in the electrical fraternity.

PERSONAL

MR. C. B. WHITE, formerly with the Central Electric Co., Chicago, is now associated with the Walker Manufacturing Co., and is located at their Chicago office, in the Marquette building, in that city.

MR. FRANK BILLINGS, who is prominent in Cleveland manufacturing circles, as president of the Walker Company and as vice-president and treasurer of Billings, Taylor & Co., has also taken charge of the iron ore and pig iron business of Tod, Stambaugh & Co. Mr. Billings represents the interests of the estate of John Tod, late head of the firm.

A. M. ROBERTSON, general manager of the Minneapolis General Electric Company, was remembered New Year's day by the employés of the company, who presented him with a hunting case gold watch. S. P. Wright, chief engineer, made the presentation speech, and Mr. Robertson responded briefly.

MR. FRANK A. MAGEE, late with the E. S. Greeley & Co., has joined the forces of the Revere Rubber Co. Mr. Magee will no doubt find his large acquaintance and popularity among electric and railway men of great advantage to him in his new labors.

EDUCATIONAL

TWENTY-FIFTH ANNIVERSARY OF THE STEVENS INSTITUTE OF TECHNOLOGY.

A NOTEWORTHY event in the annals of technical education in the United States will be the forthcoming celebration of the 25th anniversary of the Stevens Institute of Technology, on the 18th and 19th of February next.

The festivities will consist of a banquet, at the Hotel Waldorf, New York, to which representative engineers and technical educators throughout the country will be invited. On the following day the Institute will be open for inspection, and the methods of instruction, together with the apparatus in the various laboratories, will be explained.

Not the least interesting feature of the exhibition will be the collection illustrating the work of the Alumni, and consisting of machinery, apparatus, drawings, etc., representing the product of their activity during the 25 years.

The festivities also include a reception, tendered to the faculty, graduates and undergraduates, by Mrs. E. A. Stevens, widow of the founder of the Institute, at Castle Point, Hoboken. A promenade concert and dance in the evening will conclude the celebration.

The Stevens Institute of Technology was founded by the late Edwin A. Stevens, of Hoboken, N. J., and in 1870 the erection of a building was commenced by the trustees, Mrs. E. A. Stevens, Mr. S. Bayard Dod and Mr. W. W. Shippen. Dr. Henry Morton, at that time Secretary of the Franklin Institute of Philadelphia, was tendered the presidency of the institute, and gathered a faculty of eight members about him. To this number others have from time to time been added, as the work of the Institute increased, until at the present time the faculty includes twenty-two professors and instructors. The total number of student graduates is 675, and the number in attendance during recent years has been about 260 each year.

The Stevens Institute has always taken high rank among the institutions devoted to technical education in the United States, and its 25 years of successful effort is amply exemplified in the work accomplished by its graduates in all departments of mechanical and electrical engineering.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

Alternating Currents :

ON THE DISTORTION OF ALTERNATING CURRENTS THROUGH UNSYMMETRICAL SELF-INDUCTION.—By Herman Eisler and Dr. Max Reithoffer. Three characteristic current curves are discussed: (1) When the magnetic core is air. (2) When the permeability varies. (3) Variations due to permeability and previous history of the iron. The article is to be continued. First section appeared in "Elek. Zeits.," Dec. 10, '96.

Central Stations :

ANNUAL REPORT OF THE ELECTRICITY WORKS AT DUSSELDORF. Current furnished during the past year has increased 19.1 per cent. At the end of the year there were connected 17;074 incandescent, 832 arc lamps, 25 motors. Income per kilowatt hour furnished the consumer was 59.48 Pfennig. For details, see "Elek. Zeits.," Dec. 10, '96.

Dynamos and Motors:

ARMATURE WINDING OF UNIPOLAR ALTERNATING CURRENT MACHINES.—By Koloman v. Kando. By unipolar winding author means stationary armature windings. The advantages claimed for these machines, concerning drop, are considered exaggerated. There are, however, decided advantages to these dynamos. A numerical example and actual calculation is given.—"Elek. Zeits.," Dec. 10, '96.

Electro-Physics :

DETERMINATION OF SPECIFIC HEAT BY MEANS OF THE ELECTRICAL CURRENT.—By A. Schlamp. This method consists in sending an electric current through two known resistances, which are immersed in two liquids in series.From the current strength and the heat developed in the two liquids, the specific heat of one can be found in terms of a function of the specific heat of the other.—"Zeitschr. f. Instr. Kunde.," Nov., '96.

Electro-Chemistry:

ELECTROLYTIC PROCESS FOR THE PRODUCTION OF COPPER, SILVER AND OTHER METALS.—By the Hoepfner process, which consists in leaching the powdered ores with a warm solution of perchloride of copper, containing also chloride of sodium or of calcium, pure electrolytic copper can be obtained directly from the ores containing any amount of impurities. 100 lbs. of copper can be produced with a consumption of 100 lbs. of coal.—"Eng. & Min. Journ.," Dec. 19, '96.

Measurement :

A DIRECT READING WHEATSTONE BRIDGE.—By A. P. Trotter. An improvement on the methods proposed by Swinburne.—"Zeits. f. Instr.," Nov., '96.

Mining :

ANACONDA COPPER MINING COMPANY, MONTANA.—The annual report almost in full in "Eng. & Min. Journ.," Dec. 26, '96.

Miscellaneous:

SAFETY RULES FOR HIGH TENSION INSTALLATIONS.—The various German electrical associations and societies in conjunction with some fire insurance companies have decided on a set of rules for wiring which have now been in use just one year. Editorially it is pointed out that all expectations for successful operations under the new system have been realized.—"Elek. Zeits.," Dec. 10, '96.

Power Transmission:

MAKING OR BUYING ELECTRICAL ENERGY ON A SMALL SCALE.—In reply to a question put to the editor of the paper at what point of consumption it is preferable to generate electric current on the premises, a number of engineers, whose names, however, are withheld, give their views. They all lean toward centralization for small plants, but agree that each case must be considered separately.—Lond. "Elec. Rev.," Dec. 25, '96.

Telephony, Telegraphy, etc:

COMMUNICATIONS BETWEEN COAST AND LIGHTSHIPS. An editorial comment on the failures of communications between coast and lighthouses without wires. The conductivity of the water according to Mr. Preece, was too great and interrupted the electric waves, thus performing the same function as an iron plate. An abstract of Prof. Blake's report published by the U. S. Lighthouse Board for 1895 is given in Lond. "Elec. Rev.," Dec. 25, '96.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTICAL PATENTS ISSUED DECEMBER 29, 1896.

Alarms and Signals:—

FIRE ALARM. J. A. McGahy, New York, 573,903. Filed April 30, 1896.

FIRE ALARM SYSTEM. A. C. Rogers, Plainfield, N. J., 573,924. Filed Jan. 25, 1896.

Means whereby the different fire stations and central office will be immediately notified of the number of the fire alarm box from which the alarm was turned in without having to wait until the gong in the station tolls off the number of the box.

ELECTROPNEUMATIC BLOCK-SIGNAL SYSTEM. A. H. Thorp. Toledo, O., 573,932. Filed April 10, 1896.

Details of construction.

FIRE ALARM. A. H. West, Lynchburg, Va., 573,944. Filed March 30, 1896.

Automatic system adapted for residences.

CIRCUIT CLOSER FOR ELECTRICAL ALARM CIRCUITS. J. C. Wollin, Williamsport, Pa., 573,948. Filed Sept. 11, 1896.

Especially adapted for use as a supplementary high and low water alarm for steam boilers.

PUSH BUTTON. G. Jepson, Meriden, Conn., 574,247. Filed Oct. 5, 1896.

Consists of a casing, a lever mounted in the casing and formed with oppositely inclined cam faces, two inwardly bowed fingers mounted in the case, one above and one below the cams, and overlapping each other in the path of their movement.

ELECTRICAL ANNUNCIATOR. R. L. Hunter and H. B. Higgins, Minneapolis, Minn, 574,327. Filed Nov. 19, 1895.

Adapted to be used with either an open or closed circuit battery.

Conductors, Conduits and Insulators; –

INSULATOR HANGER. R. Duncan, San Francisco, Cal., 573,966. Filed Dec. 31, 1895.

Consists of a flat piece of metal bent to fit over the flange of a metal beam, the hanger being retained on the beam by the horizontal tension of the wire.

INSULATOR. C. B. Martin, Schenectady, N. Y., 574,101. Filed Sept. 28, 1896.

Rail insulator for "third rail" systems.

TERMINAL FOR ELECTRIC CABLES. E. S. Reed, New York, 574,343. Filed March 29, 1892.

Dynamos and Motors:—

ELECTROMOTOR MAGNET. C. Partington, Newport, Ky., 574,215. Filed March 6, 1896.

An electromotor magnet with an armature at each end of the coil, each connected to a device which is moved by the two armatures simultaneously and conjunctively.

MOTOR GENERATOR. C. E. Scribner, Chicago, Ill., 574,278. Filed June 1, 1889.

Comprises a motor having a single closed coil armature and provided with two sets of brushes in combination with a main circuit through the machine, and a derived or local circuit connected with one set of brushes and a regulator connected with the local circuit to maintain a constant voltage in the local or working circuit.

Electro-Metallurgy :—

ELECTROPLATING APPARATUS. R. J. Marks, Hartford, Conn, 574,038. Filed Oct. 12, 1896.

A work holder comprising two adjacent relatively insulated conductive sections and two conducting hangers, one of which is connected to one section and the other of which is connected to the adjacent section at opposite ends.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. L. H Page, Chicago, Ill., 573,911. Filed March 12, 1896.

INCANDSCENT LAMP FITTING. A. Swan, New York, 573,929. Filed March 28, 1896.

The neck of an incandescent lamp provided with a bead of glass near the end of a metallic collar placed behind the bead, forming one of the lamp terminals.

SEARCH LIGHT. A. E. Colgate, New York, 573,962. Filed Dec. 24, 1895.

Feed mechanism.

ELECTRIC ARC LAMP. C. E. Scribner, Chicago, Ill., 374,045. Filed May 9, 1893.

Employs two pairs of carbons and an oscillating magnet placed in a permanent magnetic field whereby on the reversal of the current the arc will be shifted to the opposite pair of carbons.

ELECTRIC ARC LAMP. H. A. Seymour, Washington, D. C., 574,117. Filed June 30, 1896.

Enclosed arc lamp for alternating currents.

ELECTRIC ARC LAMP. H. A. Seymour, Washington, D. C., 574,118. Filed July 11, 1896.

Similar to patent below.

ELECTRIC ARC LAMP. H. A. Seymour, Washington, D. C., 574,119. Filed July 18, 1896.

An arc inclosing globe provided with a cover which is mounted upon and supported by the carbon holder.

ELECTRIC ARC LAMP. E. Thomson, Swampscott, Mass., 574,123. Filed Aug. 21, 1896.

Feed mechanism

ELECTRIC LAMP BASE. W. C. Bryant, Bridgeport, Conn., 574,301. Filed Oct. 31, 1896.

For use on lamp bases of the Thomson-Houston type.

Miscellaneous :

DENTAL PLUGGER OR MALLET. H. A. Edgecomb, Mechanic Falls, Me., 574,025. Filed Sept. 25, 1895.

Details of construction.

BULB FOR X-RAYS. J. Von Der Kammer, Chicago, Ill., 574,065. Filed March 17, 1896.

A bulb provided with cavities containing, respectively, the anode and cathode electrodes, being so arranged that they are presented in substantially the same direction.

ELECTRIC BRANDING STAMP. J. M. Kirker, M. Miller and J. A. Williams, Louisville, Ky., 574,203. Filed March 6, 1896.

Details of construction.

RACE STARTING MACHINE. W. Maxwell, St. Louis, Mo., 574,205. Filed June 29, 1896.

A suitable barrier movably suspended across the track and electrically operated mechanism for holding and releasing barrier.

APPARATUS FOR GENERATING OZONE. Marshall Pridham, Philadelphia, Pa., 574,341. Filed Oct. 15, 1896.

A combination of separated casings, one being dielectric, both provided with a coating of powdered conducting material. A brush discharge passes which traverses oxygen fed through the casings.

Railways and Appliances:—

DRUM FOR ELECTRIC CONTROLLERS. S. Harris, Johnstown, Pa., 573,874. Filed Oct. 6, 1896.

Embodies the use of pins extending upwardly and downwardly from the contact rings of the drum, and recesses on the top and bottom of the insulating disks of the recesses being adapted to receive the pins.

ELECTRIC LOCOMOTIVE. J. F. McLaughlin, Philadelphia, Pa., 573,905. Filed March 21, 1890.

Combines an electric motor with worms of different pitch, and gearing for the same, interposed between the motor and drive wheel axles, and means for coupling the motor and axles together through either worm gear.

ELECTRIC CAR BRAKE. E. A. Sperry, Cleveland, O., 574,120. Filed June 26, 1896.

Combined brake magnets, storage battery, circuit connections for supplying the magnets and the battery with current from the motor, a shunt round the battery, a high resistance solenoid in the shunt, and devices controlled by the solenoid for breaking the battery charging circuit.

ELECTRIC RAILWAY. J. A. Roche, Chicago, Ill., 574,171. Filed April 13, 1895.

Sectional conduit system.

MECHANISM FOR LOCATING AND DETERMINING DEFECTS IN RAIL BONDING. P. O. Keilholtz, Baltimore, Md., 574,333. Filed Feb. 29, 1896.

Comprising a series of contacts connected in pairs through potential indicating or recording instruments and electrical conductors, each pair of contacts being arranged to make sliding contacts at simultaneously corresponding points of a separate conductor.

TROLLEY. N. D. Stanley and J. S. Reynolds, Essex, Vermont, 574,345. Filed April 16, 1896.

Employs auxilliary trolley wheel controlled by the trolley rope.

CURRENT CONTROLLER OR RHEOSTAT. E. E. Werner, Dallas, Tex. 574,231. Filed June 22, 1896.

A cylinder having upon its periphery a substance composed of black lead and an alcoholic solution of shellac, with a brush adapted to travel laterally along the cylinder.

Regulation:—

APPARATUS FOR VARYING SPEED OF ELECTROMOTORS. L. Imhoff, Berlin, Germany, 573,979. Filed July 3, 1896.

Certain connections of switches and resistances which alter the number of active windings on the armature of the motor.

METHOD OF AND MEANS FOR REGULATING ALTERNATING CURRENT GENERATORS. B. G. Lamme, Pittsburg, Pa., 574,035. Filed March 11, 1896.

Consists in varying the slip of a non-synchronous motor driven by current derived from the generator and driving an exciting generator by such non-synchronous motor.

ELECTRIC WATER WHEEL GOVERNOR. A. Giesler, Dayton, O., 574,320. Filed April 20, 1896.

Employs a mechanical governor to control an electric current which operates the reversing mechanism to turn the gate in either direction.

VOLTAGE REGULATOR FOR DYNAMOS. T. M. Pusey, Kennet, Pa., 574,217. Filed May 22, 1896.

A brake regulated by the current is applied to the armature.

Secondary Batteries:—

ELECTRODE FOR SECONDARY VOLTAIC BATTERIES. G. A. Grindle, Prestwich, England, 574,322. Filed Oct. 13, 1896.

Consists of a rolled up strip of lead, having on its one side transverse ridges and furrows, all the ridges being connected by a central longitudinal ridge.

Telegraphs:—

KEYBOARD APPARATUS. F. R. McBerty, Downer's Grove Ill., 573,992. Filed Oct. 29, 1895.

Details of construction.

Telephones:—

AUTOMATIC TELEPHONE EXCHANGE SYSTEM. R. Callender, Brantford, Canada., 563,859. Filed March 19, 1896.

Comprises subscribers' lines and individual switches at which they terminate normally under the subscribers' control, and means for giving independent progressive motion to a switch on the reception of a preliminary impulse from the subscriber normally controlling it.

AUTOMATIC TELEPHONE EXCHANGE. A. E. Keith, Chicago, Ill., 573,884. Filed Sept. 16, 1893.

Means whereby the release mechanism of an exchange may be operated by a current of electricity controlled by the weight of the telephone receiver after it is hung up.

TELEPHONE CIRCUIT. C. E. Scribner, Chicago, Ill., 574,005. Filed April 20, 1895.

Circuit for telephones in which the transmitters are supplied with current over the line circuit.

TEST SYSTEM FOR MULTIPLE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 574,006. Filed July 5, 1895.

Embraces a visible and audible test signal to indicate to the operator making connection whether the line be free or not.

TOLL BOX FOR TELEPHONES. C. E. Scribner, Chicago, Ill., 574,046. Filed May 14, 1896.

A locking device for coin receptacles of telephone toll boxes designed to be controlled from the central station.

TELEPHONE EXCHANGE SYSTEM. C. E. Scribner, Chicago, Ill., 574,221. Filed June 6, 1894.

Automatic call and disconnection signals.

SELECTIVE SIGNAL SYSTEM. C. E. Scribner, Chicago, Ill., 574,222. Filed Jan. 8, 1895.

For use on party telephone lines.

SELECTIVE SIGNAL. C. E. Scribner, Chicago, Ill., 574,223. Filed Aug. 23, 1895.

Combines a ratchet wheel and pawl, means for imparting to the pawl successively a longitudinal movement radially to the wheel and then a transverse movement, a detent, and a link connecting the detent to be disengaged from the ratchet wheel during the transverse movement of the pawl.

SPRING JACK FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 574,224. Filed July 5, 1894.

Details of construction.

SIGNALING APPARATUS FOR TELEPHONE LINES. C. E. Scribner, Chicago, Ill., and F. R. McBerty, Downer's Grove, Ill., 574,225. Filed Aug. 17, 1895

Adapted for use on telephone lines carrying current for charging local storage batteries at the sub-station.

TELEPHONE SWITCH BOX. W. A. Houts, Parker, S. D., and L. G. Nilson, Sioux City, Ia., 574,245. Filed Aug. 25, 1896.

A mechanism whereby upon hanging up the receiver the parts will be automatically returned to a normal position.

TELEPHONE EXCHANGE APPARATUS. F. R. McBerty, Downer's Grove, Ill., 574,255. Filed May 25, 1896.

Means to permit the operator to send a call to both subscribers automatically in the process of making the connection.

SIGNALING CIRCUIT FOR TELEPHONE TRUNK LINES. C. E. Scribner, Chicago, Ill., 574,279. Filed May 14. 1896.

A device for preventing interference with the operation of the signals by currents arising from sources foreign to the signaling circuit.

AUTOMATIC SIGNALING DEVICE FOR TELEPHONE EXCHANGES. C. E. Scribner, Chicago Ill., and F. R. McBerty, Downer's Grove, Ill., 574,280. Filed Nov. 27, 1894.

A source of continuous current permanently connected with the plug circuit.

PLUG FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., and F. R. McBerty, Downer's Grove, Ill., 574,281. Filed May 31, 1894.

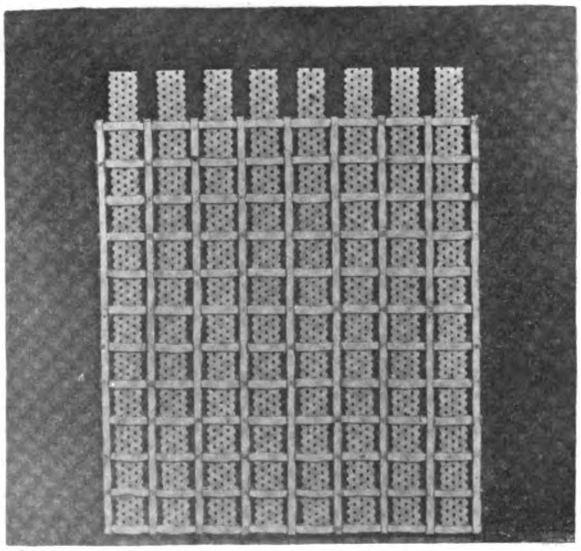
TRADE NOTES & NOVELTIES

THE ROONEY STORAGE BATTERY.

MANY devices have been contrived to lessen the weight of storage batteries by employing a grid made of insulating material to which the active material is applied, instead of employing a lead grid as is the usual practice. An ingenious arrangement of this nature is exhibited in the storage battery plate recently patented by Mr. John J. Rooney, of New York.

In the Rooney plate the grid is constructed by laying strips of wool felt in parallel rows lying in two directions at right angles to each other, so that the two sets or rows of strips form rectangular pockets or holes for the active material.

An odd number of strips is laid in one direction and an even similar in the other, the strips being of such a thickness that when pressure is applied in order to finish the grid, it will be of a uniform thickness. The strips are fastened quickly and inexpensively by a cementing composition, which is hard when cold, but softens under the influence of heat. This cement is painted over one side of the felt sheet, after which it is cut into strips.



ROONEY STORAGE BATTERY PLATE.

In building up the grid, metallic conductors are disposed between the even layers of felt, so as to lie along the middle of the holes or pockets formed in the grid. These conductors are never exposed to the electrolyte, except through the pellets of active material. Therefore in charging there is no shunting of the current at any point, but the entire flow must traverse the pellets of active material.

In order to secure the pellets in place, a perforated hard rubber or a metal sheet is folded over the pasted grid. When the latter is used, it is so put on that there is no metallic connection between it and the conductors inside the grid, for the reason previously explained.

These sheets are not fastened to the grids, but when the plates are assembled, the separators hold them rigidly against the pellets, the entire section, or element, being securely bolted. The expansion of the active material is therefore confined in the plane of each plate, tending to compress the felt and make secure contact with the conductors.

Owing to the porous nature of the grid, a large amount of electrolyte is absorbed, thus quickening the circulation throughout the mass of the pellets. Also the gases liberated around those faces, bordering on the felt, escape easily and in minute bubbles, so that high rates of charge and discharge may be used without detriment to the pellets. The felt grid, as it were, allows the cell to breathe and liberates the gases formed.

In building up the cell, the strips of felt and metallic conductors are guided and kept in place by a form, consisting of a base-plate having rows of vertical wire-pins, and provided with a false bottom or tray, which slides up and down on the pins. A large number of grids are built up on one form, and a top plate, of the same plan as the grid, is placed in position. The form is then placed in an oven, and when the cementing composition has sufficiently melted, pressure is applied and sustained until the cement has hardened. The tray is then lifted off with the empasted grids.

Grids constructed in this manner are very light, and the proportion of active material to conducting metal large, giving a high capacity per pound.

Owing to the non-conducting support, each plate may be transformed into a battery by reversing the polarity of the alternate rows of pellets. The plates may then be placed very close to each other without danger of short-circuiting.

Our engraving shows one of the Rooney plates constructed in the manner described.

THE BAILLARD X-RAY APPARATUS.

A NEW X-ray outfit has recently been put on the market by Mr. E. V. Baillard, of 106-108 Liberty street, New York, The distinguishing feature of the coils is their superior insulation. This feature is so marked that the coils average two inches of spark per pound of wire, a result far beyond the ordinary. This makes the internal resistance so low that the sparks are remarkably thick and fat and therefore very suitable for X-ray work. Additional length is given the spark by means of an ingenious modification of the vibrator whereby the current is allowed to attain its full value before breaking circuit and the time of breaking is much shortened. Two outfits are offered for sale, as follows: First, an exhibition outfit employing a fluorescent screen, and hood covering the observer; and second, a medical outfit using a fluoroscope. The latter is more convenient for general use, and the former for exhibition purposes where an admission fee is charged. Either of these coils will be furnished with a rotary circuit breaker and a variable condenser if so desired.

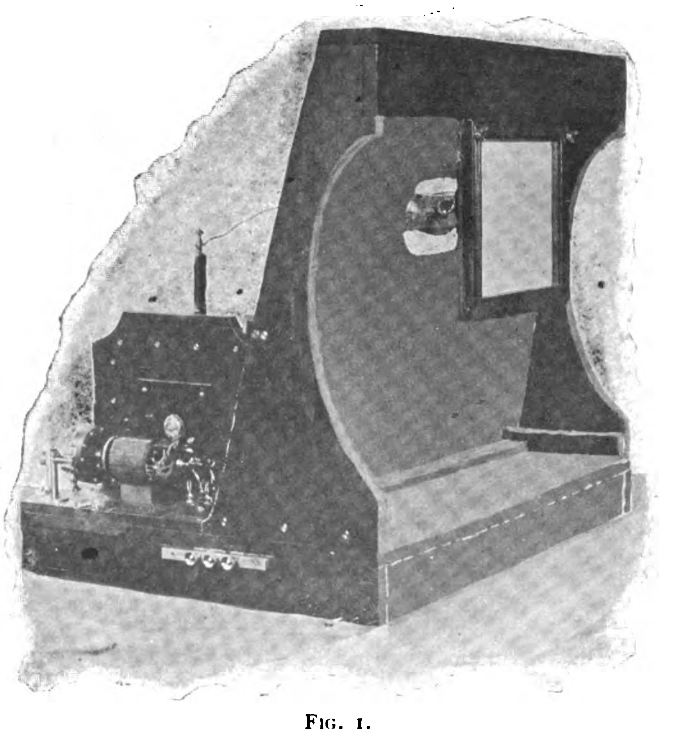


Fig. 1.

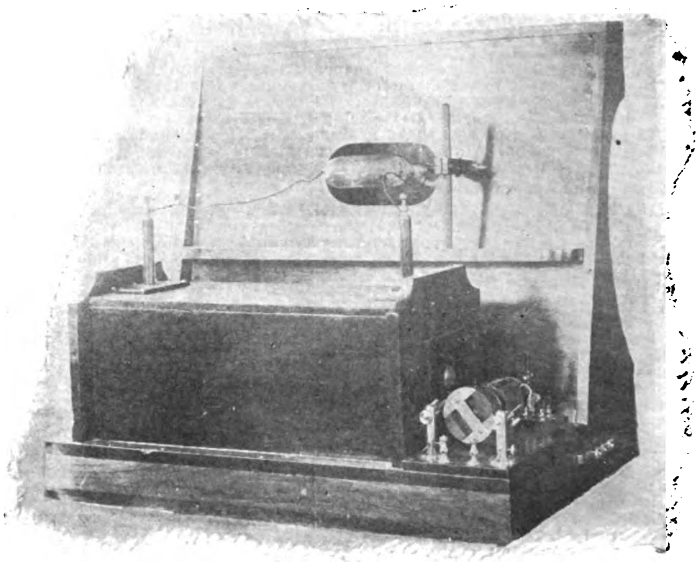


Fig. 2.

The tube used in these outfits is highly penetrating and examinations of the human trunk can be conducted with ease by its aid. The exhibition outfit is shown in two views in Figs. 1 and 2, and Fig. 3 depicts the medical outfit which is used for general experiment.

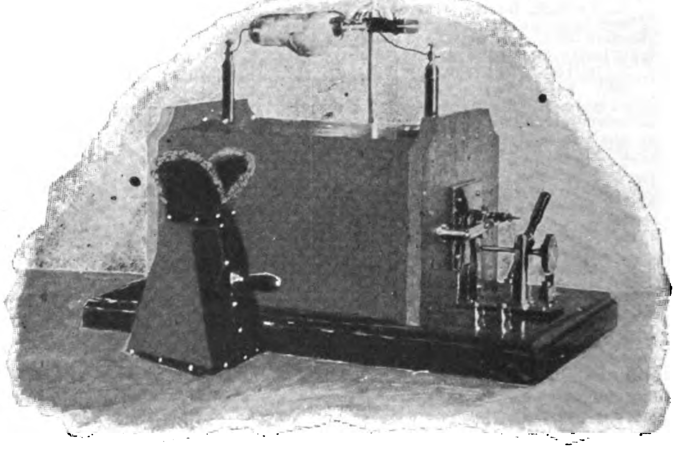


Fig. 3.

A $300,000 GENERAL ELECTRIC CONTRACT FOR POWER APPARATUS.

The General Electric Company has secured the contract for the machinery for the new power house of the Pillsbury-Washburn Flour Mills Company at the dam, Minneapolis, Minn. This award is a big plum for the company as the amount of the contract is in the neighborhood of $300,000. Seven sets of generative machinery will be installed at this time and three more will doubtless be added within a year or so. It is calculated that the seven will generate 7,000 horsepower, which will be more than sufficient to operate the street railway systems of the two cities of Minneapolis and St. Paul under ordinary circumstances.

G. E. NATURAL DRAFT HIGH POTENTIAL TRANSFORMERS.

ONE of the forms which the transformer for use with high voltage currents has taken is shown in the accompanying illustrations of the special "type H" natural draft type, developed by the General Electric Company, in its long distance transmission work. In transformers of this type the primary coils well taped and bound are insulated from each other by thick layers of felt; in that shown the primary coils are eight in number. Between the coils of the primary and the secondary winding an air space of one-half an inch intervenes. The whole is mounted upon a solid iron foundation and securely braced, and is then covered with a corrugated iron cylinder provided with a ventilating roof.

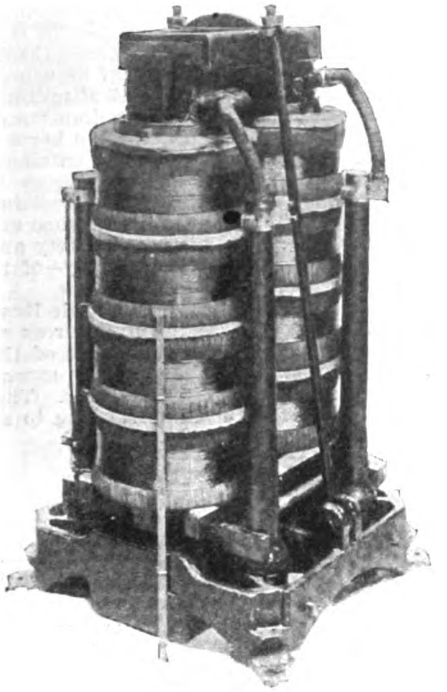


FIG. 1.—GENERAL ELECTRIC HIGH POTENTIAL TRANSFORMER.

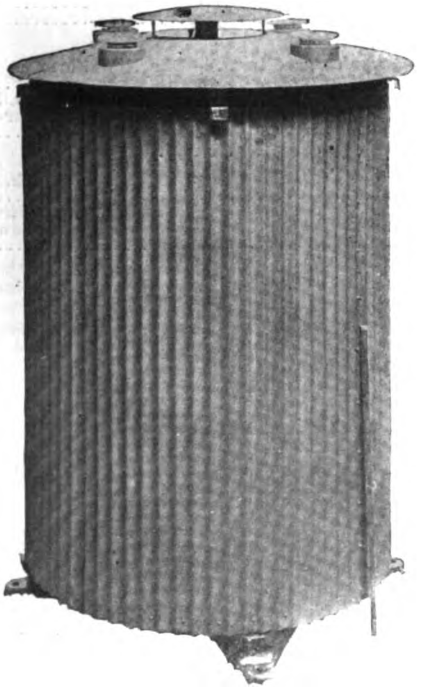


FIG. 2.—GENERAL ELECTRIC HIGH POTENTIAL TRANSFORMER.

One of the first transformers of this type has been for the past five months in service where it is necessary to reduce directly from 10,000 volts to 125 volts without intermediate transformers. It is used on the transmission lines of the Redlands Light and Power Company, at Redlands, Cal., to furnish low voltage current at a point some ten miles away from the substation secondary lines.

In the engravings, Fig. 1, shows the transformer open and Fig. 2 with the enclosing case.

WESTERN UNION NOT IN TELEPHONY.

Circumstantial statements having been printed in the Chicago newspapers as to the purchase by the Western Union Telegraph Company of the Western Telephone Construction Company, Mr. J. E. Keelyn, president of the latter, telegraphs us as follows: "Western Union Company has not purchased our company." This is certainly emphatic and final.

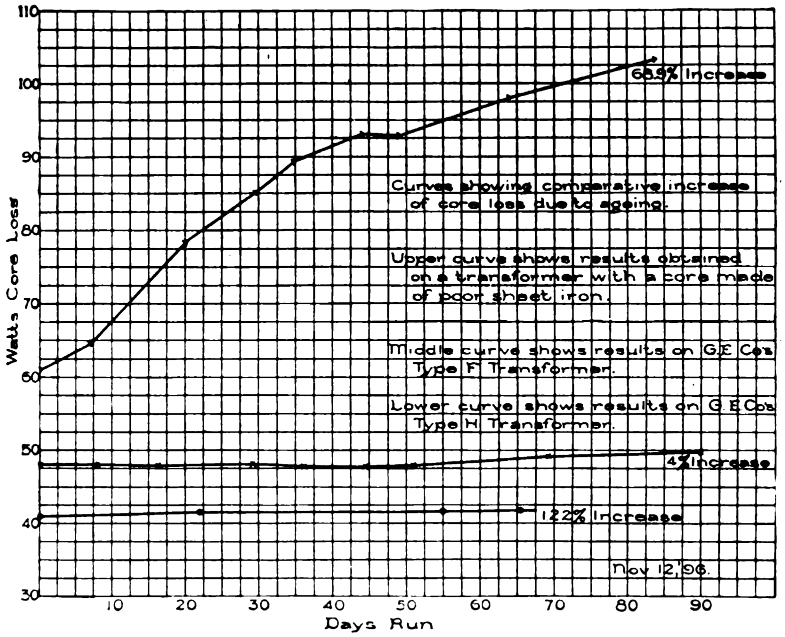
PACKARD LAMPS.

Notwithstanding the advance in the selling price of the standard makes of lamps, made necessary largely by the fact that the manufacturers have been operating under an actual loss for the past two years, the Electric Appliance Company report that the sales on Packard lamps have increased since the time of the advance, showing that their customers appreciate a good thing, and are willing to pay a fair price for a first-class article. The Packard lamp business has always been a very satisfactory part of the Electric Appliance Company's trade.

MAGNETIC FATIGUE OR AGEING OF TRANSFORMER CORES.

IT is now a well recognized fact that the loss in a given body of sheet iron subjected to a definite number of magnetic reversals per second and at a definite density of magnetization does not of necessity always remain the same. It is only by the greatest care that iron is brought into the condition in which it gives minimum loss when subjected to alternating magnetization, and the manner in which this result is obtained and the conditions to which it is subjected in actual use have both to be considered to insure keeping it in this condition.

Failure to properly consider these facts will produce a transformer which may give a fairly low core loss when first produced, but which after being in use for a short time will give a core loss 25, 50, or even 100 per cent. greater than at the start.



AGEING CURVES OF TRANSFORMER CORES.

This phenomenon is known as "ageing." The accompanying diagram shows a curve of actual results recently obtained on a 2,500 watt transformer of well-known make, tested by the General Electric Company, as a practical illustration of this fact. At the time of the last test the increase in core-loss, it will be seen, was 68.9 per cent. after a run of 90 days under normal conditions of commercial operation.

To reduce this loss in its transformers has formed the subject of exhaustive study by the engineers of the General Electric Company at Schenectady. The result of continued experiment allows this company to guarantee its transformers as free from the serious defect of "ageing"; in most cases absolutely negligible and in extreme cases not more than 4 or 5 per cent. On the same curve are given the actual results obtained on one of the General Electric standard type H 60-cycle transformers, and from this it will be seen that the loss comes within the above limit.

ADVERTISERS' HINTS

THE BOLGIANO MANUFACTURING COMPANY, 102 W. Pratt street, Baltimore, Md., will furnish one of their water motors at $5, which may be used for running revolving fixtures in show windows, sewing machines, small dynamos for electric power and light and a great many other purposes.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 527 West Thirty-fourth street, New York, will send a sample of their new standard iron armored insulating conduit to those who request it.

THE WESTERN UNION TELEGRAPH COMPANY'S system includes over 800,000 miles of wire with 21,000 offices.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, publish a letter from a central station man in which he says of the Boudreaux dynamo brushes: "They are just the thing I have been looking for."

NEW YORK NOTES.

THE PURITAN ELECTRIC COMPANY, of New York, are having a very brisk demand for their alternating current arc lamp, which burns one hundred hours and is noiseless. They have already sold a large number of these lamps, their short length and grace of design commending them to all purchasers.

MR. SETH C. ADAMS, of the Bossert Electric Construction Company, of Utica, has been in the East for the past few days for the purpose of arranging agencies for the sale of their well-known specialties in wall outlet and junction boxes which they are now making of drawn steel. Mr. Adams has already arranged with the Bibber-White Company, of Boston, to represent them in New England.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., is about to ship one of its new American Ball engines to the Chinese government to be used in driving machinery for the coinage of silver.

WESTERN NOTES

MR. O. M. HUBBARD, manager, Electrical Department the Bradford Belting Company, Cincinnati, paid a visit to Chicago a few days ago, and reports that their New Year's business began under very encouraging conditions. They started out on January 2 by shipping some good orders, amongst them being an immense belt for the Peoples' Light and Power Company, Newark, N. J., which they claim is about as large a belt as has ever been made, being 80 inches wide, 3 ply and about 165 feet long. Mr. Hubbard is also very hopeful of a nice trade in their electrical supply business during the year 1897.

THE NATIONAL CARBON COMPANY, Cleveland, O., have sent out their calendar for 1897, it having, like its predecessors, a chromolithographic view of the huge works where they turn out so many varieties of carbon product.

EUGENE MUNSELL & CO., miners and importers of mica, Chicago, announce that they have moved into their new quarters at 117-119 Lake street. The increased facilities for handling their Western business will enable them to carry a larger stock of mica and drop forge copper segments, and thus place them in a position to fill all orders promptly. The Mica Insulator Company, of New York, Chicago, and London, announce that they also have removed their Western headquarters to 117-119 Lake street, Chicago, and are in a position to fill all orders for their "Micanite" specialties promptly. During the past year the company have enjoyed an increased trade in the West among the electrical manufacturers, electric railways and lighting companies.

MR. F. S. TERRY, of the Sunbeam Lamp Company, Chicago, has been a welcome visitor to New England and New York City.

THE CINCINNATI MILLING MACHINE COMPANY, of that city, have just issued and have sent us a copy of their catalogue devoted to an entirely new line of milling machines which they describe as possessing many important improvements incident to modern milling practice not heretofore introduced. They will be glad to send this catalogue to any address on application.

BRUNT & THOMPSON, the electrical porcelain manufacturers of East Liverpool, O., have sent us a huge chromolithographic calendar for 1897. The picture is pretty and shows a girl in big straw hat fondling a young puppy—of the dog order. The calendar is nearly two feet long.

BOILER SCALE.—The Pittsburg Boiler Scale Resolvent Co., of Pittsburg, Pa., will send free to any address on application a copy of their pamphlet on the subject of their admirable specific. The book discusses the subject, gives directions for use, and quotes a number of testimonials. The company will be glad also to answer questions relating to such steam engineering matters.

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The Electrical Engineer.

Vol. XXIII. JANUARY 20, 1897. No. 455.

ELECTRIC LIGHTING

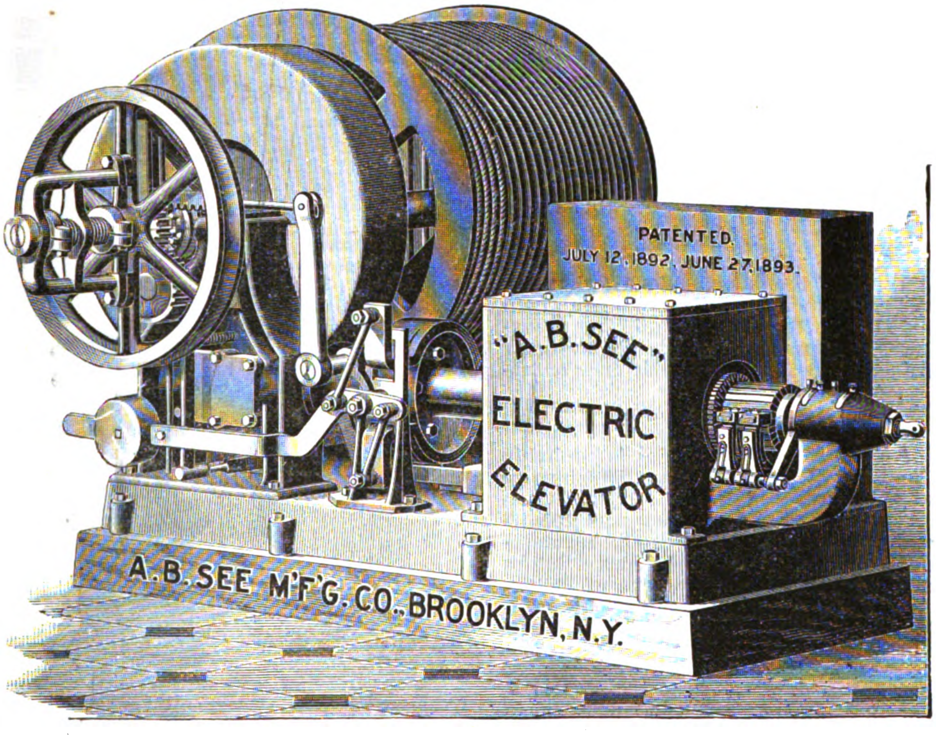
THE EVOLUTION OF THE ISOLATED ELECTRICAL PLANT DURING THE LAST FIFTEEN YEARS.—III.

(Concluded.)

CHARLES H. DAVIS.

FIXTURES.

AT first the electric lamps were placed irrespective of the location of the gas outlets and were hung on cotton cords, afterwards insulated with rubber and sometimes covered with silk. Adjustment was made by wooden hooked balls or wooden sticks, still in use. The desire to have the gas and electric lights on the same fixture led to "fixture attachments" with the flexible cord wound around the gas fixture or passing down the sleeve of the main stem and hanging below the body, and to which the lamp or cluster was attached. Soon "electroliers" came into use and "combination fixtures," also desk lights with patent shades, globes, etc., and horizontal, inclined, vertical and revolving shades and lamps; pendants of brass and iron tubes hung from a universal joint; patent loom fixtures and others for special kinds of work in breweries, factories, etc., in constantly increasing varieties. A constant source of annoyance and difficulty was the use of fuses in the base of the fixture; it was to avoid this that the idea of "panel boards" first suggested itself. To-day we use fixture boxes of iron with or without fuses as the case requires.


PATENTED
JULY 12, 1892. JUNE 27, 1893.
"A.B. SEE"
ELECTRIC
ELEVATOR
A.B. SEE M'F'G. CO. BROOKLYN, N.Y.

Modern Electric Elevator.

LAMPS.

The development of the lamp is most interesting. From the clumsy platinum filament to that of carbon; from the low voltage to that of the higher; from wooden bases to porcelain; from 6 watts per candle-power to 3.2 to 4 watts per candle power; from an average of a few hundred hours' life to 800 and 1,000.

MOTORS.

In the use of motors occurs one of the greatest changes, particularly on account of the large increase in capacity of plant required for their operation. The use of motors was confined, at first, to small fans used in the summer time, but now they ventilate, pump, run elevators, in fact, furnish the power required in all parts of our modern buildings. The engravings show several elevators of to-day.

CONTRACTS.

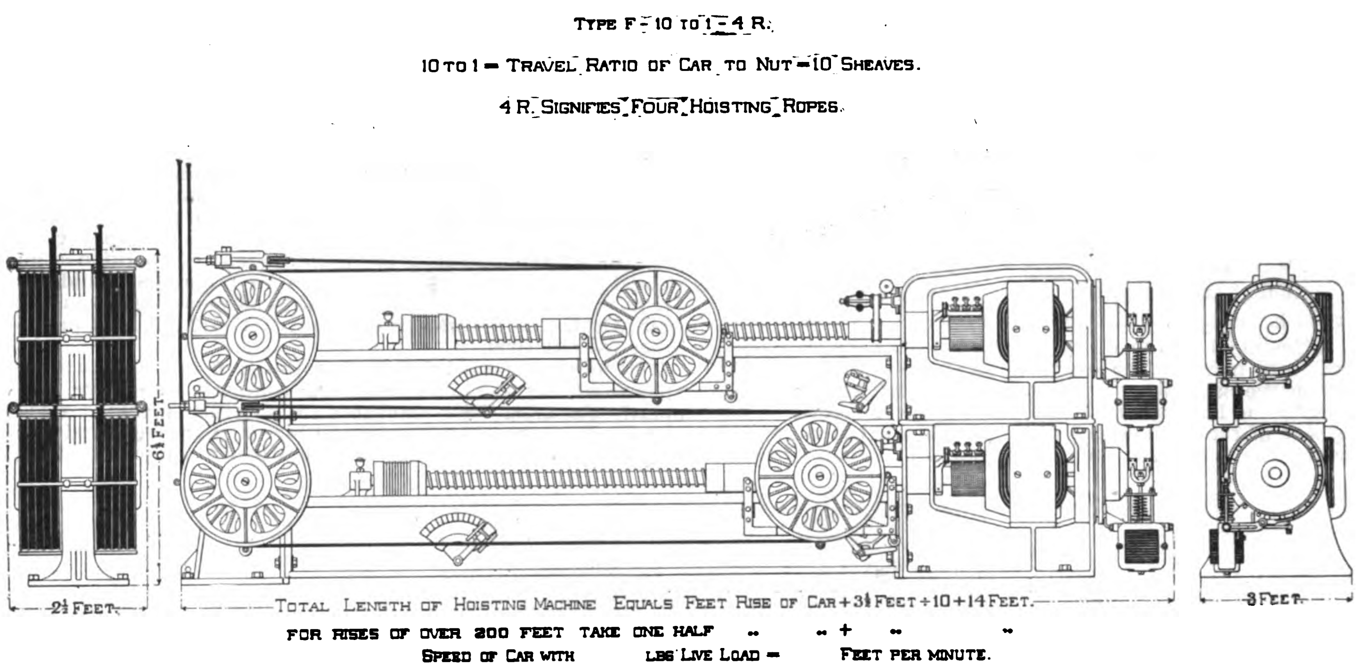
In the growth of this industry an interesting and remarkable change has taken place in the methods and requirements. Originally the manufacturers of dynamos undertook to build and install the entire plant; a new industry, undeveloped, and little understood by the buyer, and with large profits, enabled this to be done. The parent companies did the manufacturing, the engineering and the construction; competition soon caused absurd guarantees and bids on prominent buildings for advertising purposes, that caused enormous losses—in one case within the knowledge of the writer, $10,000, and in another over $20,000.

The purchaser soon found that the lack of individual responsibility of the manufacturing concerns who were constantly changing their managers (in one case within a week and frequently several times within a year), required the services of some one with equal knowledge to represent him; thus the growth of the consulting engineer's office. Furthermore, the enlargement of the electrical industry in all its branches was so enormous that the manufacturers were forced to decline undertaking contract work; they tried to avoid dropping this by construction departments and sub-construction companies, but the smaller office expenses and salaries on construction partnerships enabled the latter to obtain and control the business. While the owner can obtain a better and cheaper plant, if brought together properly, through a division of contracts under the main headings of engines, dynamos, switchboards, wiring, lamps and fixtures, yet a large majority of work let is placed by a bulk contract for the entire plant at an additional cost to the purchaser of from ten to twenty per cent.

LABOR.

In the old days one of the greatest sources of annoyance and loss both to producers and users was the lack of proper and skilled labor. Often the engineer had to show the employé of the manufacturer how to start and run his own machines;

foremen and superintendents were sent hundred of miles away from the factories to erect plants when they had only a week's experience with the apparatus to be used and knew little, if anything, about the requirements of wiring. The ordinary wiremen and helpers, employed locally by the foreman, were oftener day laborers than carpenters or men with some mechanical knowledge. These facts account largely for many evils existing during the growth of the business. Now, the question of labor is very different; the men are better trained, more experienced, and through the labor unions (whatever may or may not be their other merits or demerits) are given a longer and better schooling before they are allowed to undertake work that requires skill and judgment; this is one of the most important advancements during the existence of isolated plant work.


TYPE F - 10 TO 1 - 4 R.
10 TO 1 = TRAVEL RATIO OF CAR TO NUT = 10 SHEAVES.
4 R. SIGNIFIES FOUR HOISTING ROPES.
6½ FEET
2½ FEET
TOTAL LENGTH OF HOISTING MACHINE EQUALS FEET RISE OF CAR + 3½ FEET ÷ 10 + 14 FEET.
3 FEET
FOR RISES OF OVER 200 FEET TAKE ONE HALF " " + " "
SPEED OF CAR WITH LBS LIVE LOAD = FEET PER MINUTE.

Modern Electric Elevator.

COST.

The change in cost of apparatus and supplies is probably greater than those unfamiliar with ancient electrical history realize. In 1880 a plant was purchased from the Edison Company and shipped to Lake Superior, its capacity was 100 16-candle-power lamps and it consisted of dynamo, regulator (rheostat), ammeter, indicator (voltmeter), base frame, lamps and sockets, for the sum of $2,000 f. o. b. works of Edison Company. In 1887 the same plant, but better apparatus from the same sampany could be bought f. o. b. factory, for $800, and to-day the slower speed heavier constructed dynamo can be purchased for $400, f. o. b. factory, while a direct-connected 300 r. p. m., 25 kilowatt (400 lights) dynamo costs to-day $800, f. o. b., factory. Lamps of 16 candle-power which then sold at $1.25 each, now sell for 16 cents and are much better. Sockets at $1, now ten to fifteen cents. Cut-outs from several dollars down to under one dollar, switches the same.

THE FUTURE.

The future development of the isolated electrical plant (outside of radical changes that would occur through discarding the use of steam as a motive power) in large buildings will undoubtedly be towards the discarding of all use of gas, of steam or water heating (this is somewhat problematical as today low temperatures are best produced by water, steam or air while high temperatures are more easily accomplished by electricity), of hydraulic elevators, steam pumps and all small steam apparatus, all of which will be replaced by electric heating and motor devices. Furthermore, the future will see the use of higher potentials, say, up to 220 volts, by the perfection of the higher voltage lamps; the use of such a system would solve many problems, such as the conversion of existing large installations using street current on the three-wire system to isolated plants as a matter of economy, the reduction in size of wires and tubing to more easily conceal them, and the great reduction in first cost of all apparatus and material.

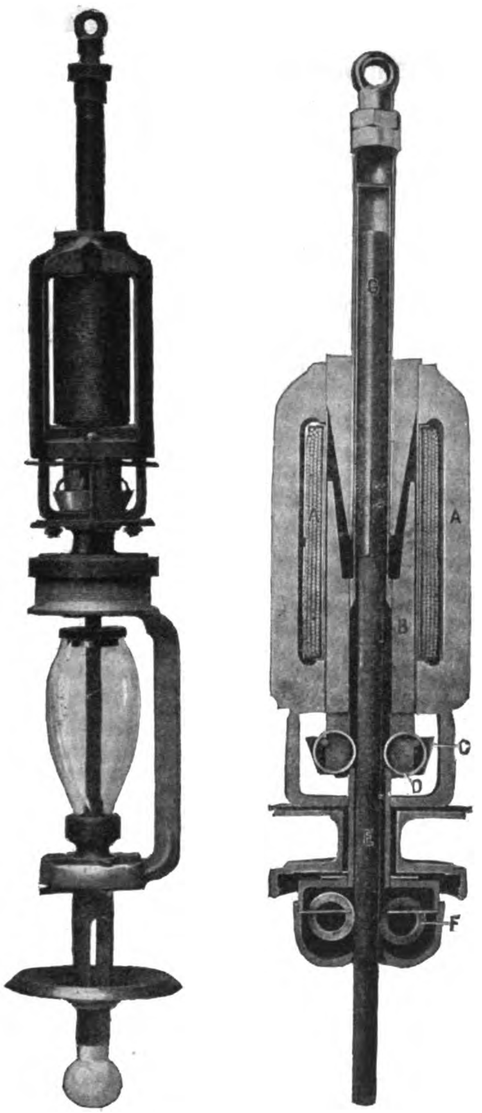
THE MANHATTAN ENCLOSED ARC LAMP.

Although Manhattan enclosed arc lamps are met with everywhere, the construction of the mechanism of the lamp is not as well known as it should be. The lamp embodies a number of exceedingly novel features which have not heretofore been described. Our engraving, Fig. 1, shows the Manhattan lamp complete. It will be noted that the beauty of the lamp is greatly increased by doing away entirely with the carbon rod and making the length of the lamp in keeping with its other proportions. In the Manhattan lamp the upper carbon,

The Manhattan Enclosed Arc Lamp.

extended by a thin metal sheath, is fed directly through the mechanism.

The outer globe is airtight at all points, except at the bottom, where there is a hand-hole large enough to permit of trimming the lamp and cleaning the globe. This hand-hole is closed by a yielding pan. The outer globe is permanently secured to the frame of the lamp, and the top opening made airtight with asbestos gaskets.



FIGS. 2 AND 3.—MECHANISM OF MANHATTAN LAMP.

In Fig. 2 is shown a lamp with the shell and outside globe removed, and Fig. 3 shows a section of the body of the lamp with the bracket and lower carbon holder also removed.

In Fig. 3, A is a solenoid; B is its armature. Attached to this armature is a pan C in which are placed four clutch rings D, which extend through openings in the armature, and clutch the carbon E or carbon sheath G direct; F shows the brush box, in which are laid 21 rings; these rings bear against the carbon by gravity, and make 21 points of contact, feeding the current to the carbon. The action of the lamp is extremely simple.

The armature is held in suspension when the lamp is burning, and is raised or lowered according to the variation of the resistance across the arc. The raising of the armature causes the clutch rings to grasp the carbon, and when lowered loosens the clutch rings, which allow the carbon to descend until the resistance across the arc is again equalized. It will be seen that, practically, the entire moving mechanism of the lamp consists of the armature, which is a solid piece of tool steel weighing 3½ pounds, and the 4 clutch rings stamped out of brass. The lamp is entirely without springs or adjustments of any description.

The lower part of the yoke, in the shape of a ring, admits the arms of a spider on the lower carbon holder. This spider secures the lower carbon holder in the yoke and closes the circuit through the lamp.

As will be seen in Fig. 3, the carbon sheath is slightly larger than the carbon. The opening in the inner globe cap is of such size as to readily admit the upper carbon, but will not allow the carbon sheath to pass through, so that when the upper carbon has burned to the proper limit the arc lengthens and cuts out the lamp automatically. When the lamp cuts out it leaves 5 inches of the upper carbon in the sheath. This stub is used as a lower carbon in the sheath. This stub serves as a lower carbon for the next run, so that 150 hours' life is obtained from a total of 12 inches of carbon.

ENGLISH INCANDESCENT LIGHTING STATISTICS.

WHAT make in many ways a remarkable showing, are the statistics of the growth of electric lighting in London and the provinces..This is illustrated in the accompanying diagrams taken from the London "Electrician."

The Metropolitan Electric Supply Company still continues to lead the way in the matter of lamp connections in London, its 1895 total of 257,000 having been increased to 310,000 during 1896. Not only does this concern continue to lead the way, but its curve (see Diagram 1) shows no signs of that bending over which is so marked a characteristic of that of the Westminster Electric Supply Corporation. The rate of progress of the city of London Electric Lighting Company, also, is well maintained; indeed, its curve runs sensibly parallel to that of the Metropolitan Company. After these three giants we come, after a big descent, to the London Electric Supply Corporation. The great majority of the companies, the curves of which are so uncomfortably crowded together at the bottom of the diagram, appear to be making healthy progress; that is to say, only one or two concerns show signs of having exhausted their territory.

From Diagram 2 it will be seen that the provincial electric lighting undertakings have during 1896 caught up and passed the metropolis in the matter of lamp connection; the total for London being 1,462,000, that for the provinces being 1,602,000, so that the grand total for the United Kingdom is now well over three million 8 candle-power lamps.

In Diagram 3 we give a graphical representation of the favor relatively enjoyed by the alternate current and continuous current systems. From this and Table I. it will be seen that the United Kingdom is now about equally divided on this point.

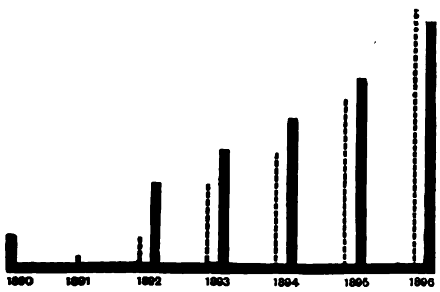


DIAGRAM 2.—Lamp Connections of London and Provinces.
London ▬▬ Provinces - - - -
Scale (approx.), 1 inch = 800,000 8 c.p. lamps.

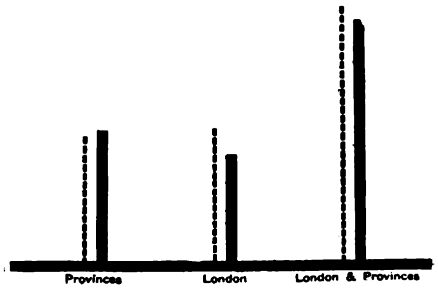


DIAGRAM 3.—Alternate-current (- - - - -) Continuous-current (▬▬)
Scale (approx.), 1 inch = 800,000 lamps.

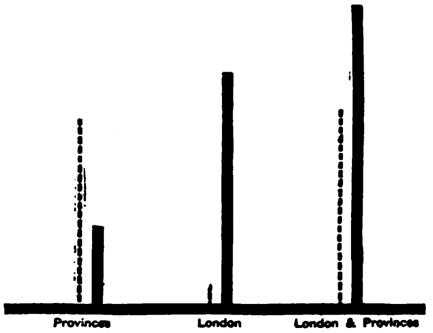


DIAGRAM 4.—Municipal (- - - - -) Company (▬▬)
Scale (approx.), 1 inch = 800,000 lamps.

ENGLISH ELECTRIC LIGHT STATISTICS.

In London the municipalization of the electric light makes but microscopic progress; in the provinces, on the other hand, its advance is rapid, the municipal lamp connection at the end of 1896 being 55 per cent. greater than it was at the end of 1895, an advance due to some extent to the conversion of Liverpool, Southampton and Exeter to the municipal faith.

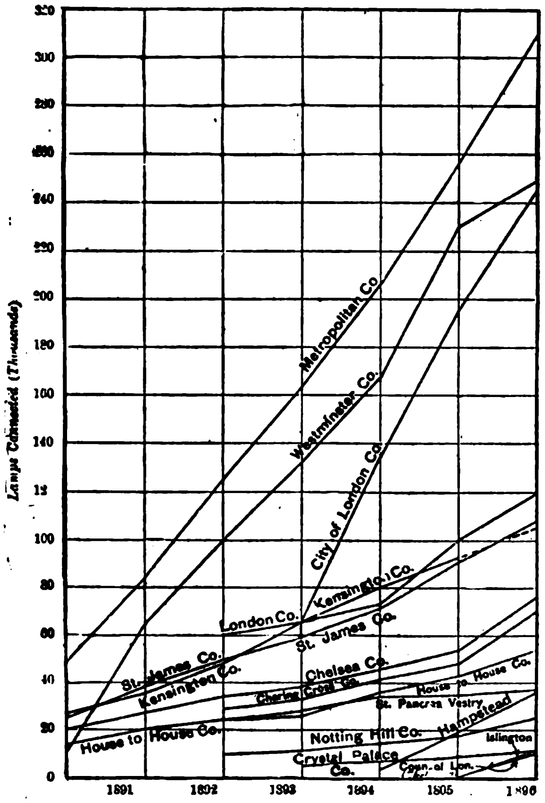


Diagram I.—Lamp Connections of the London Companies

English Electric Lighting Statistics.

The tables (I. and II.) given below state in figures what the diagrams (3 and 4) set forth graphically.

Table I.—*Alternate-current and Continuous-current Lamp. Connections.*

—	∽	—	Totals.
London	792,000	670,000	1,462,000
Provinces	778,000	824,000	1,602,000
Totals	1,570,000	1,494,000	3,064,000

Table II.—*Municipal and Company Lamp Connections.*

—	Municipal.	Company.	Totals.
London	84,000	1,378,000	1,462,000
Provinces	1,126,000	476,000	1,602,000
Totals	1,210,000	1,854,000	3,064,000

NEW YORK CITY ELECTRIC LIGHT AWARDS.

The Gas Commission have awarded contracts for lighting the city for the coming year to the following companies:

	Lights.	Nightly Cost.	
Brush Electric Co.	771	40c.	$112,566.00
Mt. Morris Electric Co.	519	40c.	75,774.00
Harlem Electric Co.	66	40c.	9,636.00
Manhattan Electric Co.	728	40c.	106,288.00
Edison Electric Co.	208 double	50c.	37,960.00
Edison Electric Co.	233 single	40c.	34,018.00
North River Electric Co.	934	45c.	153,409.50
Total			$529,751.50

The city expenditure for street gas lamps will be $472,843.

MISCELLANEOUS

THE THEORY OF THE WIRING TABLE.[1]

BY THOMAS G. GRIER.

THE theory of the wiring table is simply one of proportioning resistances. The first point to be considered is, how is the resistance varied in any substance? The law states that the resistance of any substance varies directly as its length and inversely as its cross section. This law has been verified by experiment and is universally accepted as a law of nature.

The resistance varies directly as the length of any given substance, means that if the length of a wire is doubled, the resistance is doubled, and three times the length means three times as much resistance.

The resistance varies inversely as the area of cross section, means that if the area of a wire is doubled, that is, if there is just twice as much metal for a given length of wire, the resistance is decreased one-half. If the area is increased three times, the resistance is decreased to one-third. In a wire of a given substance if the length is doubled, and at the same time the area is doubled, the resistance remains the same, or if the length is increased to three times as great, and at the same time the area is increased three times, the resistance remains the same.

From this application of the law already referred to, it can be seen how it is possible to vary the size of a wire so that the resistance remains constant for any length, or how the resistance may be changed to suit any condition or circumstance.

The next consideration is the action of the electric current. The pressure is measured in volts, and the rate of flow is measured in amperes. The volts are all used up in forcing the amperes against the resistance.

The resistance, if it were all in the wires, would mean a total loss of the electrical energy, because the volts would be used in doing work from which no results were obtained. It is necessary, therefore, to make the resistance of the wire which conducts the current but a proportion of the total resistance. The rest of the resistance of a circuit being that which exists in the lamps and the other devices or apparatus which convert the electrical energy into commercial forms, as light, power or heat.

To so compile a table and calculate the sizes it is necessary to consider the relation which exists between the unit of resistance, the ohm; the unit of pressure, the volt; and unit of current, the ampere.

One ohm resistance requires the pressure of one volt to transmit one ampere. Two ohms require two volts to transmit one ampere. One volt will transmit but one-half an ampere over two ohms, and 100 volts will transmit ten amperes over ten ohms.

This is Ohm's law, which, when given in the form usually found in text books is as follows: The rate of flow, or current, measured in amperes, is equal to the volts divided by the ohms. The volts are equal to the amperes multiplied by the ohms, and the ohms are equal to the volts divided by the current flow or amperes.

Knowing the relation of resistance to the flow of currents, and the pressure, the next point to be considered is the substance used for the wires, and ascertain the amount of its resistance for a given length and size, to be used as a unit for making the calculation necessary in compiling the table.

Copper commercially and physically represents the best conductor for the transmission of the electric current. A dollar's worth of copper will conduct a greater amount of electric current than any other metal of equal value with the same loss of energy. In the illustrations following, copper will be the substance considered, as the wiring tables used for ascertaining the size of wire are for copper wire.

The units by which wire is measured are the circular mil and the foot. The circular mil is the area of a circle whose diameter is one one-thousandth of an inch. The foot is a unit familiar to all.

The unit of wire then, would be a wire one foot long, the area of which is one circular mil, and the resistance of this unit of copper wire is between 10 ohms and 11 ohms, depending upon the temperature of the wire.

Ten and six-tenths (10.6) ohms may be assumed as the resistance which approximates closely to the average at ordinary temperatures. Taking this as the basis for compiling a wiring table, it is known that to send an ampere through this unit of wire would require 10.6 volts. For, as stated in Ohm's law, the volts must equal the ohms multiplied by the amperes. But in everyday problems, the known quantities are the volts and amperes, and the calculation is to find wires of proper resistance to suit the conditions. The resistance, or the ohms, must equal the volts divided by the amperes. To solve this problem, the volts are divided by the amperes, and we have the resistance.

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[1] Abstract of a lecture delivered before the Chicago School of Electricity.

The resistance varies as the length and inversely as the area. It is the area of a wire which is desired, and one the resistance of which will equal the resistance found by dividing the volts by the amperes. The resistance of one foot of copper wire, one circular mil in area, equals 10.6 ohms. The resistance of any wire is equal to its length multiplied by 10.6 and this divided by the area. Now, it is known that the volts divided by the amperes equals the resistance, and the volts divided by the amperes are therefore equal to the length of the wire multiplied by 10.6 and divided by the area.

In any problem of wiring we have the number of volts and amperes, also the distance the current is to be transmitted, and the only thing remaining to be found is the area. To find this, we multiply 10.6 by twice the distance or the total length of wire (in multiple arc work there is one outgoing wire and the return circuit, which makes the total length of wire double the distance), and multiply this by the amperes, and divide the product by the volts used, which gives the area of the wire.

The volts used are not the total volts of the system, but the volts lost in the wire. If the problem is given as so many per cent. loss, it would mean a per cent. of the total number of volts. To illustrate: If the wire is to use up 2 per cent. of the pressure, and the voltage of the system was 50, then you would divide by 2 per cent. of 50 or one volt, or, if the pressure was 100 volts, you would divide by 2 per cent. of 100 or 2.

In compiling a table, let it be assumed for a 50 volt system for a regular increase of distances of ten feet, the following method is pursued: First, the per cent. loss is ascertained, let it be 2 per cent. This then would be one volt. Then one ampere will be considered, first, as the total current flow, and the following calculations would be made: 10.6 would be multiplied by 10 feet and by 2 to get the length of wire, and this multiplied by 1 ampere and the product divided by volts lost, or in this case, by one which would give us an area of 212 circular mils. This would be the size of a wire necessary to allow one ampere to be transmitted 10 feet with one volt loss (or 2 per cent. of 50 volts).

The next calculation would be for 20 feet distance, and as the resistance of the wire must remain the same, the area first found, namely, 212 circular mils, must be doubled as the distance has been doubled. For 30 feet to keep the resistance constant, the area is increased three times, and so on, until the limit of the table, say 200 feet, is reached, when the area will be increased 20 times, as the length has been increased by that amount.

Then the same method will be continued for two amperes, namely, multiplying 10.6 by the distance and by 2 to get the length of wire, and this multiplied by amperes and the whole divided by the volts lost. This is continued until the area for all the wires for each of the distances and for the various number of amperes have been determined.

As it is necessary to multiply 10.6 by the distance, multiplied by 2, in every instance, 2 × 10.6 or 21.2 is used instead, and the straight distance used. The whole resolves itself into the simple formula:

$$\frac{21.2 \times \text{distance} \times \text{amperes}}{\text{Divided by volts lost}} = \text{area of wire in circular mils.}$$

When these areas are found, the commercial sizes of wire are inserted in the table which are nearest to the size found, but always larger, never smaller; that is, if the area found in the calculation came between a No. 0 wire and a No. 00 wire, the No. 00 wire would be the size used in the table.

CARVINGS AT THE STATE CAPITOL.

Among the forty heads carved in the cluster capitals on the grand stairway of the State Capitol at Albany are those of Benjamin Franklin and Joseph Henry.

DAVY-FARADAY RESEARCH LABORATORY.

This laboratory was opened on January 18. Under the deed of trust, workers in the laboratory are entitled, free of charge, to gas, electricity and water, as far as available, and, at the discretion of the directors, to the use of the apparatus belonging to the laboratory, together with such materials and chemicals as may be authorized. All persons desiring to be admitted as workers must send evidence of scientific training, qualification, and previous experience in original research, along with a statement of the nature of the investigation they propose to undertake.

The laboratory is attached to the Royal Institution, London.

ELECTRICITY IN NAVAL LIFE.—XIV.

BY LIEUT. B. A. FISKE, U. S. N.

CARE OF THE ELECTRIC INSTRUMENTS.

THE principal enemy of the electric instruments is the same as that of all other instruments used on shipboard, namely, sea air and moisture. For this reason, the galvanometer cases should not be opened, except when necessary, and should be left open as short a time as possible.

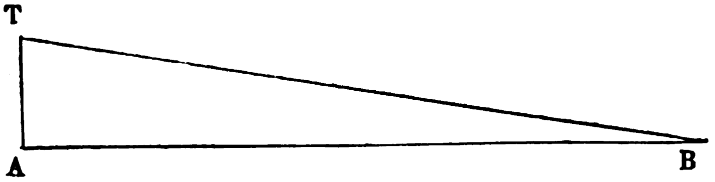
In case of any trouble whatever with any of the electric instruments, the cause will be, in nine cases in ten, due to a broken wire or connection, or else a connection is faulty, that is, neither firmly made nor completely broken. If the connection is completely broken, a galvanometer will not move at all; but if the connection is merely faulty, the resistance of the connection will vary between infinity and some very small quantity, and cause an oscillation of the galvanometer needle. This may appear periodically, as the rolling of the ship from side to side brings the two loose contacts against or away from each other; or it may occur irregularly and be due to unnoticed causes, such as draughts of air, manipulation by the hands of the operators, or other causes tending to make the loose contacts touch and let go. The remedy is to examine all contacts and connections, and make them firm.

THE STADIMETER.

The stadimeter was introduced originally as an adjunct to the range finder, and designed to be used in concert with it, in such a way as to combine the portability and convenience of a one-observer instrument with the accuracy of a two-observer instrument.

But it has a distinct field of its own in navigation, fleet tactics, torpedo boat work, and wherever it is desired to know the distance of an object whose height, or length, or breadth is known; or where it is desired to know the height, length, or breadth of an object whose distance is known, the micrometer head M being graduated in yards of distance, the index bar B being graduated in feet, representing the height, length or breadth of the object.

As will be seen from the drawing, it is a modification of the sextant. It is, moreover, of the same size as the ordinary sextant used in ships.



Clearly, from the diagram,

$$AT = BT \text{ sine } ABT\text{; or}$$
$$BT = AT \div \text{sine } ABT.$$

So that in either case the measurement involves the measuring of sine ABT.

To accomplish this with the stadimeter, bring the reflected ray from the top of the object into coincidence with the direct ray from its bottom, by moving the index bar which carries the index glass I on its pivot, in the same manner as in using the sextant. To move this index bar, rotate the micrometer head M. The sine of the angle through which the index glass has been moved is clearly the amount by which the micrometer screw has moved longitudinally, divided by the distance from the pivot of the index bar B to the point on its edge where the force of the micrometer screw is applied. The German silver spring G presses the index bar against the end of the micrometer screw, and prevents lost motion.

Now, by the theory of the sextant, the angle between the reflected ray from the top of the object and the direct ray from the bottom of the object is twice the angle through which the index glass has been moved out of parallelism with the horizon glass H. Therefore, assuming that for such small angles as those here used the sines of angles are proportional to their arcs—

$$AT = BT \times 2 \times \frac{\text{Length of movement of micrometer screw}}{\text{Distance from pivot to point of application of screw on index bar.}}$$

or,

$$BT = AT \div 2 \times \frac{\text{Length of movement of micrometer screw}}{\text{Distance from pivot to point of applica- of screw on index bar.}}$$

As the length of movement of the micrometer screw longitudinally can be determined by the amount of angular movement of the micrometer head, it is plain that, if we know the pitch of the micrometer screw, the micrometer head can be graduated in units of distance and the index bar in units of height, or vice versa.

In the stadimeter this is done, and furthermore the point of application of the micrometer screw on the index bar can be varied at will. This is accomplished by mounting the micrometer screw on a block or nut which rides on the long screw S, so that by turning S the block or nut is moved in either direction.

To use the stadimeter to measure the distance of an object whose height is known, set the micrometer screw opposite that graduation on the index bar which indicates its height in feet, and bring into coincidence the reflected image from the top of the object and the direct ray from its bottom. The distance of the object in yards will then be found opposite the pointer on the micrometer head.

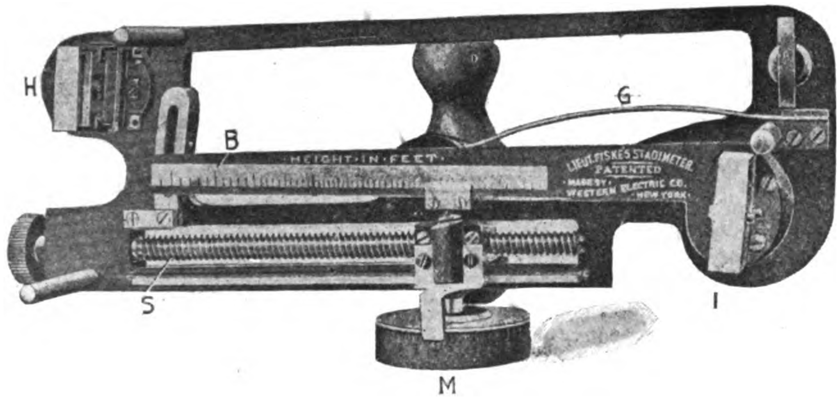
To measure the height of an object whose distance is known, assume the height to be 100 feet, and set the micrometer screw at the 100 mark on the index bar. Proceed as before, and read off corresponding distance (which may be called D) upon the micrometer head. Obviously,

$$\text{True height} : 100 = \text{true distance} : D.$$

$$\text{True height} = 100 \times \frac{\text{true distance}}{D}$$

The stadimeter may now be set at the true masthead height and used as explained before.

When employed in connection with the range finder in a naval battle, take the distance of the enemy with the range finder very carefully before the action has become hot, bringing her as nearly abeam as convenient, and when distant, say, 2,500 or 3,000 yards, find out her masthead height simultaneously with the stadimeter, and set the stadimeter at this height and keep it ready for use. If afterwards the range finder becomes disabled, or if it cannot be used for any reason, proceed with the stadimeter.



STADIMETER.

A moderately skilled observer can get eight observations per minute.

The foretop is a good place in which to use the stadimeter, the observer being connected by speaking tube, telephone, or range indicator with the person who telegraphs the ranges to the guns.

In fleet actions endeavor, if possible, to get exactly the masthead heights of all the enemy's ships and make a memorandum, to be used when required.

The manner of using the instrument is the same as that of the ordinary sextant, as are also the precautions to be observed regarding the parallelism of the mirrors.

To make the horizon glass parallel to the index glass, when the micrometer reads INFINITY, move very gently the two set screws at the bottom of the horizon glass, slacking one screw and screwing up the other, until the direct and reflected images of a distant object coincide. In using these screws remember that the reflected image seen in the mirror of the horizon glass goes in the direction in which the screws are advanced. If, for instance, the reflected image is below the direct image, screw up the lower screw and slack the upper one. Whereas, if the reflected image is above the upper one slack the lower screw and screw down on the upper one. Do not turn the micrometer head on its screw to accomplish this purpose.

When a very careful observation is desired, as in navigation, it is very desirable to assure the parallelism of the horizon and index glasses after the carriage has been set at the proper height.

Be careful not to force the micrometer head to turn, in case it turns hard, because the reason for its turning hard will be that the micrometer screw is clamped; and if force is used, the head may turn around independently of the micrometer screw. For this reason do not clamp it unnecessarily tight, and do not clamp it at all unless necessary.

The micrometer head is secured to the micrometer screw by the friction of three stout set screws, in such a position that when it reads INFINITY, the edge of the index bar is parallel to the slot along which the micrometer carriage moves on the long screw. If the horizon glass is adjusted to parallelism with the index glass when the micrometer reads INFINITY, and when the micrometer screw is set opposite any height graduation (say 200), the mirrors will remain parallel if the screw is moved opposite any other height graduation (say 60); because the index bar remains parallel to the movement of the micrometer carriage. But if, from accident, the micrometer head is forced to turn independently of the micrometer screw, then when the micrometer reads infinity, the screw will have placed the index bar at an incorrect distance from the long screw, so that if the horizon glass be made parallel to the index glass when the screw is opposite any height graduation, and if the carriage be then moved opposite to another height graduation, the index bar will also move and the parallelism of the mirrors will be destroyed.

This contingency is not probable, but in case it occurs, the micrometer head can be returned to its correct position on the screw by slacking the set screws and turning the head around till the adjustment marks scratched on the screw and the micrometer head near the set screws come opposite each other.

In case some accident should befall the instrument such that a total readjustment of the micrometer head on its screw becomes necessary, also to adjust during manufacture, proceed as follows:

Place the screw opposite 200, align the index bar approximately by eye, slack up the three set screws, make the micrometer read infinity, and reclamp the set screws. Make the mirrors parallel by moving the horizon glass, until the direct and reflected rays from a distant object coincide, as in adjusting a sextant. Move the micrometer carriage down to 60. Bring into coincidence the direct and reflected rays from a distant object, by turning the micrometer head.

If when the carriage is moved down to 60, the infinity mark on the pointer, it is because the index bar has moved further away from the long screw, showing that when the micrometer head was at infinity and the screw was at 200, the screw was forcing the index bar too far; so that when the screw got down to 60, and was further away from the pivot of the index bar, it did not force the index bar so far, and hence the micrometer head had to be turned to the right, bringing infinity to the right of the reference mark, in order to bring the index glass back to parallelism with the horizon glass.

If when the carriage is moved down to 60, the infinity mark is to the left of the reference mark, when the mirrors are parallel, the same reasoning shows that it is because the then existing position of the micrometer screw does not force the index bar far enough away.

Therefore, in the first case, when the mirrors are parallel, the screw is too far advanced; and in the second case, too little advanced.

If on going to 60 the distance in fractions of an inch that the infinity mark is to the right of the reference mark is A, turn the micrometer screw until the mark is about ⅓ A to the left of the reference mark and clamp the micrometer screw. Go back to 200 and make the horizon glass parallel to the index glass. Go down to 60. If now, in order to make the index glass parallel to the horizon glass, the infinity mark must still be moved to the right of the reference mark, the infinity mark must be moved farther to the left of the reference mark than it was just placed, and the above operation repeated. But if the infinity mark is found to the left of the reference mark, the micrometer head has been moved a little too far to the left of the reference mark and must be moved back a little, and above operation repeated.

If on going to 60 the first time, the infinity mark is found to be to the left of the reference mark, a distance equal to A, the infinity mark should be moved about ⅓ A to the right of the reference mark, the screw set 200, mirrors made parallel, and the same operation followed as above outlined, until the mirrors remain parallel when the micrometer carriage is at 200 and at 60.

If, when the screw is opposite graduations below 100, the variations from infinity are not more than $^1/_{32}$ inch, the error is negligible for practical purposes.

When the proper position for the micrometer head on its screw has been found, clamp the micrometer screw, slack the three set screws on the micrometer head, turn the micrometer independently of its screw until infinity mark is opposite the reference mark, tighten the set screws carefully and then unclamp the micrometer screw.

In case the known height of an object is more than 200, set the screw at 200, and measure the distance correspondingly, which may be called C. Now D, the true distance, is found as follows:

$$D : C = \text{True height} : 200$$

$$D = \frac{C \times \text{True height}}{200}$$

The stadimeter has been issued to nearly all our ships in commission; the New York, being a flagship, has two. The Texas has one for ordinary ship work, and another for use in connection with the range finder, the idea being that constant use of a stadimeter often in the rain, while not impairing its value seriously for use in fleet tactics, will injure the mirrors materially for fine gunnery work between 2,500 and 3,000 yards.

Note.—Some later instruments are made of an alloy of aluminum and nickel, which is very hard and durable. The weight of a stadimeter made of this alloy is less than two pounds.

ANOTHER UNIPOLAR MACHINE THAT WILL NOT WORK.

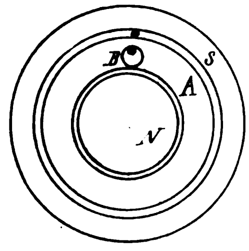
By JOHN R. MARKLE.

EXPERIMENTS made by Mr. Albert Hemingway and myself during several years past have suggested that an electric generator of the unipolar type, consistently based upon the theory of cutting lines of force could be constructed, that would afford a high e. m. f.

The basic principle involved was to be that of connecting the inductors in series by conductors so placed on the armature core as to partially evade the magnetic lines, or in other words, permit them to leak by or around the conductors.

Reference may first be had to the Siemens improved unipolar machine, consisting of a tube, or series of tubes revolved between the poles of an electromagnet, one pole of which completely surrounds the outer circumference of the tube, the magnetic lines passing radially through the tube to the other cylindrical pole within the tube.

In place of the tube an iron core, A (see diagram), is substituted. The conductor is placed across the outer circumference parallel with the axis of rotation and returns through holes or channels, B, in the armature core, and is given many turns. An e. m. f. would thus be raised equal to the effective e. m. f. of one turn multiplied by the number of turns.



UNIPOLAR DYNAMO.

By calculation the e. m. f. of one turn should

$$= (\text{total lines} - \text{leakage} \times \text{velocity} \times 10^8).$$

$$= (\text{total lines} \times \text{velocity} \times 10^8)$$

After much experimentation and careful checking for errors it is found that this arrangement does not produce the slightest e. m. f. Wherein it fails does not appear where the present accepted theory of "cutting lines of force" is consulted. Therefore the conclusion appears unavoidable that the theory of "cutting lines of force" is in some manner at fault, we believe, is absolutely erroneous. By applying the law of "induction" in this case the problem is solved readily. No necessity for this experiment shows when this law is consulted.

It is stated by all authors I have read on the subject that "the magnetic field is structureless," and the assumption always follows "that it has lines of force," and hence, I take it, has structure. Does not a contradiction appear here and possibly with it a "root of evil" out of which has grown a convenient or easy-going theory that has worked the art incalculable injury?

ROENTGEN RAYS

AN EXPERIMENT SHOWING THE DEFLECTION OF CATHODE RAYS BY A MAGNETIC FIELD.[1]

BY J. A. FLEMING, F. R. S.

AN interesting experiment, showing the effect of a magnetic field upon cathode rays, was lately tried in my laboratory. It is so simple that nothing would surprise me less than to learn that many people had noticed the same thing before, although I cannot recall to mind having seen it anywhere mentioned in print.

Happening to have one of the well-known pear-shaped Crookes' vacuum tubes for showing the shadow of an aluminum cross fixed in the tube on the phosphorescent end wall when an induction coil discharge is passed through the high vacuum, I asked Mr. Morris to arrange it in front of an electromagnet, that I might see produced the effect described by Mr. Campbell Swinton lately, whereby a magnet pole placed at the end of the tube destroys in great part the green phosphorescence of the glass, and gathers the discharge into the axial line of the tube. It was then noticed by us that another curious change took place at the same time, in the form of the shadow of the metal cross; and Mr. Morris and Mr. Clinton who were experimenting with it, finally were led to try a coil traversed by current, placed round the tube as shown in Fig. 1, as a substitute for the magnet.

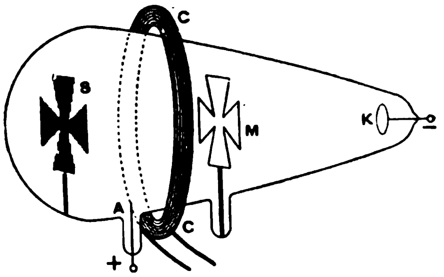


FIG. 1.—Crookes' Vacuum Tube.

K = Cathode. M = Metal Cross. A = Anode. C = Magnetising Coil. S = Fluorescence Shadow of the Cross. The diagram shows the normal condition when no current is flowing through the coil C, but when the discharge is passing through the tube.

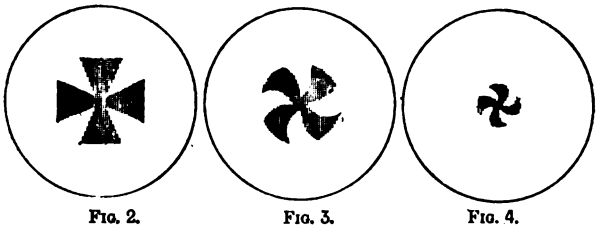


FIG. 2. FIG. 3. FIG. 4.

End-on view of the vacuum tube in Fig. 1, showing the appearance of the fluorescence shadow on the glass wall as the current in the coil C is gradually increased. Fig. 2.—No current in coil C. Figs. 3 and 4.—Gradually increased current.

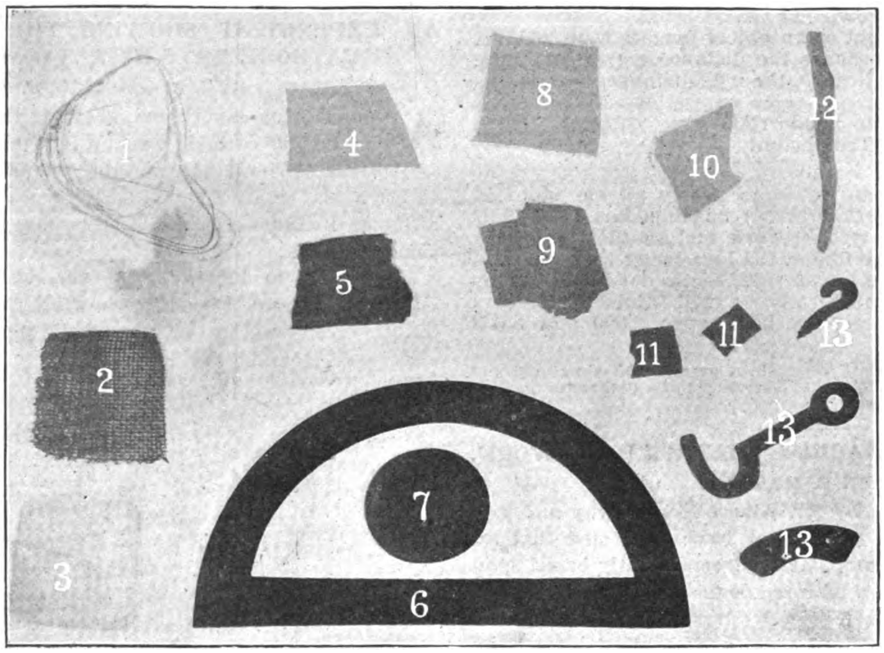
---

[1] Lond. Electrician.

The following striking effects were then noticed. When the coil embraced that part of the vacuum tube beween the metal cross and the end wall on which the shadow is formed, and when no current traversed the coil, the shadow of the cross was a dead black shadow on an apple-green phosphorescent ground, and was strictly the shadow of the cross defined by the cathode rays as in Fig. 2. When the embracing coil had a current passed through it the shadow rotated clockwise or the reverse according to the direction of the coil current, and the arms of the shadow were a little distorted or twisted round, so as to resemble Fig. 3, the leading edge of the shadow being rather sharper than the trailing edge. Moreover, the shadow was altogether smaller than in the first case. As the current through the coil was increased the shadow cross twisted itself more round, and got still smaller, as in Fig. 4; and finally as the coil current was still more increased the cross shadow was further rotated and diminished until it vanished. At the same time the phosphorescent area on the end wall contracted, but as long as there was the smallest patch of green, a tiny little cross shadow could be seen in it. At this stage the coil current was increased still more, and a new and larger cross shadow made its appearance. This shadow was not so well defined, and the background less uniformly green; but it too, as the coil current was still more augmented, screwed itself round very slightly. This second shadow had arms more sickle shaped than the previous one.

If the magnetizing coil, instead of being placed to embrace the tube between the metal cross and the end wall farthest from the cathode, was placed over the portion in between the cathode and the metal cross, then the shadow went through the diminishing process, but not through the rotating and distorting phases, as the coil current was gradually increased, step by step. In this case also there is a second stage in which a second and very much larger cross makes its appearance, which in turn contracts in size.

Any one possessing a vacuum tube of this kind, and a coil of a hundred turns or so, through which 10 or 12 amperes can be passed, can easily repeat this curious experiment. It is obviously due to the effect of the magnetic field upon the direction of the cathode rays on discharge. It is not difficult to see why. in the first case, the cross shadow rotates and diminishes; but the appearance of the second fainter and larger cross shadow seems to indicate that the effective radiant point of the cathode rays is moved nearer to the metal cross after a certain intensity of field is reached. As I hope to be able to examine the effect with vacuum tubes of other forms, I forbear to enter on any speculations at present as to the precise nature of the actions going on under these conditions. I merely mention the matter here that others may repeat the experiment, if it should prove not to be generally known at present.



PROF. MCKAY'S MAGNETOGRAPHS.

(X-Ray Phenomena Attributed to Electro-Magnetic Radiation.)

PROF. McKAY'S MAGNETOGRAPHS.

In acknowledging the receipt of a copy of the book entitled "X-Rays and the Phenomena of Anode and Cathode," by Edward P. Thompson and Prof. W. A. Anthony, Lord Kelvin states his belief that hitherto nothing in the way of diffraction has been discovered for the Röntgen rays, and doubts very much the genuineness of McKay's magnetographs described in the book. No other experimenter, says Lord Kelvin, has given any confirmation of these experiments.

As the matter here referred to seems to be well worthy of further investigation, we reproduce from the work above referred to the part referring to Prof. McKay's experiments:

"Although this experiment does not belong to that class connected with discharge tubes, yet the phenomenon has a theoretical interest in connection with X-rays. He obtained a photograph of different objects in the dark by means of radiations from the poles of an electro-magnet after two hours' exposure, but it need not have been so long, as he obtained clear images in five minutes in one experiment with frequent variations of current by means of a rheostat, and by approach and recession of the armature.

"The elements involved in the experiment were arranged in the following order: First, a large inverted magnet for supporting 100 lbs., the poles hanging downward. Next in order was a wooden board pressing flatwise against the ends of the poles of the magnet. Next the objects and the sensitive plates backed thereby and all enclosed in a completely opaque wrapping extending over the sides, face, back, etc., of these two elements. Next in order was an armature about as heavy as the magnet would support. The cut herein (see illustration) represents the photograph that was produced of the different objects named.

"By reading Prof. McKay's very detailed description in the 'Scientific American," April 18, 1896, p. 249, the reader may feel certain that the photograph was not due to light for he tried the experiments in different ways and with various precautions. In a course of experiments carried on by student Austin, about Feb. 15, 1896, in the Dartmouth laboratory, a sciagraph of what appeared to be the lines of force was obtained by means of X-rays, but upon repeating the experiment the result was negative. See "Elec. Engineer," March 11, '96, p. 257. Article by E. B. Frost."

The numbers on the accompanying engraving designate the following objects: 1. Platinum wire. 2. Copper gauze. 3. Iron gauze. 4. Tinfoil. 5. Gold foil. 6. Brass protractor. 7. Silver coin. 8. Platinum foil. 9. Brass. 10. Lead foil. 11. Aluminum. 12. Magnesium ribbon. 13. Copper objects.

BECQUEREL RAYS.

FOLLOWING out the experiment of Becquerel that certain uranium salts, after exposure to sunlight, emit radiations which, like Röntgen rays, are able to affect photographic plates with opaque material intervening, Prof. McKissick, of Auburn, Ala., has recently carried out a series of experiments, which led him to the belief that the Becquerel ray is the connecting link between the ordinary light and the Röntgen ray.

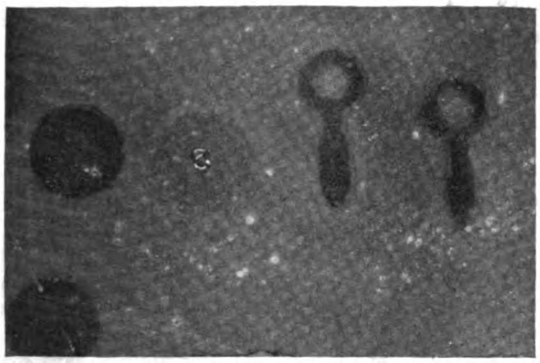


FIG. 1.

Prof. McKissick investigated the action of all the known phosphorescent and fluorescent compounds available and found that lithium chloride (in solution), barium sulphide, calcium sulphate, quinine chloride, quinine sulphate, calcium nitrate, chalk, glucose, sugar, sodium tungstate, sterein, uranium acetate, and ammonium-phospho-molybdate, give active photographic radiations after exposure to sunlight. To take the pictures, the articles were placed in contact with the sensitive plate, and the substance, after exposure to sunlight for two hours, sprinkled over the plate holder. The whole was then enveloped in a dark cloth, so as to prevent the action of any external light on the plate. The plates used were "slow" (sensitometer No. 16). Ordinary developer was used and in some of the experiments the development required an exceedingly long time.

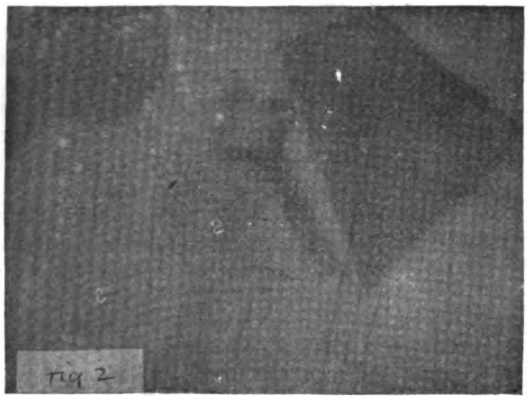


FIG. 2

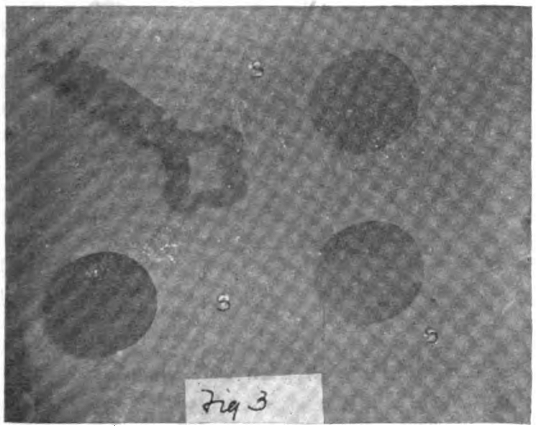


FIG. 3.

Figs. 1 and 2 are photographs reproduced of different articles taken with uranium nitrate, Fig. 1 being two keys and two copper cents, and Fig. 2 a piece of glass, a key and two coins (a copper cent and a quarter). A very peculiar property of this radiation is that generally more than one image of an object is produced on the plate although the object is in contact with the plate) as may be seen by closely inspecting the photographs reproduced. For simplicity we may designate the sharper and more pronounced image the primary and the less distinct ones the secondary, being marked with the letter "S" in the center.

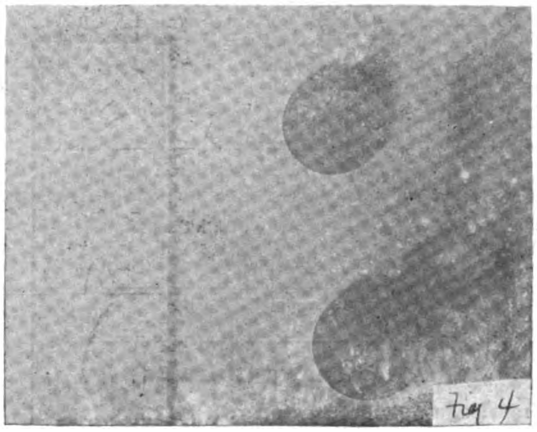


FIG. 4.

Of all the substances tried Prof. McKissick found that white granulated sugar gave the best results. Fig. 3 is a photograph of a key, three copper cents and an irregular piece of glass (secondary images marked as usual with "S"). Fig. 4 is a photograph of two coins, a key and a piece of glass, sugar being used but acting through a piece of wood 2½ inches in thickness. In one negative Prof. McKissick noticed as many as five images of one object and sometimes on the same negative there would be two images of one object and only one of another object only two inches away.

It was suggested by Prof. B. B. Ross that inasmuch as quite a number of fluorescent and phosphorescent substances possess high molecular weights, other substances of high molecular weights, although not known to be either fluorescent or phosphorescent, might give off these rays.

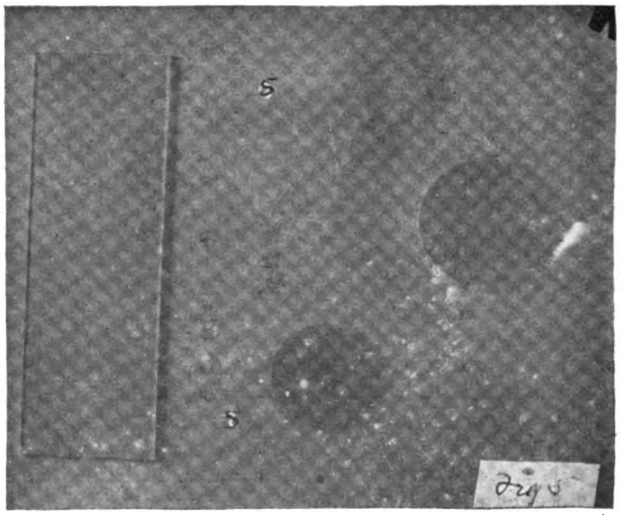


FIG. 5.

With this idea sterein and ammoniumphospho-molybdate were tried, and both were found to give off Becquerel rays, the first, sterein, very slightly, the second, ammoniumphospho-molybdate, giving a fairly clear and sharp negative, as will be seen by inspecting Fig. 5, the articles being a piece of glass, two coins and a key. The secondary images are marked as usual with the letter "S," that of the key being rotated through an angle of about 45 degrees. Uranium nitrate sprinkled on top of the plate holder and then exposed for 18 hours to the sun gave only a faint negative.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - -	per year.	$3.00
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[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, JANUARY 20, 1897. No. 455.

WHAT WILL SHE DO WITH IT?

THE marriage union of Niagara with Buffalo was celebrated last week, three months after the consummation. But in reality, the festivities were precipitate rather than tardy, for had matters been left to the ordinary course of physical events, the arrival of Niagara at Buffalo would be a convivial opportunity for our descendants 60,000 years hence. A little computation will show that at its crab-like travel of two feet a year, Niagara would not have eaten its way backward through shale and limestone to the water front of Buffalo in any shorter period. Thus do the modern inventor and the genius of electricity anticipate the flight of time. It is curious that the same year which learned the discovery of the supersubtle X-ray should have witnessed, at the other end of electricity's scale, the harnessing and distribution of Niagara's illimitable energy. The year 1896 was memorable, and when we have fairly emerged from its wrecks and disasters we shall recognize its many lasting benefits. In America we established anew our national honor; we vindicated our right to lordship in this Western world; by a treaty of arbitration we federated willing England into the American Union of mutually pacific States; and chief among the triumphs of peace, we subdued nature at Niagara that we might give larger liberty to every American workman.

How wild and fantastic it all seemed a few short years ago, this Niagara project! The tightrope dancer balancing himself painfully above the roaring, awful abyss of the Falls had not more nerve and courage than the men whose money and brain have created a new power center for the world, to whose balance industries must now poise themselves as do peoples in international politics. A region of 22 miles radius, with Buffalo as its center of attraction and Niagara as its source of power, has within six years been made the potential heart of manufactures in the United States. The organizers of the great enterprise have gone to Niagara and after a brief but decisive struggle are able to turn around and say to all who need cheap power and are willing to come to the Buffalo region for it: "We have met the great Cataract—and she is yours." The Delilah who has tamed this Samson of water powers can invite us all to witness and enjoy the spectacle, without fear of harm or future danger for anyone, and in the knowledge that Samson is the better man for having his hair cut in a civilized fashion. Of a truth, the salad, festive days of Niagara are over, and a career of strenuous effort has begun. While the older methods of utilization disfigured her, this modern plan is unobstrusive in its continuation or protection of her charms. As a matter of fact, the power of Niagara has more beauty than her beauty has power, for hitherto the human intellect and imagination have avoided her as a background for their creations. Ideas vary as to desirable qualities. Dean Stanley admired Jenny Lind immensely, but said she would have been simply delightful if she had not sung. The deep note of Niagara is now mitigated into the cheerful hum of toil; the present picturesque aspect of the Falls is preserved and conserved; Buffalo has attained the long-felt wish of seeing Niagara at play and work in her back yard—and the Power company is already selling 25,000 horse-power for somewhere around half a million dollars a year. Is not this a happy result in common for aesthete, financier, inventor and engineer? And how rarely it happens!

To Buffalo we would simply address the friendly admonition of liberality. It has cost that city absolutely nothing to have the power of Niagara brought to her doors. Freely she has received, freely let her give. Now is the time for her to encourage the Niagara Power Company to spend more money in her behalf. The whole question now that Buffalo has got the power is: What will she do with it? If she reward largeness of enterprise with corresponding largeness of welcome, there is no doubt as to her future. No greater mistake can be made than for people or city to stand suspiciously aloof when great progressive enterprises touching their welfare are afoot. "We don't own it," growled a passenger angrily when disturbed in his sleep and told that his services were needed at the pumps because the steamer was going down. Such narrowness of mind is always suicidal, and nothing that represents thrift, property and courage is ever injuriously affected without the community feeling it far more than the few individuals. The dignified and manly plea of Mr. Stetson at the banquet, for honorable treatment of his company which right through the hard times has spent its money with Niagara profusion, must find a cordial response from every public-spirited Buffalonian.

In a sense, the Niagara-Buffalo banquet was a distinct tribute to the modern electrical inventor, and as all these sentiments crystallize around personalities, the honors were paid very appropriately to Mr. Tesla, who when everybody else felt dubious, said the thing must be, taught us how to do it—and it is. That such men as Brush, Thomson, Sprague and other electricians were there to share these honors, was eminently fitting and fortunate, for while each great worker does something, no one genius can do it all. What such men need from us is encouragement, sympathy, applause. The hanging of Frank Sprague in effigy at Louisville because his trolley freed the mule, simply shows that the way of the inventor, like that of other transgressors, is generally hard. The extent of his innovation marks the degree of his impropriety, and society has usually seen to it in days gone by that the punishment should fit the crime. Even now, when the inventor is becoming more and more a person to magnify, it is all struggle for him; frequent defeat, rare victory; headlong torrents and sheer cliffs to breast and lift above; and once in a while, like Capt. Webb, the brave swimmer is carried under, a victim to his own intrepidity. We cannot follow these men in all their efforts and intuitions, but we can feel for them as fellows, sorrow when achievement lingers, rejoice when victory greets some golden morning, and, as on occasions like this Niagara banquet, drink royal toasts of amity and admiration in their honor.

THE COST OF MUNICIPAL ELECTRIC LIGHTING.

NEW ENGLAND thrift is proverbial and the high order of economy which has been reached in its famous mills and manufactories is reflected to a large degree in the administration of municipal affairs in that section. New Englanders generally look before they leap, and a striking example of the carefulness with which municipal expenditures are undertaken in that section is shown in the results of an investigation set on foot by the municipal authorities of Brookline, Mass., with a view to the installation of a municipal arc light plant. We have before us the report made by Mr. Nathan Matthews, Jr., to the Selectmen of Brookline, and we commend this document to all citizens as well as municipal authorities in general, as one of the best on the subject which has yet come under our notice. It has been the general practice for municipal authorities about to install electric light plants to send a junketing committee abroad to visit plants and to report upon their impressions. These reports as a rule contain statements and statistics which rarely receive thorough investigation as to their reliability, the cost of municipal lighting in the majority of cases being given as merely equivalent to the ordinary running expenses of the stations without taking into account other essential items. In marked contrast to this is the plan adopted by the Selectmen of Brookline. Instead of a junketing committee they employed two independent competent engineers; one of these, Mr. Wm. Jackson, city engineer of the city of Boston, and Messrs. Stone and Webster, electrical engineers, also of Boston. Each of these made independent reports and submitted answers to questions put to them involving estimates of the cost to construct and operate electric light plants of a capacity varying from 250 to 750 lights. The annual cost of operation of one arc lamp per year, as given by the two experts, runs from $106.65 for the largest plant, to $149.83 for a plant of 500 lights run for 250 only. As the margin of 100 per cent. in the capacity of the power station in the last mentioned case is more than would seem to be necessary, Mr. Matthews takes as more nearly meeting the actual conditions another figure submitted, namely, $123.04, which represents the cost of operation for running 375 lights with a plant having a total capacity of 500. The figure $106.65 is that given for 500 lights operating from a station with a total capacity of 750.

As Mr. Matthews very truly points out, these figures are on the one hand considerably less than the cost of manufacture as claimed by the private companies interested in the business, and on the other hand higher than the cost of lights operated on public account as set forth by some of the advocates of municipal ownership. Mr. Matthews believes that the fact that these prices are lower than private companies commonly claim to be the actual cost of manufacture and distribution is explained, among other things, by the fact that many of the companies now engaged in electric light business are conducting their business with old-fashioned or obsolete machinery, which in the aggregate has cost considerably more than a fresh modern plant would and is more expensive to operate. But he also shows that these prices on the other hand are higher than those frequently set up by theoretical advocates of municipal ownership. This is due first to the very general omission by the latter of adequate allowances (when any are made at all) for interest, depreciation, insurance and taxes; and secondly, to the fact that many, in fact, nearly all, of the official accounts published by municipal corporations of the operation of their electric light plants fail to include among the actual expenses of operation many items which should properly be charged thereto, such as general office or administrative expenses, rent, salaries, etc. Thus, in figuring the actual cost of operation for Brookline there has been included interest on the total cost of the plant at the rate of 4 per cent., and not, as is commonly done in such calculation, on the amount of bonds outstanding, if any, issued for the purpose of procuring the plant. That interest should in this matter be reckoned into the calculation is disputed by some advocates of municipal ownership, but Mr. Matthews points out that the problem is practically the same as that which arises in the domestic economy of the individual citizen when calculating the relative advantage of hiring a house or buying one to live in. If in this calculation of the cost of living in a purchased house, he would leave out interest on the cost of the house, the result would obviously be fallacious; for if he had not invested his money in the purchase of the house he would have it to invest in interest- or income-producing property. It seems strange that such plain facts should require to be so explicitly stated, but that they are necessary is evident from what we have seen in municipal plant operations in the past.

Taking the probable figure of the cost of electric light at Brookline as given by Mr. Matthews as $123.04 per lamp per annum, it will be seen that this comes very close to the prices charged by most private companies throughout the country, where the amount of lighting is in fairly concentrated districts. In New York, for example, the rate of 40 cents per night makes the cost per lamp $146, or only $23 more than that given for Brookline with the highest type of modern apparatus. When we consider that, as truly pointed out, much of the apparatus employed in the present stations in New York City is antiquated and that the New York companies are burdened with rentals of underground conduits and other incidental expenses which the Brookline plant would not be subject to, we leave it to any fair-minded citizen to judge of how much profit there can be in arc lighting at 40 cents per night. We wish that every municipality before entering into the subject would as thoroughly investigate it as have the citizens of Brookline. If such had been the case we would probably not see so many municipal plants at the present time struggling along under a loss to the citizens and in many cases unable to compete with private companies.

A year or two ago fire insurance companies were howling calamity, declaring frightful losses in their business and loading all the blame on poor electricity. Never a bad or mysterious fire happened, but they at once surmised the cause to be "a defective electric wire." Last year one company made a clear profit of 86 per cent., another of 61, another of 55, another of 48 and another of 29. Suppose they now give a little tardy credit to electricity which is more used to-day than ever.

EVEN the elect are sometimes deceived, but Dr. Richard Hodgson,president of the Boston Society of Psychical Research, intimates that Dr. Oliver Lodge was more than fooled by the Italian medium, Eusapia Paladino, who has lately been exposed. It would appear that Dr. Lodge wrote a paper in her behalf, read it before the British Society of Psychical Research and would have published it in the transactions but for the intervention of a merciful Providence. We have not seen the volume, but if Dr. Hodgson may be believed, the title is in the table of contents, though the paper by the great physicist is missing.

THE Pacific cable is still in the air—instead of in the water—and the New York "Sun" thinks that as Congress is handy, an American Company may still do the work and own the cable. It is not easy to find out just "where one is at" in this matter, but it will be strange if an English cable, after all, is not the first to cross the Pacific. The English are just as able at cable laying as they are at ship building, and one more link in their cable system is quite in the natural order of things. But our politico-financial interests in the East require that the United States should at least have a say in the matter, and not stop short at mere "say."

IT is a pity that the word "Electric" continues to be so abused by misapplication. The puzzled electrical journalist can never be sure now whether a new enterprise is electrical or not, judging merely from its name. An electric grain elevator company has just been formed, but the managers now say that no reference is made to the use of electric power. Last week an "electric" laundry company was formed at Rochester, N. Y., but it is quite possible it will employ "electric" soap and not Mr. James I. Ayer's ingenious flatirons, using the juice of the dynamo.

EDDY POWER PLANT IN THE CONSOLIDATED DENTAL CO.'S FACTORY.

THE processes of dental manufacture are numerous, intricate and often delicate, requiring that the power applied to the machinery shall be smooth and uniform. Competition in the industry of late years has been no less rife than in other lines of trade, so that every possible economy has had to be inquired into with a view to its adoption. These considerations readily explain the decision of Mr. G. J. Bultman, vice-president of the Consolidated Dental Manufacturing Company, when equipping their large new factory at One Hundred and Sixty-second street and Brook avenue, New York City, to equip with electric power entirely. The plant is illustrated herewith, and must be regarded as a model of its character and class.

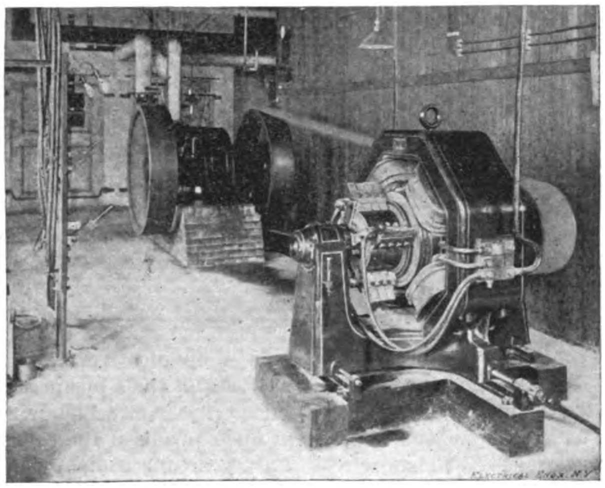


FIG. 1.—EDDY GENERATOR DRIVEN BY ARMINGTON & SIMS ENGINE, CONSOLIDATED DENTAL FACTORY.

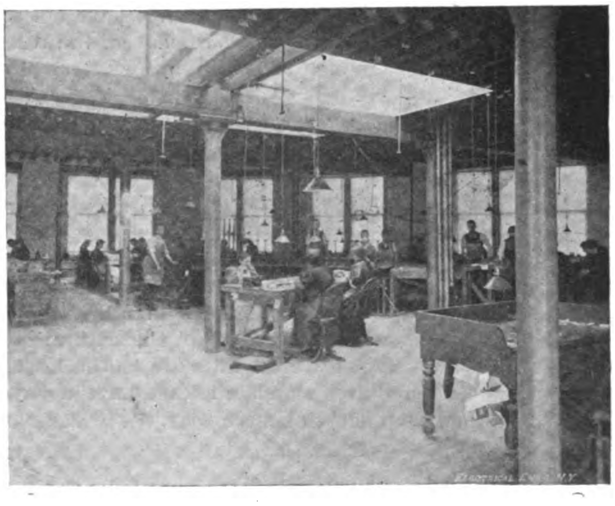


FIG. 2.—TRIMMING ROOM, USING ELECTRIC HEAT IN ITS WORK.

The electrical equipment referred to and shown in the engravings was furnished by H. B. Coho & Co., of 203 Broadway, New York. It comprises a 60 kilowatt Eddy generator driven by a 13 by 12 Armington & Sims engine operating no fewer than ten Eddy motors, ranging from 2 horse-power up to 10 horse-power. The dynamo supplies current for light, power and heat, and all the circuits are controlled from the switchboard in the engine room, each motor being protected by an automatic release box and circuit breaker, as required by the Fire Department. The plant is so designed that each room has its own independent motor, and in some places where the work on one floor is unlike or separated, two motors are placed in the same room. For example, the polishing rooms require considerable power at certain periods of the day, and these have an independent 5 horse-power Eddy motor. The main idea running all through the work is that when no power is required, none shall be furnished and thus none wasted, so that the item of power in the operating expenses is kept down to the lowest notch. Fig. 1 shows the dynamo room. Fig. 2 is the trimming room; Fig. 3 the machine shop, and Fig. 4 illustrates a 5 horse-power motor on a wall bracket, used for the cutting and rolling work.

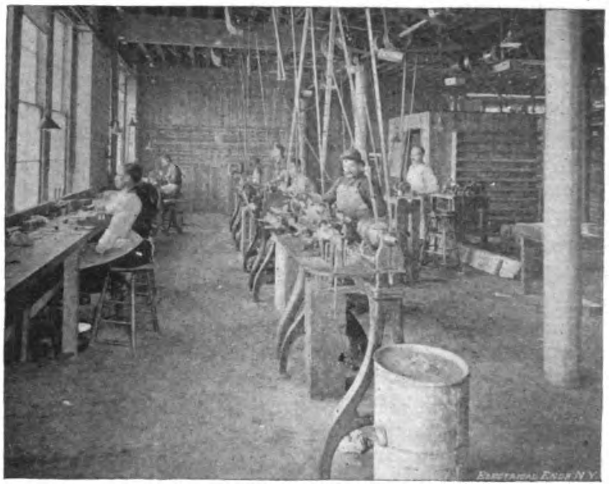


FIG. 3.—MACHINE SHOP OPERATED BY ELECTRIC MOTOR.

It will be seen that a large part of the capacity of the generator is taken up by the motors, but for night work, etc., no fewer than 250 lights of 16 candle-power have also been installed. As to the motors, it may be noted that they have been very carefully installed, being all placed out of the way of travel and run of shop work material and protected from dust or dirt. In addition to the current supplied for light and power, about 80 amperes is taken by some special electric heating appliances, used in porcelain teeth making processes where very regular and steady heat is required, susceptible of fine gradation and regulation. These heaters or muffles were made by the American Electric Heating Corporation of Boston. It should be added that the Consolidated Dental Company not only make teeth but fine steel dental instruments, etc., and are a busy concern whose reputation has been made by the quality of their goods. This general resort to electricity by Mr. Bultman and his associates in the company is, therefore, at

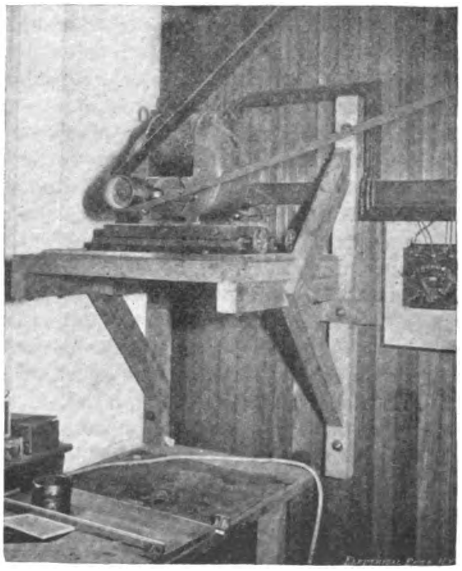


FIG. 4.—5 H.-P. EDDY BRACKET MOTOR DRIVING THE CUTTING AND ROLLING MACHINERY.

once encouraging and significant, while the plant itself reflects much credit on the contractors and the manufacturers of the apparatus.

THE BUFFALO-NIAGARA POWER CELEBRATION.

A Memorable Banquet in Buffalo, Jan. 12, 1897.

No sooner had the energy of Niagara been actually delivered in Buffalo, by means of electricity, and applied to the operation of the street cars, than it was felt that such an occasion ought to be fitly celebrated. Just in what way the great event should be signalized, it was, however, difficult to decide. Many people in the city of Buffalo wanted a big electric carnival and will probably have it sooner or later, but time was slipping by, and the occasion was losing the impressiveness that is always given by a public function. In this state of affairs, the Cataract Power and Conduit Company, which is the corporation handling the power in the city of Buffalo, took the matter in charge for itself, and determined to give a banquet that by its character should do justice to one of the grandest achievements of the century; and the organization of this was judiciously entrusted to the two well-known Buffalonians, directors in the company, George Urban, Jr., and C. R. Huntley. The date of January 12 was fixed and the beautiful new Ellicott Club was selected for the purpose.

Many of the guests arrived early on Tuesday, the 12th, and spent the day at the Falls, viewing the works, a party being made up under the care of the Niagara Power people; and in the evening some 400 mustered at the club. It is not necessary that we should give the complete list of the invited, but the subjoined names of those present in behalf of the various branches of electricity will afford an idea of the gathering and of its representative nature: E. G. Acheson, C. F. Brush, W. A. Brackenridge, C. A. Coffin, W. G. Case, W. L. R. Emmet, T. H. Feary, H. A. Foster, S. D. Greene, F. A. Gilbert, F. W. Hawley, S. M. Hamill, J. S. Humbird, R. Hammond, G. B. Hayes, E. J. Hall, S. M. Hamill, C. R. Huntley, W. J. Johnston, W. H. Lawrence, H. M. Littell, F. D. Locke, T. C. Martin, B. F. Miles, F. Nicholls, D. O'Day, J. P. Ord, C. W. Price, D. B. Parker, E. W. Rice, Jr., C. P. Steinmetz, F. J. Sprague, W. W. Sloan, H. G. Stott, Elmer E. Sperry, Elihu Thomson, Nikola Tesla, C. A. Terry, J. G. White, H. M. Watson, P. M. Lincoln, L. B. Stillwell, B. Van Horn, P. A. Porter, N. J. Porter.

The company itself was represented by Directors D. O. Mills, F. L. Stetson, E. D. Adams, E. A. Wickes, D. O'Day and Messrs. Urban and Huntley. The distinguished guests representing politics, finance, engineering, journalism, etc., were numerous. The menu was handsomely printed in the shape of a little book about a quarter of an inch thick, bound in thick aluminum covers, the metal being made by the power of Niagara in the works of the Pittsburg Reduction Co., at the Falls.

The speakers and officers occupied a raised table across one end of the room. Mr. Urban introduced MR. STETSON, who said:

Mr. Mayor and Gentlemen.—To these festivities, which you have honored by your presence, the Cataract Power and Conduit Company of your city of Buffalo has requested me to bid you welcome and to make a brief statement concerning the part taken by the company in the introduction of Niagara power into this Queen City of the Lakes. Shortly after enterprising citizens of Buffalo had proposed to give $100,000 as a prize for the device of a practicable method of using the Niagara power in Buffalo, there was organized, in 1886, exclusively by citizens of Niagara Falls, the company which since 1889, has been known as the "Niagara Falls Power Company," or the "Tunnel Company," and which in July, 1889, entered into a contract for the construction of its works at Niagara.

This contract was made with the Cataract Constuction Company, composed then exclusively, and now principally, of citizens of New York. In the course of the six years since this original contract the Cataract Construction Company, without thus far receiving one penny of profit or dividends or interest, has provided for expenditures exceeding $6,000,000 in money, exclusive of interest, thereby acquiring substantially all of the stock of the Niagara Falls Power Company.

Incidentally, the power company has promoted the formation and the business of the Niagara Falls Water Works Company, and of the Niagara Falls Junction Railway Company, and also of the Niagara Development Company, intended for the provision and establishment of a satisfactory residential district for employés connected with the various industries established and to be established around the power house at Niagara Falls.

Naturally, the interest and object of first importance to the Niagara Falls Power Company would be the establishment and development of its installation at Niagara; but, notwithstanding the fact that the employment of its power at Niagara Falls would be much more profitable than its transmission for use elsewhere, it was and is impossible for the company not to recognize the ultimate benefits both to itself and to this community of providing for the use of its power in this great, growing and enterprising city of Buffalo.

Accordingly, in October, 1894, the Niagara Falls Power Company made application to the local authorities of Buffalo for the right to introduce Niagara power into the city and to make use of the city's streets for its transmission and distribution. That this application was not granted in precipitate haste or without due consideration is indicated by the date of the franchise, which was approved by His Honor the Mayor on December 16, 1895, 14 months after the original application.

As granted, the franchise was free from a number of conditions originally proposed, which to the Power company seemed unduly onerous, in view of the fact that now, at its own risk and without asking compensation, it was offering to bring about the result for which a few years previously public sentiment in this city had proposed to give a prize of $100,000. In its final form, the franchise was intended to be fair to both parties, and no reasonable complaint of its conditions can be made by either, although some modifications may yet become necessary, as to one of which presently I shall have something more to say.

Naturally enough, the Niagara Falls Power Company, in the introduction and distribution of its power in this city, desired local support and assistance. Accordingly, several prominent and public-spirited citizens of Buffalo were induced to organize the corporation now known as the "Cataract Power and Conduit Company," to which, with the consent of the common council, under the 12th article of the franchise, the Niagara Falls Power Company has assigned its grant, and this new Cataract Power and Conduit Company, directed principally by citizens of Buffalo, has undertaken the duty of distributing, within the city limits, the power brought to the boundary by the Niagara Falls Power Company.

The franchise of December 2, 1895, required the Power company, within 90 days after acceptance of its provisions, to present and to file with the Board of Public Works, for its approval and for the approval of the common council, plans and specifications for its work, and with this condition the power company strictly complied. It was further required that on or before June 1, 1897, the company should be prepared to supply 10,000 horse-power to consumers within the city, and with this condition the company has so far complied that upon the first day of December, 1896 (six months before the specified date), it introduced into the city of Buffalo 1,000 horse-power, which from that time on has been satisfactorily employed by the enterprising, intelligent and public-spirited directors of the Buffalo Street Railway Company, whose president and whose manager we are glad to see here to-night, and to whose justifiable confidence in the sufficiency and continuity of Niagara power the city of Buffalo is indebted for this early introduction.

It is, however, proper to observe that a reasonable postponement of the date before which the remaining 9,000 horse-power shall be required to be ready for use in this city will be necessary. It is entirely credible that, like the business men of every other city of the United States, the citizens of Buffalo found the spring and summer of 1896 exceptionally unfavorable for the promotion or prosecution of business enterprises involving novel elements, or calling for the expenditure of considerable sums of money. But whether or not this were so in Buffalo, it is true that during the year 1896, and prior to November 4, few corporations undertook or accomplished in the way of new construction more than did the Niagara Falls Power Company and the Cataract Power and Conduit Company in the installation of the line, for generating and transmitting the Niagara power now in use in the city of Buffalo. Naturally enough, all desired that such installation should be established with such care as to avoid, so far as possible, the chance of failure and disappointment in operation, and, therefore, it was deemed best, not to provide all the new machinery required for 10,000 horse-power until after the actual test of the transmission of the 1,000 horse-power, for the delivery of which upon December 1, Mr. Littell contracted in August, 1896.

The actual test having been made with results wholly satisfactory, the Niagara Falls Power Company now has concluded its contracts for the immediate generation of not merely 10,000 but of 25,000 additional electrical horse-power, of which as much as required will immediately thereupon be available for transmission to Buffalo. The contracts for this purpose have been actually assented to, and the money therefor has been actually provided.

The contract for an extension of the wheel pit sufficient to receive all the machinery for 50,000 electrical horse-power was made in 1896, and work thereunder has been and now is proceeding with the stipulation for its completion during the month of May, 1897.

It had been supposed that the turbine wheels and the generators also could be furnished before that date, but the contractors are now unable to promise such completion, and, accordingly, there must be an extension of the period within which the delivery of the remainder of the first 10,000 horse-power to this city shall be required, so as to enable the contractors progressively to furnish the five turbines and the five dynamos for which, as I have already said, the contracts have already been made and the money provided. We have no doubt that the public spirit of Buffalo, which originally perceived the city's peculiar and great advantage in its proximity to Niagara power, will now recognize the appropriateness of the request for such an extension, and by prompt acquiescence will encourage and stimulate the extended provision of Niagara power for use in this city.

It is a pleasure to be permitted to welcome here one of the most distinguished sons of Buffalo, the Comptroller of the State of New York. For it is not to be forgotten that through the wise and liberal disposition of the executives and legislatures of the State, the development of the Niagara power has been made possible within its boundaries.

Rights in respect of the Niagara power, upon the Canadian side, have been granted by the Province of Ontario upon terms which, though specially advantageous to the Province, are in some particulars more favorable to the company than are those conceded by the State of New York. For while it is true that the Canadian Niagara Power Company is under agreement to pay to the Province of Ontario an annual rental of $25,000, this rental secures to that company the right to place its works inconspicuously within the limits of the public reservation, and so near to the very Falls themselves as to avoid more than 6,000 feet of tunnel, which upon the New York side had to be constructed at a cost of nearly $600,000, to bring the power house of the company above the limits of the State Reservation. It requires but a moment's calculation to show that the interest upon the additional construction required in the State of New York is more than equal to the entire rental paid to the Province Ontario, and that thus I am justified in saying that in some particulars the Canadian grant is more favorable to the company than that in the State of New York, although there results to the provincial treasury a pecuniary profit which similarly might have resulted to the State of New York, except for the requirements as to the position of the company's works.

From beginning to end the Power company has recognized the glory of Niagara Falls as the first object of great natural beauty and power upon the face of the earth; and therefore, while conscious that its works on the American side might have been constructed as near to the falls as will be those of the Canadian Niagara Company, without conspicuous or undesirable interference with the aspect or the volume of the mighty river or its cataract, the officers of the Power company have cheerfully acquiesced in a requirement which has resulted in the erection of its beautiful buildings and works at a point more than a mile above the falls and utterly beyond observation therefrom.

The result thus accomplished, with every promise of immediate and satisfactory extension, for this, the second city of the Empire State, may also in a future not far distant be made available under conditions of course less favorable than those prevailing, but still upon terms advantageous to other cities in our State, and also for use as required upon the canals of the State. For, though the Niagara Falls Power Company has no relation whatever to any grant upon the canals, excepting a license for its very slight use of canal lands in Niagara and Erie counties, it cannot fail to recognize the energy and enterprise of other organizations which may become users of Niagara power for the relief of the important interests, which either in the ownership or the navigation of canal boats or of their cargoes, contribute largely to the commercial importance of the Empire State and of its cities upon the line of the canal and of the Hudson River.

Under these conditions the promoters of the use of the Niagara Falls power and its electrical transmission feel that not improperly they may presume themselves in some degree to be working for the public benefit, as well as for legitimate personal profit.

Such, too, is the position which the Cataract Power and Conduit Company desires to occupy with reference to the city of Buffalo. This company hopes and believes that an extensive and continuing use of Niagara power in this city not only will result to the material and financial advantage of those now producing nearly 40,000 horse-power from steam engines, at a cost believed to be at least twice that of Niagara power, but also will relieve this beautiful guardian of Lake Erie and the Niagara River from the veil of smoke so often obscuring her charming aspect. While it is true that in this particular Buffalo already is more fortunate than some of her Western neighbors, still it is to be desired that, availing of the opportunity which she alone possesses, she may entirely cast off this pall.

Extended investigation by this company into the cost of steam power from coal or from oil or from natural gas in the various cities of the world, has convinced us all that nowhere upon this earth has any great city such an advantage as that now opening for Buffalo through this introduction of Niagara power; and in sanguine expectation of such prosperity and profit, which can result only from a service that shall be equally profitable and satisfactory to this city, the Cataract Power and Conduit Company bids welcome to the citizens of Buffalo, and to its Mayor, from whom we all now desire to hear.

MAJOR JEWETT responded with a brief and interesting speech of welcome to Buffalo. He was followed by State Comptroller J. A. Roberts, who gave some figures on the importance of New York, in response to the toast of "The Empire State." Then came what in many ways was regarded and treated as the event of the evening, the response given below to the toast of "Electricity" by MR. NIKOLA TESLA:

I have scarcely had courage enough to address an audience on a few occasions which were unavoidable, and the experience of this evening, even as disconnected of the cause of our meeting, is quite novel for me. Although on these fête occasions, of which I have retained agreeable memory, my words have met with the most generous reception, I have never deceived myself, but have known full well that my success in those instances was not due to any excellency in their rhetorical or demonstrative art. Nevertheless, my sense of duty to respond to the call with which I was honored a few days ago was strong enough to overcome my very grave apprehensions as to my ability of doing justice to the topic which is assigned to me. It is true that at times, even now as I speak, it seems to me as though my mind would be full of the subject, but I know that just as soon as I attempt expression the fugitive conceptions will vanish and I shall experience those well-known sensations of a certain abandonment, chill and silence. I am deeply earnest in my wish that I were capable to have the flame of eloquence kindled in me that I might dwell, in terms adequate to the occasion, on this wonderful science of electricity, on the marvelous progress which electrician honors have recorded and which one of the speakers justly said stamped this age as the age of electricity, and more particularly on this extraordinary event which we are commemorating this day. Unfortunately, this, my desire, must remain unfilled, but I shall hope that in my formless and incomplete statements, in a few ideas I shall mention, there may be something of interest, something befitting this unique occasion.

Gentlemen, there are in the intellectual development in recent years certain features which are especially comforting to all those who have truly at heart the advancement and welfare of mankind. First of all, the inquiry into the nature of our organs and senses by the aid of microscope and otherwise, particularly into the nature of those organs with which we commune directly with the outside world and to which knowledge is conveyed to our minds, has revealed their exact construction and mode of action, which is in strict accord with simple physical principles. Therefore, the observations we make of facts we derive by their help are real facts and observations and our knowledge is true knowledge. To illustrate, for instance, our knowledge of form is dependent upon the fact that light propagates in a straight line, whereby an image thrown upon a lens is exactly similar to the object seen.

In fact, my thoughts in these lines and directions have led me to the conclusion that all human knowledge is resting upon that simple truth, for any idea or conception, therefore knowledge, involves a visual impression or image; but if, for instance, light would not propagate in a straight line, but according to any other law we might presently invent whereby not only the image would not resemble the object, but even the images of the same object at different times and distances would not bear any resemblance, then our knowledge of form would be incomplete and defective, because then we might see a three-cornered figure, or six or twelve-cornered. You see, therefore, that the exact knowledge of our organs, of the mode of action of the mechanism, disposes altogether of a doubt as to the truth and reality of the outward impressions, and thus we bar out, forever we shall hope, that unhealthy speculation and scepticism which formerly used to take hold even of the strongest mind. Let me tell you of another comforting feature: The progress, as measured in a given time, is nowadays much more rapid; greater than it ever was before. This is in strict accord with the fundamental law of motion which commands that there shall be acceleration, or increase of momentum, of accumulation of energy under the action of a continuous force or tendency.

For what is progress if not a movement, infinitely complicated and sometimes unscrutinizable, it is true, but yet exactly determined as to the quantity and quality of movement by the conditions and laws governing it. Now, this feature is nowhere better shown than in the gradual merging of the forces, sciences and arts in the obliteration of the hard-and-fast lines of separation of borders which, only a few years ago seemed unsurpassable and which, like veritable Chinese Walls, surrounded every department of inquiry and barred progress. A sense of connectedness of the various forces and phenomena, a deeper understanding of nature is taking hold of our minds now, a sense not clear and definable as yet, but still sufficiently keen to fill us with confidence as to the greatest realization in the near future. But these features which I have mentioned and which bear upon the subject more intimately than I have said, only interest the scientific man, the thinker, the reasoner. There is another feature far more comforting, of far more universal interest, because of its bearing upon the welfare of mankind. Gentlemen, there is in all departments of human activity an influence felt which grows stronger day by day, which is asserting itself everywhere wherever human activity shows itself, an influence most fruitful and beneficial, the influence of the artist.

It was he, the artist, who abolished that narrow, pedantic school teaching which made often an aspiring student a galley slave. It was he who afforded freedom and choice of subject of study and facilitated free development. Now, there are some men who delight in the exercise of the powers of criticism who will tell you that this asymmetric development is a departure from the normal, a degeneration or degredation of the race. But these men are wrong. This is a healthy state of things, a blessing, the establishment of conditions best suited for progress. Let each of us concentrate all his energies in one single effort. Let him perceive a single truth, even though he be consumed by the sacred fire. Then millions of less gifted people will follow.

Therefore, it is not the quantity, but the quality of work which determines the magnitude of progress. It was the artist, too, gentlemen, who awakened that broad, philanthropic spirit which, even in old ages, is shown in the teachings of noble reformers and philosophers, a spirit which makes men in all stages and positions work, not as much for any material benefit or compensation, although reason may dictate this also, but for the sake of success, for the pleasure there is in achieving it and for the good they might do thereby to their fellowmen. Under this influence a type of men is now pressing forward, inspired with deep love for their study, men whose chief aim and enjoyment is the acquisition and spread of knowledge, men who look far above earthly things, whose banner is Excelsior! Gentlemen, let us honor the artist, let us thank him, let us drink his health.

Now, in all these features, in all these possibilities which I have mentioned at random, the knowledge of electricity, the expansion of the science of electricity has been a most potent factor. With these cheering prospects we do not need to look with any feeling of uncertitude or apprehension on the future. There are men who will tell you anxiously that the nations are arming; that they are arming to the teeth; that they are going to pounce upon each other at a given signal and destroy each other, like the cats of Kilkenny; that they are trying to outdo that victorious, great, wonderful German army, against which there is no resistance, for every German has the discipline in his very blood; every German is a soldier. But these men say again; look at our experience in the Venezuela difficulty with the British. Two other nations might have crushed together, but not the Anglo-Saxon; they are too far ahead. These men who tell you so are ignoring forces which are at work silently, but resistlessly, forces which say Peace.

Now, and none too soon, a cry will be echoed everywhere, let us stop these high-handed matters, these remnants of barbarism so inimical to progress; let us turn our attention to the common enemy, to the common dangers which threaten us everywhere—in the air we breathe, in the water we drink, in the food we consume. Is it not strange, is it not a shame, that we, beings of the highest stage of development, with such immense powers of thought and action, we the masters of the universe, that we cannot know whether in a swallow of food or drink we are taking in joy and life or pain and destruction? But enough of this. Let me turn again to the more pleasant and real things.

I have referred before to the certain merging of sciences, to a certain understanding of connection between the various widely-different phenomena and forces. We know through the efforts of a bold pioneer chiefly that heat, radiant heat I mean, light, magnetic and electric phenomena are very nearly alike. The chemist professes that the combinations and separations of bodies he observes in his department are due to electrical forces, and the physician or the physiologist will tell you that even life's process is electrical. Thus electrical science has gradually gained a universal meaning, and with right we may call this age the age of electricity. But I have very strong reasons, reasons which my co-workers will appreciate, to follow a precedent established by a great philosopher, and I shall not dwell on the purely scientific aspect of electricity. There is another reason to the claim which I have before stated, which is even more potent than the former, and that is the immense development in all electrical lines and the influence of this development upon other branches of science and industry.

MR. TESLA had just begun to make an interesting reference to the steam engine and the part that he hoped his oscillator might play hereafter in the integral combination of dynamo and engine, when he was informed that he must leave at once to catch his train. He therefore closed as follows:

"I am just informed, gentlemen, that in three minutes we have to leave. I congratulate you. (Laughter). What can I say, if not words which I am sure will be echoed by you all. I can only congratulate those who have co-operated in bringing about this great advance. I can congratulate the courageous pioneers who have embarked in this enterprise and carried it to success. And lastly, and this most sincerely: Buffalonians, I would say friends, let me congratulate you on the wonderful expanse of possibilities open, and let me wish that in no time distant your city will be a worthy neighbor of the great cataract which is one of the great wonders in nature.

MR. C. W. GOODYEAR then responded to the toast of "The City of Buffalo," which he spoke of as producing two presidents—Fillmore and Cleveland. Then came a string of very handsome regrets and congratulations from President-elect McKinley, Mark Hanna, "the king-maker;" T. C. Platt, Thomas Lowry, and others. Young Mr. Cramp, of the great Philadelphia shipbuilding firm, then spoke of himself briefly and very pithily as the builder of the Niagara turbines and mentioned the interesting fact that in the city of Franklin he had been a classmate of Elihu Thomson.

MR. C. R. HUNTLEY, in his own frank, hearty way that is so taking with a large body of men, spoke in response to calls that would not be quieted, and said that while, like many others, he had some years before doubted the coming of Niagara power to Buffalo, he was glad and proud now to be helping in its introduction; and he elicited hearty cheers by his happy references to Messrs. Brush, Thomson, Sprague, Nichols, Lawrence, and others.

MR. C. F. BRUSH then said a few kind, congratulatory words, and was emulated in brevity by his table neighbor,

PROF. ELIHU THOMSON, who also met with a most enthusiastic reception. He paid his colleague in invention, Mr. Brush, a graceful compliment as the man who had taught them all long distance transmission, and he went on to speak highly of the prospects for the growth of Buffalo with the help of Niagara power.

Speeches were then made in rapid succession by Messrs. H. H. Littell, John N. Scatcherd, Ald. Smither, T. T. Ramsdell, G. Bleistein, and Congressman Mahany, who brought the oratorical proceedings to a close by a charming burst of eloquence in honor of electrical inventors. The banqueters dispersed about 2:30 a. m.

The record of this great event would not be complete without expression of regret of the absence caused by bereavement, of Prof. A. G. Bell, who has recently lost his mother, and of Mr. W. B. Rankine, secreary of the Niagara Power Company, who mourns the death of his father. Mr. Rankine has done so much in the promotion and prosecution of the Niagara enterprise that it is impossible to think of any stage of it without recalling his ever active and energetic share in the work. He was among those who might with propriety, if they chose, regard the banquet as serving to mark a personal triumph.

A SAW MILL OPERATED BY THREE-PHASE MOTORS.

The saw mill of the American River Land and Lumber Co., which is located close to the power house at Folsom, Cal., of the Folsom-Sacramento Power Transmission, was started successfully on the 1st of December, cutting fifty thousand feet of lumber per day. The saw mill is the first in the country which is operated by electricity.

The current is three phase taken from the power house at Folsom and the motors are all of the induction type, the installation having been made by the General Electric Company. The motors employed are one of 75 horse-power, one of 50 horse-power, both running at 720 volts; three of 30 horse-power, and one of 5 horse-power, operating at 200 volts.

THE HARTFORD ELECTRIC LIGHT CO'S NEW STORAGE BATTERY EQUIPMENT.

ONE of the most interesting station equipments in the United States is that which has gradually taken shape in the work of the Hartford (Conn.) Electric Light Co. As already pointed out in these columns, the company has for some time availed itself of a water power by utilizing a fall of the Farmington River, and bringing in current at 10,000 volts for a distance of nearly 11 miles by the three-phase system. The power at present available is about 1,200 kilowatts, which is generated at 500 volts in two turbine driven alternators of 600 kilowatts each.

Heretofore the power thus transmitted was availed of only at the time of greatest load, but by the introduction of a storage battery it is now practically used continuously and the local plant at Hartford correspondingly relieved, one of the stations being shut down entirely after 6 p. m., and depending entirely on the storage battery as the source of current. The transmitted power is used in three ways. A part of it, after passing through the transformers, goes directly into the lines for some of the incandescent lighting in the central part of the city. The transformation is from 10,000 volts down to 2,000 volts. A large part of the current after being reduced in Pearl street from 10,000 volts to 2,000 volts, goes to the State street station and is there passed through a rotary transformer, which converts it into the direct current, for charging the storage battery, and for supplying power at either 110 or 220 volts over the three-wire system under ground as far as it extends in Central Square, Main street and Asylum street. Any surplus of power not used at the central station becomes available for operating the 600 kilowatt motor generator at the Pearl street station, which is illustrated in Fig. 1.

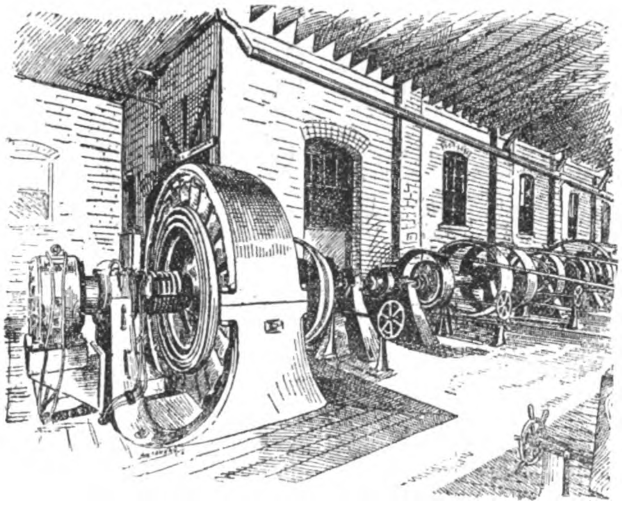


FIG. 1.—WESTINGHOUSE MOTOR GENERATOR, HARTFORD STATION.

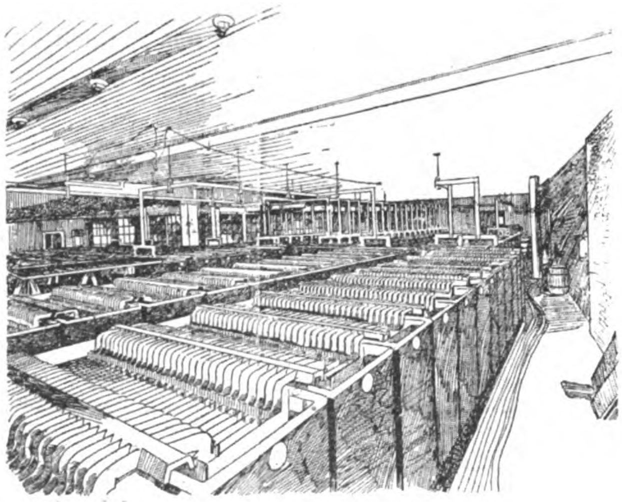


FIG. 2.—CHLORIDE STORAGE BATTERY ROOM.

The storage battery, Fig. 2, has a capacity of 500 horsepower hours, or 10,000 ampere hours.

Fig. 3 is a diagram showing the station operation for December 12 last. The figures at the sides of the diagrams represent amperes, and the shaded areas tell the story of inflow and outflow of electric current to and from the station from midnight to midnight. The line enclosing "B" and "C" spaces shows the current which went from either the rotary converters or the storage battery into the lines. As shown, the consumption has fallen at midnight to 350 amperes (notice left end of line enclosing "B" space). The outflow runs along at about that rate until 6 a. m., when it begins to jump, and at 8:30 a. m. it has gone up to 1,550 amperes. During all the time from midnight until 8 o'clock the current from the river (represented by "A") has been flowing into the battery, but now it comes to the aid of the transformer and helps it out, taking the peak of the load for about an hour and a half. Then the demand from the lines runs along at between 1,300 and 1,400 amperes until noon, when it suddenly takes a drop to 750 amperes—so many lights and motors are turned off between noon and 1 p. m. During that hour the current begins to flow into the battery again. But from 1 till 3:30 the river current is all required by the lines and the battery gets nothing. At that hour the rotary transformer is stopped and the battery is allowed to take the whole load until 11 p. m. Between 4 and 5 the load runs up to 2,300 amperes. Then it drops off rapidly and gets down to 1,500 amperes a few minutes after 6. There is another lower peak to be surmounted at 8 and then the consumption falls off rapidly until 11. At that hour the drawing of current from the battery stops and charging begins again, the current from the lines being obtained direct from the rotary transformer.

Formerly the river power could be utilized only during the hours when the arc lights and incandescents were actually in use. Now it can be used every hour in the day when there is water in the river, and as this added power costs absolutely nothing, the storage battery plant is, it is claimed, to pay for itself in three years at the furthest.

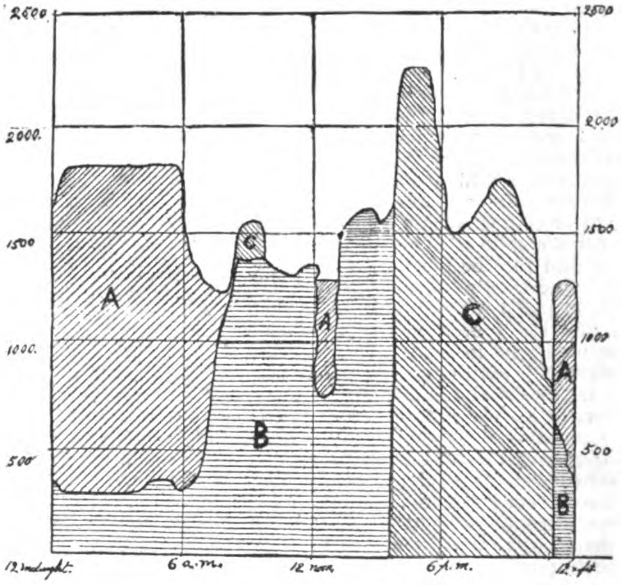


FIG. 3.—LOAD DIAGRAM OF HARTFORD ELECTRIC LIGHT STATION.

The battery cells are 130 in number, weighing in all, 300 tons.

MR. H. C. PAYNE AND THE POSTMASTER GENERALSHIP.

President J. E. Keelyn, of the Western Telephone Construction Co., is circulating petitions against making Mr. H. C. Payne, of Wisconsin, Postmaster-General in the new administration, and is addressing these memorials to Mr. McKinley. The ground taken is that Mr. Payne is a deeply-dyed Bell telephone man and a lobbyist for monopoly. It may be noted that Secretary Olney, in President Cleveland's cabinet, is or was counsel for the American Bell Telephone Co.

MUMFORD, N. Y.—The town of Mumford is now lighted by a plant consisting of a 110-volt dynamo, 7 arcs and 75 incandescents run by water power.

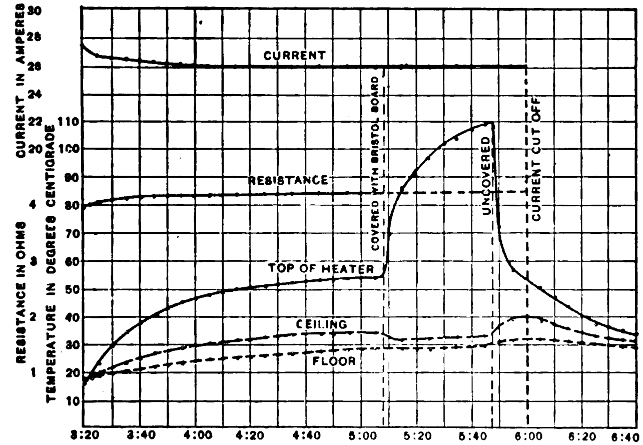
ELECTRIC HEATING.

INCANDESCENT LAMPS vs. COMMERCIAL HEATERS.

BY E. Y. PORTER AND C. D. WARNER.

WHILE engaged in a series of experiments in electric heating at the University of Nebraska, in the spring of 1896, it occurred to the authors that a comparison of the heating effect of incandescent lamps with that of the usual form of electric heaters might develop some interesting facts.

In accordance with this idea a 3½ horse-power car heater of the Whittingham system was selected as representative of the electric heaters now on the market, and was subjected to a careful test. This heater consists of twelve wrought iron tubes, one inch in diameter and six feet long, having a total radiating surface of 2,592 square inches. Each tube contains three strands of No. 20 B. & S. German silver wire, twisted together and inserted in a ¼-inch glass tube, the whole being filled in with clean sand.



Electrical Engineer

FIG. 1.—TEST OF 3½ H. P. ELECTRIC HEATER.

For the purpose of testing, the heater was surrounded on the ends and sides by a box 1 foot by 2 feet by 6 feet 4 inches. This box was made by stretching heavy manila paper over a wooden form so as to leave one inch dead air space in the walls. The heater and box were elevated 4 inches from the floor to allow free circulation of air through the heater.

The room in which the test was made is 10 feet long, 7 feet 9 inches wide, 16 feet 8 inches to the plate, and 19 feet 2 inches to the ridge, giving a total volume of 1,396 cubic feet. It contains one window and three doors with transoms. The heat capacity of the extra volume of air in the doorways and windows was assumed to be equal to that of the heater box and ladder. The room is situated in the center of the Engineering Building, on the second floor, and, except for the roof, is entirely surrounded by other rooms where the temperature was practically constant throughout the test. The walls, floor and doors were of pitch pine. The area of wood was 755.5 square feet. The area of glass in windows and transoms was 25.3 square feet.

The temperature was taken by means of three Centigrade thermometers, one 3 in. from the floor, another at the top of the box, 18 in. directly above the heater, and the third suspended from the ceiling. A metal vane supported the second thermometer above the heater and directed the hot air against it. When the temperature above the heater became nearly constant, the box was covered with sheets of heavy bristol board. In order to read the thermometers it was necessary to separate the boards about ½ inch for a moment.

Readings were taken at five minute intervals, from which the accompanying curves have been plotted.

Referring to the curves, Fig. 1, it is seen that as the temperature at the floor and ceiling gradually rises, the difference between them constantly increases to the point where the heater was covered. Then the temperature at the ceiling dropped about 2½ degs., while the floor temperature was slightly affected. When the heater was uncovered it was seen that both ceiling and floor temperature rose; the temperature at the ceiling, however, rising much higher than the other, and the curves reaching their maximum difference twelve minutes after uncovering. When the current is cut off, both curves fall and approach each other. It may be noted in this connection that the more rapidly the heat is given off, the greater is the difference in temperature between the top and bottom of the room.

The curve of temperature at top of heater shows a very gradual rise. This indicates considerable heat capacity in the heater. It will be noticed that the difference between this curve and the floor temperature curve becomes nearly constant after an hour's run. On uncovering the heater the rise of temperature is quite rapid, and would probably have reached a constant difference as before, if it had been allowed to continue long enough. When the heater was uncovered the up-rush of heated air caused the sudden rise of temperature at the ceiling, and temperature at top of heater dropped within twelve minutes, even below the former point. The temperature drops gradually after the current is cut off and approaches the other two curves. If it had not been for the heat capacity, the difference between the curves would have diminished much more rapidly.

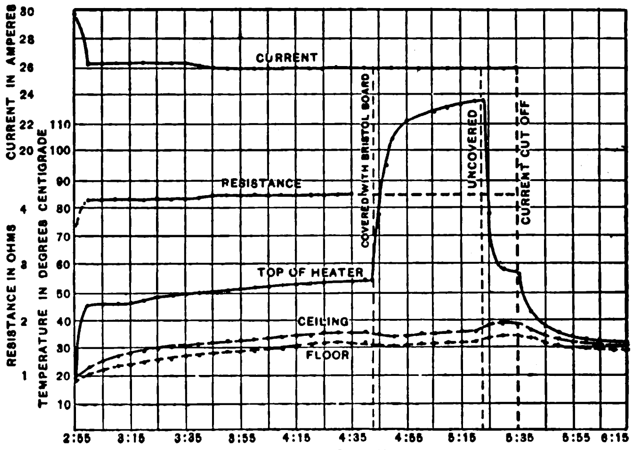
In the upper part of the diagram are shown the current and resistance curves, the voltage being kept constant. The small rise of resistance as the heater warmed up, means a low temperature coefficient. We might expect that when the heater is covered the resistance of the wire would rise still higher. But the fact that it does not, proves that there is no perceptible rise of temperature in the resistance wires themselves. The low temperature coefficient, by permitting a constant current to flow under wide difference of temperature, does not show the self regulating effect so noticeable in iron wire heaters.

Summarizing the results of the tests, we have:

Mean watts	2,881
Time of run	2 hrs. 40 min.
Watt hours	7,683
B. T. units consumed	26,215
B. T. units given off by one person, 2 hrs. 40 min.	510
Mean temperature of room at beginning	19° C.
Mean temperature of room when current was shut off	35.55° C.
Mean rise of temperature	16.55° C.
Volume of air in room	1,396 cubic feet
Watts given off per square inch radiating surface	0.9

In experimenting with incandescent lamps for atmospheric heating, a bank of seventy-five 16 candle-power, 110 volt lamps, arranged in three parallel rows was used. This heater was of approximately the same size as the car heater, and was tested under exactly similar conditions, and corresponding readings were taken.

When the current was turned on, about seventy-two lamps were in circuit, but enough were immediately turned out to reduce the current to the same amount as that at which the heater ran during the fore part of the test, and later, other lamps were turned out, so that the average energy delivered to each heater was very nearly the same, the difference being within fifteen hundredths of one per cent. The temperatures at starting were nearly the same, in fact the weather conditions were almost identical on both days.



Electrical Engineer

FIG. 2.—TEST OF INCANDESCENT LAMPS CONSUMING 3½ H. P.

The ceiling and floor temperature curves, Fig. 2, rise gradually but more rapidly than before, and reach somewhat higher points before the box is covered. It is to be noticed that the ceiling temperature quickly reaches a point about four degrees above that of the floor and maintains this constant difference until the box is covered, which shows a more even distribution of heat throughout the room than do the corresponding curves of the car heater, an important feature of atmospheric heating.

When the supply of heat was cut off both curves dropped slightly, the ceiling temperature more than the floor. Again, on uncovering the box, the ceiling temperature rose quickly, but did not go as high as with the iron heater and did not exceed four degrees rise above the floor temperature, which as before rose slowly. When the current was cut off all three curves dropped more suddenly than with the other heater and approached each other more closely.

Referring to the curves of temperatures above the heater, the most noticeable thing is the very sudden rise of temprature, showing that its heat capacity is very small. The large current at starting, of course, caused a more rapid rise than would otherwise have occurred, but the form of the curve indicates that this effect did not last more than about fifteen minutes, and within this time the curve had reached a height above the floor temperature which remained practically constant to the point of covering the box. At this point the temperature shot up more quickly than with the iron heater, and within twelve minutes it reached the maximum point of the other curve. This also shows that it had small heat capacity, as does the rapid fall on uncovering the box, and again on cutting off the current.

Summarizing the results of the test, we have:

Mean watts	2,885
Watts per square inch radiating surface of heater, about	1.6
Time of run	20 hrs. 40 min.
Watt hours	7,695
B. T. units consumed	26,255
B. T. units given off by one person, 2 hrs. 40 min	510
Mean temperature of room at beginning	19.3° C.
Mean temperature when current was shut off	35.85° C.
Difference of mean temperatures	16.55° C.
Volume of air in room	1,396 cubic feet

LETTERS TO THE EDITOR

GASOLINE ENGINES AND FIRE INSURANCE.

WITH the introduction of gasoline engines one of the first things to be considered by the purchaser was, How will its use affect my insurance? This question pressed itself, with equal force, upon the fire underwriters. Experience has shown that much of the prejudice against the use of gasoline engines is without foundation. As an evidence of the correctness of this statement, the infrequency of fires resulting from gasoline engines is ample proof. It is stated by parties in a position to know, that not a single loss has been reported, to the State Board of Underwriters, of Illinois, directly attributable to a gasoline engine, this notwithstanding there are hundreds of such engines in use, particularly in grain elevators, and that they are, in the main, attended by help unskilled in the matter of machinery.

In view of the foregoing facts, it would seem that the insurance companies are charging excessive rates on property where gasoline engines are used. There are a number of gasoline engines on the market, the manufacturers and users of which know to a certainty, that there is not so much danger in the use of, than from a kerosine lamp; and yet the user has to pay "50 cents additional if engine is located in building, and gasoline supplied by air pressure." Why such a charge is made is difficult to understand, as, if the engine is properly installed and connected to a gasoline tank, the gasoline being pumped as required for use, no part of the gasoline coming in contact with the atmosphere in building, the danger from fire is, beyond question, very remote. Notwithstanding that we hear and read very frequently of fires from gasoline stoves, their use is permitted without extra charge, while the owner of a gasoline engine must pay dearly for employing one of the safest and most desirable motors available.

With the increasing demand for gasoline engines for various uses, including electric lighting in isolated plants, the question of insurance rates rises in importance; and when much of the existing prejudice has been removed, more favorable rates are sure to be obtained by the insured. As a matter of fact, gasoline engines, when properly installed and connected, are practically free from danger of originating fires. It would be interesting to learn the reasons for some of the charges fixed by the insurance companies on gasoline engine risks.

J. M. H.

Chicago, January 11, 1897.

TELEPHONY AND TELEGRAPHY

PACIFIC CABLE PROJECTS.

A special dispatch from Washington of Jan. 15 says: The Pacific cable project was considered again to-day by the House Committee on Commerce, which listened to a statement by Gen. Swayne on behalf of the Pacific Cable Company, of New Jersey, in which he is associated with Col. Spalding, of Honolulu; D. Ogden Mills, James J. Hill, Abram S. Hewitt, and other capitalists. Gen. Swayne urged the House Committee to recommend the Senate bill, which authorizes the Postmaster-General to contract for a cable from the Pacific Coast to Japan by way of the Hawaiian Islands, with an annual subsidy not exceeding $160,000. A bill has been reported to the House for a subsidy of $100,000 a year to the Pacific Cable Company, of New York, in which James Scrymser and J. Pierpont Morgan are interested.

The recent colonial conference which decided upon the project of a British cable from Vancouver to Japan by way of Australia and Honolulu, Gen. Swayne said, endangered the success of an American enterprise unless immediate steps were to be taken by Congress. He urged the House to adopt a plan which would insure competition for the subsidy, believing that no bill giving a subsidy to a particular company could succeed while it was known that other responsible parties desired to bid. That part of the project of the Scrymser company which contemplates a cable from Japan to China, Gen. Swayne held to be unnecessary, because two established cables fill that field now. Nor did he believe a cable could be finished to Honolulu within a year, and to Japan within eighteen months, as that company offers to do. He offered on behalf of the corporation which he represents to deed Col. Spalding's concessions from the Hawaiian government to the successful bidder under any bill which provided for competition.

A special dispatch of Jan. 15 from Montreal says: A dispatch from London received here says that it is currently reported that the route chosen for the Pacific cable is Vancouver to Fanning Island, Fiji Islands, Norfolk Island, thence to New Zealand and Queensland.

POLICE WIRES IN BROOKLYN.

Police Telegraph Superintendent F. C. Mason, of Brooklyn, submitted his annual report to Superintendent McKelvey, of the Police Department, last week. It shows that 210,370 messages were handled by the operators at headquarters during the year. There are in use at present 440 telephone and 353 patrol boxes and 569 miles of wire, of which 350 are on poles, mainly in the suburban districts, and 219 attached to the elevated railroad structures and underground.

Mr. Mason strongly recommends that early steps be taken to put all the police wires under ground. The work of the telegraph bureau, according to Commissioner Welles and Superintendent McKelvey, reflects credit on Mr. Mason and his corps of operators, all of whom are to be continued in their places in the Greater New York Police Department.

A POSTAL TELEGRAPHIC SPEED CONTEST.

A CONTEST of speed was recently carried out between operators of the Postal-Telegraph Company in New York, Chicago and Pittsburg, which demonstrates the work that can be accomplished by the use of the Morse system under the most favorable conditions of men and apparatus. The contestants were three expert telegraph operators in each of the three cities.

Pittsburg sent into New York during five hours 341 messages, containing 10,216 words, or an average of 68 1-5 messages per hour, which was the best average for the entire period attained during the contest.

New York sent to Pittsburg in three hours 200 messages, an average of 66⅔ messages per hour, containing 5,605 words. During the first part of the test New York sent Pittsburg 102 messages in 90 minutes, an average of 68½ messages per hour. While this was the fastest time made in an hour and thirty minutes, Pittsburg operators surpassed the others by their uniform work from beginning to end, and at no time fell below a message a minute.

The result of the contest will be appreciated when it is understood that 30 messages an hour on long circuits is considered fair work, and 40 messages is considered good, while 50 messages an hour has been regarded as the limit of the fastest sender for many years.

GERMANY JOINED TO SOUTH AMERICA BY CABLE.

A submarine cable has been completed from Emden, Prussia, to Vigo, Spain, which links the German telegraphic system with the South American and other systems. Capital has been furnished by an Anglo-German syndicate for the construction of the first section of a submarine cable between Germany and the United States via the Azores.

ELECTRIC TRANSPORTATION

GLASGOW STREET RAILWAY COMMISSIONS REPORT.

It appears to be a settled thing that Glasgow is to have the overhead trolley. The municipal authorities there have been engaged upon the transportation problem for some time, and last year sent a commission to the United States to investigate the whole subject. These gentlemen have submitted an elaborate report, which, after discussing storage batteries, oil and gas motors, compressed air, electric open-conduit and underground systems, and other devices, decides in favor of the overhead trolley. They say: "After seeing the best overhead construction for the electric overhead system, and considering its vast importance as a means of rapid transit of passengers on city and suburban streets and roads, we are perfectly reconciled to it, and feel that it only wants to be seen in use to be appreciated. It of course goes without saying that if a system as good and as cheap can be had without any overhead construction, we should prefer it. But there is none such known at present. And we feel sure that if the citizens saw this system of rapid transit in operation on the Springburn route—comfortable cars, propelled, illuminated, and heated by the same power—they would not for a moment object to the appearances of neat poles to carry the wires, especially if the old lamp-posts were done away with, and the trolley-poles made use of for electrically lighting the streets. We believe the citizens would soon conclude that it was beautiful as a whole."

THE HILLTOP FIFFTEEN PER CENT. GRADE AT PITTSBURG.

The latest electric railroad in Pittsburg, the Hilltop line, was opened there last week. It is a branch of the Pittsburg and Birmingham Traction Company, which connects the old city of Pittsburg with those districts situated on the southern shore of the Monongahela River. The Hilltop line runs across the Monongahela over the Smithfield street bridge and goes up Brownsville avenue, which road has a grade of 15 per cent. By this road the suburb of Knoxville is reached. The line has been in great demand because it will afford rapid transit facilities to about 50,000 people who have hitherto been entirely dependent upon inclines and such walking accommodations as unpaved streets afforded.

The Birmingham Traction Company operates twenty-two cars on the Hilltop line. The cars are equipped with two 50 horse-power Westinghouse motors and controllers. To take care of the increased traffic occasioned by the opening of this line, the Birmingham Traction Company has recently remodeled and re-equipped its power house at Thirty-first and Carson streets. This power house was equipped with generators of an older make. They have all been thrown out and three new Westinghouse machines take their place.

STREET CARS PAINTED GREEN.

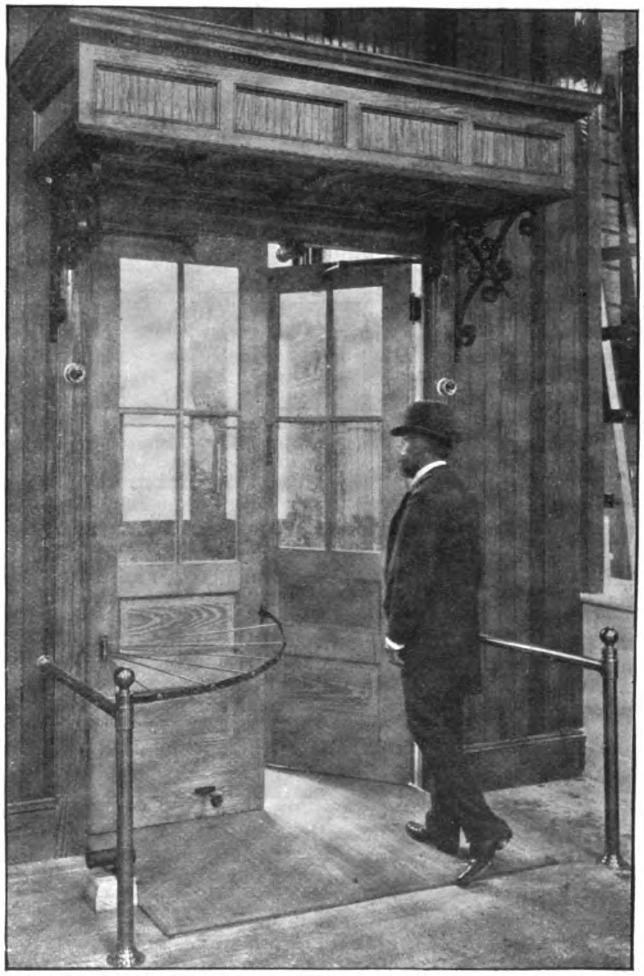
The man talking was from Boston, in New York on business involving a real estate deal. "When I began this business ten years ago," he was saying, " I didn't know as much as I do now. Neither did I know as much as would suggest to me the propriety of going in when it rained. For instance, I had got up a big thing in South Boston (where we have a tremendous Irish population) in the way of suburban properties, and I got a company to build a trolley car line to it. A rival of mine was doing something of the same sort in a different direction, but I knew I could give him four aces and beat him out of sight. His street car line was half a mile longer than mine to my property, and the location wasn't nearly so good. Just the same he walloped the everlasting pudding out of me, if you will excuse a Bostonianism, and did it in the simplest way possible. You see, I wasn't thinking, and when I ordered cars for my line I had them painted a beautiful orange to show how rich our subdivision was. The other chap, I guess to show what kind of a chump I was, had his cars painted a glorious green. The Irish did the rest. If you don't believe it you want to go out to my subdivision some time when you are in our town, if you can find it."

NEWS AND NOTES.

THE HICKS-TROY ELECTRIC DOOR OPENER.

Door checks have done much to relieve humanity from the nervous shocks engendered by slamming doors, but there is still wanted some device that will relieve one from the strain which most door checks and springs put upon the muscular system. Such a device, it may be recalled, was exhibited at the World's Fair in 1893 and described by us at the time. It is the invention of Messrs. Oliver Hicks and R. F. Troy, of the Hicks-Troy Electric Door Company, of Chicago, and two of the door-openers are now in operation, one in the city market at Springfield, Mass., and another in the State street lunch room of H. H. Kohlsaat & Co., Chicago. The doors are both double, fitted to pass in one person to the right and another in the opposite direction at the left. Fig. 1 is a photographic reproduction of the Springfield doors.

As one steps on the mat at the entrance, that door directly in front swings noiselessly open from him. If another person is following close behind, the door does not swing in one's face, but remains open until that person and any others have passed through, when it immediately closes gently.



Hicks-Troy Electric Door Opener.

The mechanism of the door consists of a motor, worm-gear, magnets, clutches, with a 110 volt current and a system of wiring. The cabinet over the door on the inside contains the motor, magnets, clutches, etc. Through the bottom of this cabinet depend arms, one connecting each wing with its corresponding motor mechanism and through which the power is applied to move it. Through the doorway is spread a specially designed mat, connected by wires with the electric mechanism in the cabinet. When the doors are closed, stepping upon the mat closes the circuit through one or more of the many metal circuit closers, causing the armature of one mat—called the mat magnet—to be depressed and an electric switch connected with it to send a current through the clutch magnet, releasing the pulley upon which is wound the belt through which the motor closes the door and the springs pull the door open. Upon stepping from the mat, the circuit is broken through the mat magnet, and consequently the switch attached to its armature cuts the current out of the clutch magnet, leaving the belt pulley secured to its shaft and the motor and the motor current is turned on. The motor revolves and winds the door shut, at the same time winding up the springs that are to open the door for the next operation. Pressure on the same spot on the mat, at one time controls one door, and at another moment the other door, depending on the position of the doors and whether the passenger is entering or leaving the building.

The switch Y, Fig. 2, being on, the door being in a closed position, the operation is as follows: The passer through the doorway upon stepping upon the mat depresses one or more circuit closers d, completing the circuit through ee, and cc, energizing the coils UU; the armature Z, is depressed, switching the current through ff, to the clutch magnet, GG, and drawing to it its armature I. The spool F is now free to revolve and the springs R, through the arms K and O, pull open the door. Upon the passer through stepping from the mat the contact is broken at the circuit closer d, the magnet armature Z, returns to its normal position, the circuit through ff is broken at T, the clutch armature I is released and the spring J, upon the shaft, binds the spool to the disk C, and at the same time the circuit is closed by the magnet switch at T, through gg, to the motor; the switch S being on, the motor revolves and the door is closed ready for the next operation; hh is the return wire for a clutch magnet, motor and mat magnet. As the door nears its closed position the motor switch S, operated by the rod b, and arm K, cuts out the current from the motor A. It will thus be seen that when the door is in a closed position no current is being used.

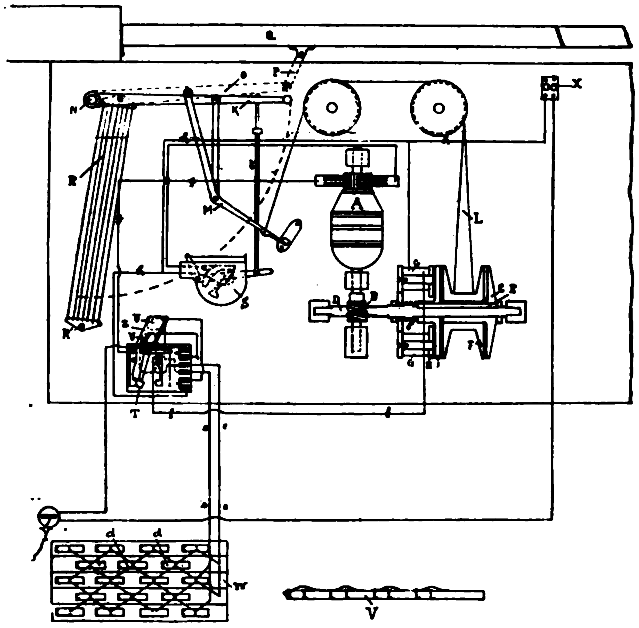


Fig. 2.—Electric Door Opener Mechanism.

The 110 volt direct current is used, the motor taking about 2½ amperes, the clutch magnet about 1/4 of an ampere, and the motor magnet ⅛ of an ampere. The electric mat proper is thoroughly insulated top and bottom by rubber and the whole is encased in a water tight zinc covering. This is then laid upon a raised wood flooring, the whole being covered with a corrugated rubber mat.

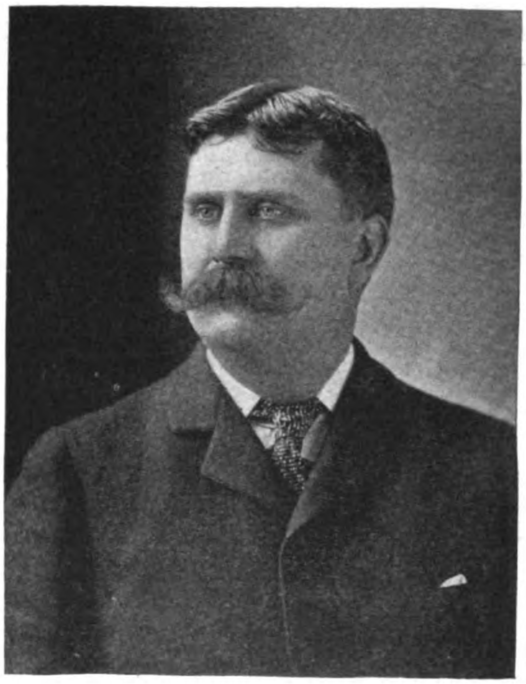
All the rapidly moving parts such as motor bearings, worm and gear, are self oiling. The mechanism shown is for one of a set of double doors and in all important details is the same as required to operate a single door.

E. A. WESTERFIELD has been appointed manager of the Chicago office of the Postal Telegraph-Cable Company to succeed G. E. Paine, promoted to the superintendency of a Western division.

PERSONAL

MR. J. M. HILL.

Mr. JOSEPH M. HILL, whose potrait is shown in this issue, has been appointed manager of the new branch of the Bryan Marsh Co., in Chicago, which will be opened on February 1. Mr. Hill has for some time acted as Chicago representative of the Columbia Incandescent Lamp Co., which position he has resigned. He also is sales agent for the Wagner Electric Manufacturing Co., and will continue to look after the interests of that company. Mr. Hill is very well known in electrical circles throughout the West, and is most deservedly popular with all those who know him, and the Bryan Marsh Co. are to be congratulated upon having secured the services of so valuable a representative.



J. M. Hill.

OBITUARY

COL. C. H. BANES.

Colonel Charles H. Banes, president of the Market Street National Bank of Philadelphia, and a leading business man of that city, died on January 15, after a protracted illness. He was born in Philadelphia on October 24, 1831, and when the civil war came became Captain of a company in the Twenty-second Regiment, Pennsylvania Volunteers. Three times he was promoted for gallant service on the field. In December, 1862, he was appointed Assistant Adjutant General, and was confirmed by the Senate in May, 1863. During the latter year he was breveted Major, and in 1864 was breveted Lieutenant Colonel. He was in the field until June, 1864, being wounded three times and participating in forty battles. He was very active in Philadelphia affairs, and will be remembered by electrical engineers as the president of the successful Electrical Exhibition in that city in 1884. He was afterwards prominently associated with the Sawyer-Mann Electric Company for a short time.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JAN. 5, 1897.

Alarms and Signals:—

ELECTRIC ALARM DEVICE. G. V. Trott, Chicago, Ill., 574,856. Filed April 10, 1896.

Burglar alarm.

Connectors, Conduits and Insulators:—

SUBWAY CONDUIT. W. H. Johnston, St. Louis, Mo., 574,430. Filed Aug. 15, 1896.

Means for drawing conducting wires through conduits.

INSULATOR. B. D. B. Smock, Wickatunk, N. J., 574,828. Filed March 10, 1896.

Consists of a body portion with an opening to receive a wire and a ribbed wedge adapted to be inserted to hold the wire therein.

Lamps and Appurtenances:—

MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS. T. B. Atterbury, Pittsburg, Pa., 574,370. Filed Dec. 18, 1894.

Consists in cementing an underground perforated stopper in the lamp by vitrifiable enamel or cement, and then heating it to vitrify the enamel.

Measurements:—

ELECTRIC METER FOR ALTERNATING CURRENTS. G. F. Packard, Fort Wayne, Ind., 574,565. Filed Oct. 26, 1896.

Combines a rotary armature provided with a plurality of radial vanes, and a counting or registering train connected with the armature.

ELECTRICAL MEASURING AND INDICATING APPARATUS. J. F. Kelly, Pittsfield, Mass., 574,739. Filed June 16, 1896.

Comprises a vibrating needle and stationary quadrants separated from each other by a wall of insulating material.

Miscellaneous:—

ELECTRIC CLOCK. C. M. Crook, Chicago, Ill., 574,669. Filed Dec. 12, 1895.

Operated by weights wound by the force of electric currents operating through electro magnets on a winding device.

METHOD OF ELECTROLYTICALLY UNITING GLASS TILES INTO A BODY. W. H. Winslow, Chicago, Ill., 574,843. Filed Nov. 2, 1896.

Consists in arranging the tiles in the order desired and then electrolytically depositing metal around their edges.

ELECTRICALLY HEATED SAD IRON. W. S. Hadaway, Jr., New York, 574,536. Filed April 7, 1896.

Embodies an electric heating conductor composed of helical convolutions arranged in three or more graduated sections.

AUTOMATICALLY CONTROLLED ELECTRIC OVEN. W. S. Hadaway, Jr., New York., 574,537. Filed May 4, 1896.

Provides an automatic switch, operated by variations of the temperature of the heated surface, to cut coil sections of the heating conductor in and out of circuit.

ELECTRIC HEATER. J. E. Meek, New York, 574,745. Filed March 5, 1896.

Means to obviate the use of a rheostat.

Railways and Appliances:—

ELECTRIC RAILWAY TROLLEY. E. M. Bentley, New York, 574,377. Filed July 28, 1896.

Combines a supporting arm upwardly spring pressed, a guideway on the outer end of the arm, a pivoted tip or end section movable on the guideway, a contact wheel on its outer end and a spring for pressing the wheel into engagement with a line conductor.

ELECTRIC PROPULSION OF VEHICLES. W. A. Butler, New York, 574,388. Filed March 19, 1895.

A steam locomotive in which the water is heated electrically.

SELF-ADJUSTING TROLLEY WHEEL. G. W. Duryea and T. W. Thompson, Brooklyn, N. Y., 574,527. Filed Aug. 3, 1896.

Consists of a trolley wheel provided with guiding arms and automatically acting devices connected therewith for finding the trolley wire.

ELECTRIC RAILWAY. W. M. Schlesinger, Philadelphia, Pa., 574,632. Filed Oct. 12, 1887.

"Third rail" system.

TROLLEY. W. L. Pepper, Philadelphia, Pa., 574,819. Filed April 2, 1895.

Comprises oppositely disposed trolley arms, each constructed in pivoted sections, the upper sections of the arms being pivoted to the trolley wheel and the lower sections of the arms pivotally attached to a support.

Secondary Batteries:—

SECONDARY BATTERY AND PROCESS OF FORMING SAME. G. W. Harris and R. J. Holland, New York, 574,417. Filed Jan. 30, 1896.

Consists of an open work plate composed of oppositely inclined intersecting ribs and grooves on its opposite sides.

SECONDARY BATTERY SUPPORT OR GRID. J. J. Rooney, Brooklyn, N. Y., 574,826. Filed Feb. 12, 1896.

Layers of strips of wool felt laid together in sets of rows which cross each other so as to form pockets or holes between the rows. See issue of Jan. 13.

Telephones:—

CIRCUIT FOR ANNUNCIATORS OF TELEPHONE LINES. C. E. Scribner, Chicago, Ill., and F. R. McBerty, Downer's Grove, Ill., 574,579. Filed May 14, 1896.

Details of construction.

TELEPHONE SWITCHBOARD. H. J. Swarts, Knoxville, Tenn., 574,642. Filed Dec. 24, 1895.

Comprises a table having a central opening to admit an operator, subscriber's line plugs located on the table around the opening and means for receiving two plugs to connect their respective wires.

TELEPHONE RECEIVER. R. S. Barnum, Chicago, Ill., 574,654. Filed April 3, 1896

Comprises a magnet supporting bridge placed at the end of the receiver-case adjacent to and parallel with the diaphragm, screws inserted into the ends of the case beneath the bridge so as to form rests or stops therefor, notches and screws.

AUTOMATIC TELEPHONE EXCHANGE SYSTEM. L. G. Bowman, New York, 574,707. Filed July 10, 1896.

Details of construction and operation.

AGITATOR FOR TELEPHONE TRANSMITTERS. S. B. Rawson, Elyria, Ohio, 574,761. Filed Jan. 14, 1895.

The operation of the lever holding the receiver agitates the transmitter.

REPORTS OF COMPANIES

BUSINESS PROSPECTS.

IT was known that the balance of trade with foreign countries was in our favor, but it was not realized until last week that for the year 1896 exports had overtopped imports by the magnificent sum of $325,000,000. This is not in itself an indication of prosperity, but it exhibits such unquestionable soundness and such strict economy on the part of the nation, that there can be but one result from it in the near future. The stock market showed an immediate effect from the publication of the figures; one has to fear that exuberant optimism may now at once take the place of a not less absurd pessimism. Steady prosperity is hindered by these violent swings of the pendulum of business sentiment.

During the past week, 15,505 shares of General Electric were sold on the New York market, the gain in the period being from 33¾ up to 34¾. In Western Union there was also an advance, on sales of 10,523 shares, up to 85½. On the Boston market, Bell Telephone advanced during the week from 208 to 209½. These three quotations attest the general drift.

The Albany "Argus" is authority for the statement that the net earnings of the General Electric Co. in 1896 were $1,976,000, on a gross business of $13,300,000. This is, however, without confirmation, and as a matter of fact, the G. E. fiscal year does not close until the 31st inst., and the annual inventory is taken the first week in February. It is reported that the company may pay up back dividends on preferred stock at the rate of 5 per cent.

Turning to the proposed combination of the Fort Wayne Corporation and the Siemens-Halske Co., which we reported three weeks ago, it may be stated that matters are about as they were then, the final closing of the deal and the amount of capital depending upon agreement as to the valuation of the plants. Should the preliminary contracts be carried out, a strong company will emerge, as we stated, under Mr. McDonald's leadership. It is well known that the negotiations have been conducted under the diplomatic care of President Insull, of the Chicago Edison Co., but that gentleman declines to add to the information on the subject. The rumors that he is coming East and would bring Bergmann's into the deal, may be dismissed as idle talk, but with his intimate knowledge of manufacturing and his influential relations to the consuming market for apparatus, it will not be strange if he is on the board of the new company he has helped to create.

SOCIETY & CLUB NOTES

HORSELESS VEHICLES.

The American Institute of Electrical Engineers will discuss the above topic at its monthly meeting on January 20, at 12 West Thirty-first street.

MR. E. H. JOHNSON has just been elected president of the Magnetic Club of New York. The choice is most happy. It would be hard to find a man who better represents the telegrapher, master of his own art and capable of anything else in electricity.

AVON, N. Y.—At the annual business meeting of the Avon Electric Company, the following officers were elected: President, Dr. Cyrus Allen; secretary and treasurer, J. D. Carson; general manager, C. F. Whiting. Mr. R. G. Elliott is the engineer.

LEGAL NOTES

THOMSON-HOUSTON TROLLEY SUIT WON.

Judge Acheson, at Pittsburg, on January 14, handed down a decision in the United States Circuit Court suit of the Thomson-Houston Electric Company against the Johnson Company and a number of other electrical concerns. The suit is based on an alleged infringement of improvements in traveling contacts for electric railways. The court holds that the claim of an infringement is valid against three of the defendants, the Johnson Company, of Pittsburg, the Steel Motor Company and R. T. Lane.

RAILROAD COMPANIES CITED FOR ALLEGED INFRINGEMENT.

The Newark and South Orange Railway Companies have been cited to appear in the United States District Court at Trenton, N. J., to defend a suit for infringement of patents held by the Thomson-Houston Company. The Consolidated Traction Company is likewise made a defendant in the action.

TELEPHONE PLUG INFRINGEMENT.

In an opinion filed in the United States Circuit Court at Baltimore, Md., on Jan. 7, Judge Morris holds that the Chesapeake and Potomac Telephone Company has infringed the patent for a telephone plug belonging to Augustus G. Davis and awards Mr. Davis one cent damages and costs. The invention was patented by Henry C. Watts, January 17, 1880, and the patent will expire this month. The plug is used in telephone switchboards for establishing communication with the telephones of subscribers.

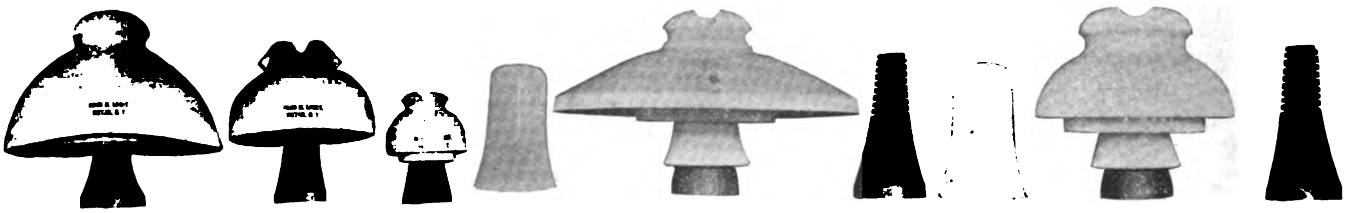
TRADE NOTES & NOVELTIES

LOCKE'S IMPROVED HIGH POTENTIAL INSULATORS.

THE introduction of high potential currents for long distance transmission has called for improved types of insulators capable of withstanding pressures of 30,000 volts and over, and Mr. Fred M. Locke, of Victor, N. Y,, as mentioned by us on Jan. 6, has recently brought out several types of insulators specially designed for this class of work. Our illustrations represent these various types. Their characteristic feature consists in the fact that they are made in two parts, the inner part of porcelain or glass, which are screwed together. By this construction it is claimed that the resistance to puncture is greatly increased, while at the same time the thickness of the two parts may be decreased, thus making the insulation lighter. In the accompanying illustrations the group, Fig. 1, at the left shows the parts of the insulator designed for 30,000 volts. Each part alone can stand 50,000 volts without puncture. The insulator is mounted on a locust pin boiled in paraffine oil and provided with the Locke steel pin which passes through the cross-arm.

The group, Fig. 2, shows an insulator of the same type with a specially wide outer petticoat.

Fig. 3 shows another group of insulators made by Mr. Locke, that at the left being the type used at Niagara Falls and de-equipments for 30 double-truck motor cars for the Oberschle-signed to carry 22,000 volts. These insulators have withstood potentials up to 70,000 volts without breaking down.



LOCKE INSULATORS FOR HIGH POTENTIAL ALTERNATE CURRENT TRANSMISSION.

MORE CONTRACTS FOR NIAGARA APPARATUS.

The Niagara power directors have authorized the officers of the company, in their discretion, to enter into contract with the I. P. Morris Company of Philadelphia, for the construction of five 5,000 horse-power turbines identical to those now in place made by that company; with the Westinghouse Company of Pittsburg for the construction of five 5,000 horse-power dynamos identical with those in use and constructed by this company, and with William Sellers & Co., of Philadelphia for the manufacture of five turbine governors and five sluice gates. No proposals were received for the construction of an addition to the power house. These will be received later. Secretary Rankine states that these contracts would aggregate over $500,000.

MICANITE INSULATION ON RAILWAY MOTORS.

The Mica Insulator Company have received the letter quoted below, as to the remarkable qualities of their micanite, tested under severe conditions of street railway use.

December 21, 1896.

Mica Insulator Company, Charles W. Jefferson, Manager.—Dear Sir: In March, 1894, you put a full body and slot insulation of micanite on one of our Edison No. 16 street car armatures, and the same was wound at once and put in service, and has been pretty steadily running ever since, the car having made over 50,000 miles. The armature has never given us any trouble in "body grounds" since it started, although it is of the "ring" type and is not protected by the motor frame, it being open to snow, slush or water from the wheels.

The wiring on this armature has just been burned out by a severe and continued overload, so heavy as to not only char the insulation of the wire, but to melt some of the wires themselves. On stripping off the wires, we were surprised to find the insulation of body and slots in apparently good order; and after fully stripping and testing we find it absolutely perfect, mechanically and electrically, and are now rewinding it, having done nothing to the insulation but to give it a coat of varnish and bake it. We consider this so remarkable a record that we think it only justice to you to inform you of it.

While the full micanite body of insulation costs several times more than our previous method of cloth, mica and paper, the results in freedom from armature "body grounds" and the ability to reuse the insulation indefinitely are points that will make us consider the use of micanite as essential in all our work for the future. Very truly yours, Schenectady Railway Company, per H. S. Cooper, Superintendent.

STANDARD AIR BRAKES IN EUROPE.

The Standard Air Brake Company has received from Germany, through its general representative, the Bergische Stahl-Industrie, of Berlin and Remscheid, an order for air-brake equipments for 30 double-truck motor cars for the Oberschlesische Dampfstrassenbahn. The company's motor-compressor type will be furnished, and in addition to the 30 outfits there is another order for 30 more to follow, making 60 cars in all. This road has been a steam road, but is about to be electrified. The company's foreign business is very active, and requests have been received recently for some three hundred additional equipments, for which it is expected contracts will be closed within a very short time. The company has not only increased its force, but has enlarged its facilities to meet the expanding business.

PORCELAIN-LINED OUTLET BOXES.

The Ward Leonard Electric Co., of Hoboken, N. J., have secured the exclusive right to the manufacture and sale of the various types of outlet boxes, switch boxes, junction boxes, floor boxes, cable boxes, drop cord boxes, receptacle boxes, etc., which have been known to the trade as the Mailloux, De Rycke, Krantz, Fountain and Soons boxes, and they are supplying the trade with these boxes porcelain lined instead of lined with paint as heretofore, the prices being in all cases equally as low as before and in many cases much lower.

The porcelain lining makes a perfect insulation for the purpose, as it is unaffected by heat, cold, acids, alkalies, oils, or, in fact, any chemicals or conditions met with in practice. The insulation is guaranteed to measure over 10 megohms and to resist 2,000 volts alternating e. m. f.

C & C APPARATUS IN THE SOUTH.

As an evidence of the confidence which is felt in the immediate development and advancement of business generally in the South, upon the part of manufacturers, we may state that the C & C Electric Co., of New York City, operating a large electrical manufacturing plant at Garwood, N. J., and one of the pioneer manufacturers of this country of electric motors, dynamos, etc., have just opened an office in Atlanta, Ga., at 630 Equitable building, of which Mr. Campbell Scott, formerly of Louisville, Ky., is manager. This office will be the headquarters of all the territory lying south of the Ohio and east of the Mississippi Rivers.

The C & C Company feel that the business conditions in the South now, are such that they will be fully justified in going to the expense of maintaining this office, by immediate returns in the shape of contracts for electric lighting and power plants. The C & C Company manufacture a full line of dynamos, generators, switchboards, elevators, controllers, etc.

SALES OF BALL ENGINES.

The Ball Engine Company, Erie, Pa., report the following shipments during the last thirty days: Shoenberger Steel Co., Pittsburg, Pa., one 150 horse-power and one 400 horse-power vertical direct connected; Chicago Public Library, Chicago, Ill., four 200 horse-power vertical cross compound and one 100 horse-power vertical cross compound; Nicopol-Mariopol Mining and Metallurgical Co., Mariopol, Russia, one 400 horse-power vertical cross compound, direct connected; to Mexico, five 25 horse-power engines; Jackson Street Railway Co., Jackson, Tenn., two 175 horse-power engines; Electric Installation Co., Geneva, Ill., one 100 horse-power engine and one 70 horse-power engine; Hammond building, Detroit, Mich., two 70 horse-power engines, direct connected; United Coke and Gas Co., Glassport, Pa., one 60 horse-power engine; Paul O. Stensland building, Chicago, one 125 horse-power engine direct connected; Crook, Horner & Co., Baltimore, Md., one 50 horse-power engine, direct connected; Church Home and Infirmary, Baltimore, Md., one 60 horse-power direct connected engine; Pine Ridge Indian Reservation, one 35 h.-p. engine, direct connected; Rosebud Indian Reservation, one 35 h.-p. engine, direct connected; Pennsylvania Tube Works, Pittsburg, Pa., one 60 horse-power engine; Junaluski Leather Co., Waynesville, N. C., one 50 horse-power engine; Wauwatosa County Insane Asylum, Wauwatosa, Wis., one 70 horse-power engine and one 110 horse-power engine; A. M. Fuller building, Chicago, one 70 horse-power engine.

GATES IRON WORKS OF CHICAGO.

The Gates Iron Works, of Chicago, announce their embarkment in the high-speed engine business with the Fischer-Gates single and four-valve self-oiling automatic engines, built according to the design and under the patents of Mr. Fred F. Fischer. Their product will be handled on the market by Messrs. Fischer & Whiteside, whose headquarters are at 700-702 Fischer Building, Chicago. Plans for extensive additions to the already very large plant of the Gates Iron Works are completed, and it is intended to push this branch of their business with the energy, experience, courtesy and business tact characteristic of this company, and they anticipate a large trade in the near future. The catalogue illustrating and describing the novel features of the Fischer-Gates engine, many of which are already familiar with the engineering fraternity, will be ready for distribution in a short time. Orders for these engines are already on their books. The reputation of this concern and that of the gentlemen who are associated with them will insure a high-class machine.

"IMPERIAL" LAMP AGENCY AND DEPOT IN CHICAGO.

MR. CONVERSE D. MARSH, president of the Bryan-Marsh Company, whose success in pushing boldly to the front their Imperial incandescent lamp, is too fresh in the minds of central station managers to need extended mention, having already opened an office on New Oxford street, London, W. C., England, has now been out West and in Chicago for the past week making arrangements to open a Chicago branch which shall act as a general distributing depot for the entire Western and Central States, except the Pacific slope, which latter will continue as heretofore to be handled by the San Francisco agents.

The company has taken a handsome suite of offices at 1239-1240 the Monadnock Block, to be opened on February 1, under the charge of Mr. Jos. M. Hill, formerly of the Columbia Incandescent Lamp Company, who becomes the Western manager.

A special feature of the offices will be a room devoted to the use of their friends when in the city, a stenographer, typewriter, and files of the newspapers and technical papers being at their disposal. Bryan Marsh Company will be glad to have their friends make their office a rendezvous and headquarters to which mail can be addressed.

A stock of one hundred thousand lamps will be carried, so that all orders may receive prompt attention; such stock will include Candelabra, Baby sign lamps, special series, etc., for which specialties this company is noted as producing the largest variety known.

THE ELECTRICAL EXCHANGE.

The Electrical Exchange, Chicago, have recently removed from their old quarters in the Monadnock Block to much larger offices in the Springer Building, 166-174 South Clinton street. In connection with their former office they had a wareroom at 173 Lake street, but with their rapidly growing business, they found that it was absolutely necessary to have more extensive offices and stockrooms to enable them to carry on their business successfully. In their new premises, which are 125 feet deep, they have about 4,000 square feet of floor space, of which the offices occupy about 1,000 square feet. The store and offices are lighted by electricity and gas, and in the rear there is a small plant for the purpose of doing repair work. The stock will consist as heretofore of new and second-hand apparatus, arc and incandescent lamps, and electrical supplies.

This concern, which commenced business less than a year ago, has already grown to very considerable dimensions, and is a good example of what may be achieved by perseverance and industry; and its members state that they believe that a great deal of their success is due to the fact that they have advertised quite extensively since they opened up for business. In connection with their business the Electrical Exchange issue a monthly bulletin containing a list of goods which they carry in stock. The Exchange was incorporated Nov. 1, 1896. The officers of the company are C. L. Glasner, president; T. S. Leane, secretary and treasurer.

CROCKER-WHEELER MOTORS IN THE NEW ASTOR HOTEL.

Thos. J. Fay and Associates, New York agents and general exporters for the Crocker-Wheeler Electric Company, 143 Liberty street, New York, have been awarded the contract for the ventilating motors to be used in Mr. John Jacob Astor's new hotel, comprising as follows: Two 24 horse-power motors, maximum speed, 190 r. p. m.; one 30 horse-power motor, maximum speed, 140 r. p. m.; one 32 horse-power motor, maximum speed 175 r. p. m.; one 40 horse-power motor, maximum speed 115 r. p. m.; one 60 horse-power motor, maximum speed 175 r. p. m.; one 90 horse-power motor, maximum speed, 140 r. p. m.

These motors will be direct connected to exhausters and blowers and the plant is probably the largest and most complete electrical equipment for ventilating work for which a contract has been let.

SALES OF AMERICAN-BALL APPARATUS.

The following is the list of machinery shipped by the American Engine Company, Bound Brook, N. J., during the month of December, 1896: One 60 horse-power American-Ball engine to the Albany "Journal," one 5 horse-power motor to the Western Newspaper Union, one 100-light dynamo to the Chattanooga "Daily News," one 5 horse-power motor to the Gazette Publishing Company; one 12 horse-power motor to the Toledo "Blade," one 12 horse-power motor to the W. D. Boyce Co., one 9 kilowatt dynamo to the Age Herald Publishing Co., one 9 kilowatt dynamo to the Dayton "Journal," one 3 horse-power motor to the Indianapolis "Sun," one 75 kilowatt dynamo to the Inquirer Co., one 3 horse-power motor to the Harrisburg "Telegram," one 9 kilowatt dynamo to the Jarecki Manufacturing Co., one 100 horse-power motor to the Boston "Herald."

MR. E. G. BERNARD, of the E. G. Bernard Co., Troy, N. Y., has sent out to his friends a tasteful card on which is mounted a thermometer, while the picture at its side does much credit to the Trojan idea of female beauty. Mr. Bernard has now installed 1,200 lighting plants and is ready to do it again.

ADVERTISERS' HINTS

THE INTERIOR CONDUIT AND INSULATION COMPANY, New York, pronounce their celebrated system of wiring ducts to be standard.

K. McLENNAN & CO., Marquette Building, Chicago, Ill., offer some testimonial letters relative to the merits of Gale's commutator compound.

THE ARMORITE INTERIOR CONDUIT COMPANY, Detroit, Mich., publish a price list of Armorite conduits, elbows and couplings.

EDWARD & SHARP, 44 Niagara street, Buffalo, advertises a 15 horse-power, 500 volt motor for $100 and other bargains in electrical apparatus.

THE FOREST CITY ELECTRIC COMPANY, Cleveland, O., are manufacturing a rail bond about which they will furnish any information desired.

MESSRS. WILLIAMS, COUCH & WHITMAN, 196 Summer street, Boston, Mass., advertise telephones for all services.

NEW YORK NOTES

S. K. REYNOLDS, AGENT, Room 626, 136 Liberty street, New York, reports a very satisfactory business. The "self-insulating" cut-out or perfect "bug" put on the market by Mr. Reynolds is meeting with immense success; thousands of them are now being ordered and placed with fixture and supply houses throughout the country, aside from being highly recommended by consulting engineers and others. The "bug" is smaller than any other on the market. Insulation is effected with the connection, therefore requires no cover, it cannot ground the fixture, and tape is unnecessary. It is claimed to be the cheapest device of its kind on the market. Circular and prices will be cheerfully mailed on application.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY have issued a very pretty calendar, in which two beautiful women are shown holding up Manhattan enclosed arc lamps, against a sky whose starry firmament spells out the company's name. The effect is quite pleasing.

THE PURITAN ELECTRIC COMPANY have issued from their New York and Boston offices a very handsome calendar for 1897. The brief reading matter relates to their noiseless arcs for alternating and constant potential circuits. The picture is that of the Puritan forefathers on their way to church through the snowy woods wherein lurk war-painted Indians.

MR. D. G. SCOTT, late of the American Electrical Works, has connected himself with the Bibber-White Company, of Boston, and will take charge of their office and store rooms at 136 Liberty street, New York, where a full line of Crefeld rubber-covered, weather-proof, magnet, annunciator, office and all other wires made by this company will be carried. Mr. Scott is a hustler, and we predict for him and for his company their full share of the business in their line from New York and vicinity.

WESTERN NOTES

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY report that their business continues to be very brisk and that they have no reason to complain of the dullness of trade which has been felt for a considerable length of time in nearly all lines of business. Their sales for last year were the best they had since they started in business.

MR. T. C. RAFFERTY, who is probably one of the best known men in the electrical supply business in the West, is now associated with the Metropolitan Electric Company, of Chicago, having disposed of all his other electrical interests. All of Mr. Rafferty's friends and customers will undoubtedly be pleased to learn of his new connection, which will afford him ample scope for his energetic work, enabling him to take care of his customers' wants in a befitting manner, and renew old and pleasant trade relations. We wish him every success in his new work and congratulate the Metropolitan Electric Company on their foresight in securing his services.

ELECTRIC APPLIANCE COMPANY.—In the advertising columns of this issue, the Electrical Appliance Company tell rather an amusing story of the enthusiasm of the contractor over his first job with Armorite conduit. It certainly is a pleasure to a contractor to be able to draw the wire into the tube without the use of soapstone and other lubricants which are usually necessary. The lining of the Armorite tube offers almost no resistance to the passage of the wire, and the wire certainly does slip through the conduit with remarkable ease.

NEW ENGLAND NOTES

BIBBER-WHITE COMPANY, since succeeding to the respective businesses of the New England Electric SupplyCompany and Bibber-White Co., have issued a New Year salutation from their headquarters at 49 Federal street, Boston, and announce that they have swung into line with "the largest stock in the East." They will make immediate shipments and stand ready to quote prices.

PETTINGELL-ANDREWS COMPANY, 72 and 74 Federal street, Boston, compliment us as usual with one of their handsome and effective calendars, the 1897 issue being in every respect worthy of the series. The company are in line for any trade going this year.

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ELECTRIC TRANSPORTATION

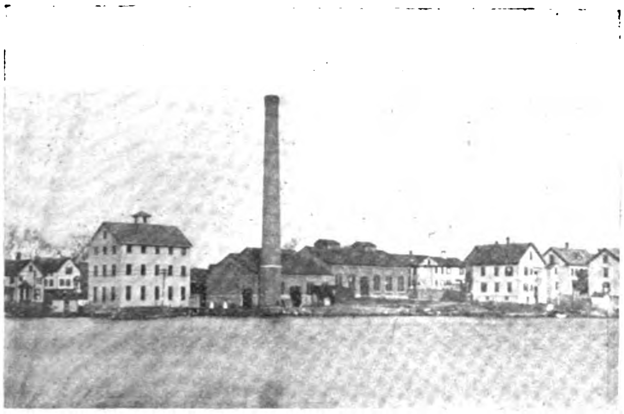
NEW POWER HOUSE OF THE NEW LONDON, CONN., STREET RAILWAY CO.

IN the early part of last winter, the directors of the New London Street Railway Company decided that the time had come when they should, for the more satisfactory and economical operation of the road, have their own power station, having heretofore rented their power from the Oneco Mills. Having reached this decision, they concluded to install a plant capable of handling their business for some years to come, and at the same time one of the highest efficiency, regardless of first cost. Mr. E. H. Kitfield, of Boston, was appointed consulting engineer, and the result is to-day a credit to every one connected with it.

All unnecessary expense for "frills" has been avoided, but the installation has been planned, and carried out in the most complete and substantial manner, for effective and economical operation.

THE POWER HOUSE BUILDING.

The company obtained a plot of ground located on Shaw's Cove, on the Thames River, about 1,200 feet from the nearest point of their road, and centrally located as regards their entire system. Sufficient ground was purchased, in case it should be, at any time, necessary to extend the plant. The plant being located on the water, there is every convenience for condensing.



New London Power House From South Side of Shaw's Cove.

Red brick with local granite underpinning was used for the building, the underpinning being laid in irregular ashlar with a cut granite water table extending all around the building. The roof is of corrugated iron and carried by self supporting steel trusses, and is provided with louvre windows over the engine room and latticed shutters for ventilation over the boiler room.

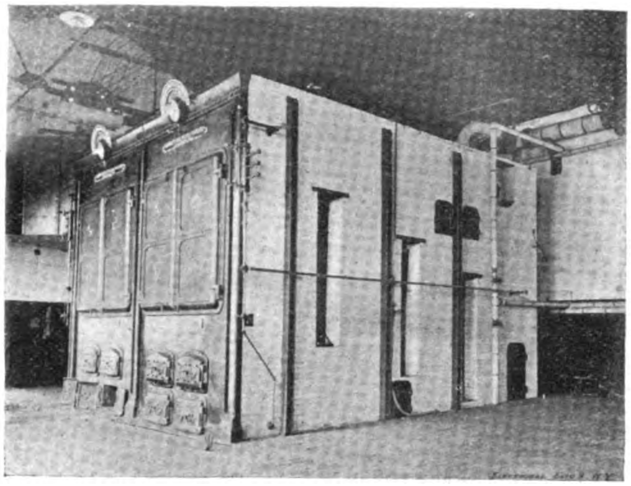
The roof was supplied by the Berlin Iron Bridge Company, and, over the engine room, is lined on the inside with the Berlin patent anti-condensation material, which absorbs the moisture condensing on the under side. The building is one story high and 132 ft. 3 in. in length by 46 ft. in width.

MASONRY WORK.

The engine room is separated from the boiler room by a brick fire wall provided with a single fire door, and an iron stairway leads down into the boiler room. The boiler room floor, and the basement of the engine room are carried through on the same level, while the floor of the engine room is 10 feet higher. This gives sufficient head room and allows easy inspection of the engine foundations, heaters, condensers, piping, and wiring located in the basement.

At the southerly end of the boiler room a brick stack has been erected, octagonal in shape, for about 24 feet from the ground, and running to the height of 125 feet, the upper portion being circular, with an inside diameter of 6 feet.

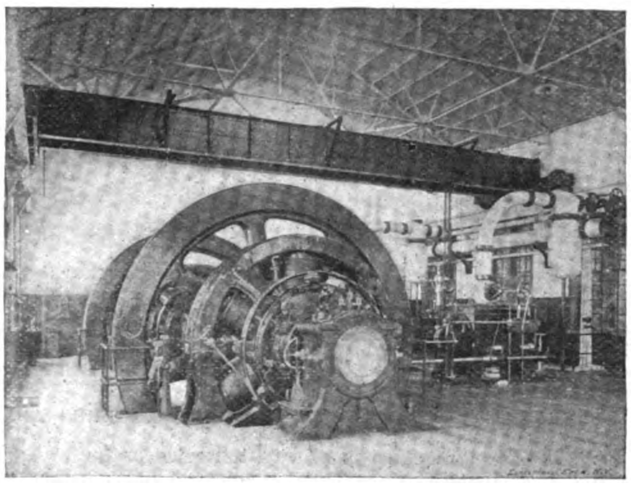
The foundation walls of the building are built of local granite laid in cement mortar, and extra heavy. It was necessary to drive piles for the foundations of the stack and engines, in order to prevent any possible chance of settling. The piles are of oak, cut off at the mean low water level, with two feet of Portland cement concrete for capping. Upon this concrete capping, granite blocks, split to nearly even thickness, and laid in Portland cement mortar, form the foundation of the stack. The engine foundations were laid up with hard burned red brick and Portland cement mortar.



First Battery of Campbell & Zell Boilers.

ENGINES AND DYNAMOS.

The engine room is 69 feet in length by 44 feet in width, and is arranged for three 24-in. by 48-in. improved Greene automatic cut-off engines, manufactured by the Providence Steam Engine Company, of Providence, R. I., speeded to 100 revolutions per minute; the capacity of each engine being 600 horsepower when used condensing, the balance wheels weighing 23 tons. Directly connected to each engine is a 300 kilowatt generator of the latest type, manufactured and installed by the General Electric Company. The switchboard is located at the southern end of the engine room, and consists of two generator panels, and two feeder panels, equipped with the usual G. E. type of circuit-breakers, switches, and lightning arresters, and Weston ammeters and voltmeters. A recording watt-



Engine and Dynamo Room.

meter is also installed on a separate panel, for recording the total output of the station. All the panels are of ornamental slate, supported on iron frames.

In the engine room is located a powerful travelling crane and carriage, the track for which, is supported on steel columns built into the walls of the building. The crane is of a capacity of 10 tons and was one of the first pieces of machinery installed, and was found especially useful in the erection of the rest of the apparatus. This crane was furnished and installed by the Berlin Iron Bridge Company, of East Berlin, Conn.

The floor of the engine room is of spruce planking, upon which is laid the finished flooring of polished maple in narrow strips.

Openings have been left in the floor over the condensers, so that they can be seen distinctly at all times from the engine room. Proper controlling wheels have also been provided on floor stands, so that the principal valves in the basement can be operated without leaving the engine room floor.

The engine room is connected with the superintendent's office in the car house, by telephone.

BOILERS, FEED WATER HEATERS, ECONOMIZERS AND PIPING.

The boiler plant consists of two batteries of improved Zell water tube boilers, of a total capacity of 1,500 horse-power, and were installed by the Campbell & Zell Company, of Baltimore, Md. These boilers were chosen on account of their rapid steaming qualities, and ability to furnish absolutely dry, and slightly superheated steam, at all times, a point of considerably economy in any steam plant.

The floor of the boiler room is laid with hard burned selected brick, laid on edge and grouted with cement, which ensures a smooth and durable surface.

The blow-off piping from the boilers is carried through the boiler room in open trenches below the floor, and covered with cast iron floor plates.

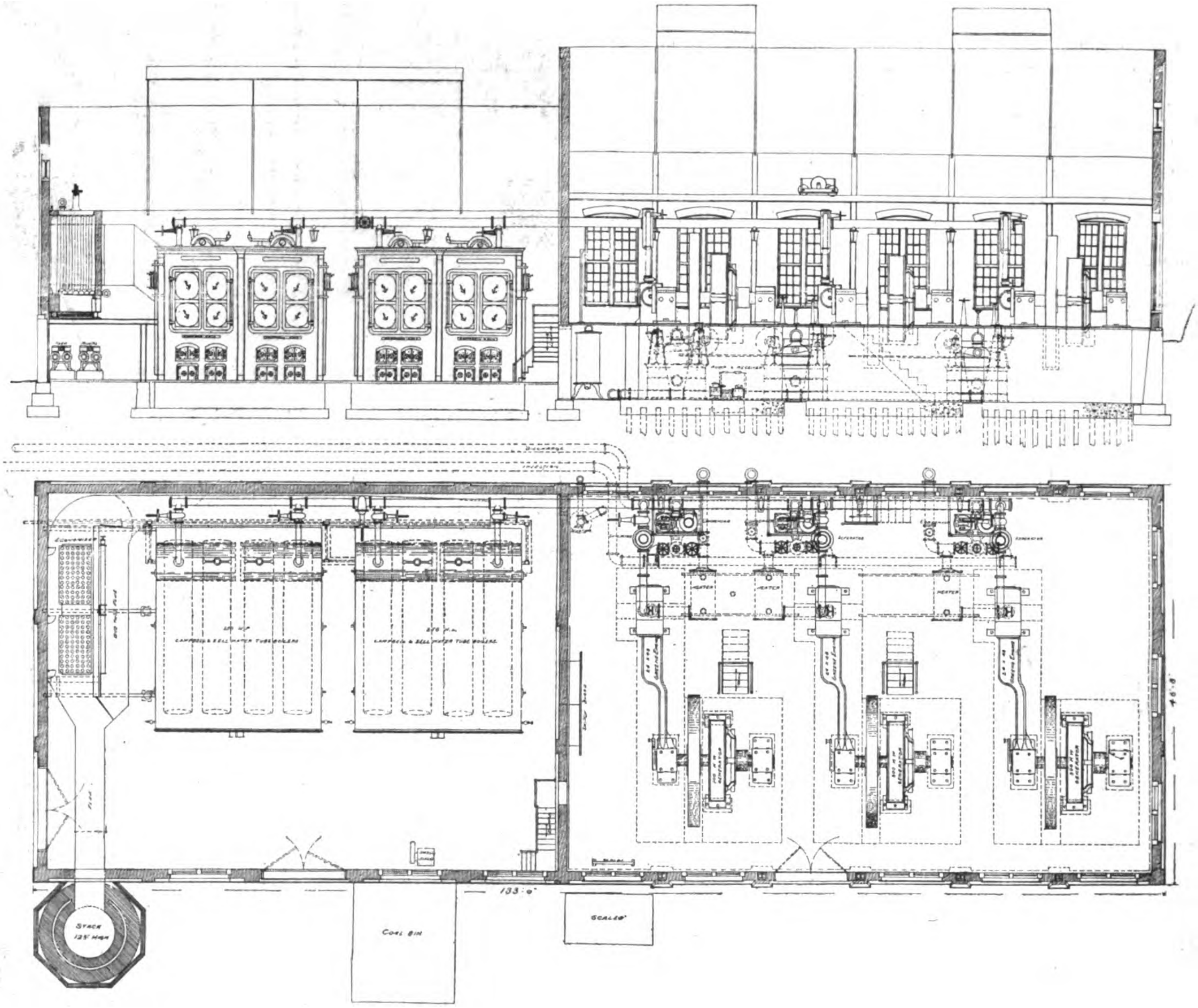
The gases from the boilers pass into the main flue, and then through a Green economizer, before entering the stack. The economizer is supported on steel girders with a head room of 10 feet underneath it, and was installed by The Fuel Economizer Company, of Matteawan, N. Y. A by-pass flue is provided so that the economizer can be cut out, if necessary, at any time.

The draft is controlled automatically by a Spencer damper regulator.

In the space underneath the economizer, the various pumps and meters are located. They consist of two Knowles duplex feed pumps, 5½-in. x 3½-in. x 6-in. stroke, two No. 10 injectors of the Körting type, and two Thomson water meters.

All feed piping and fittings from the main heaters of the boilers are of extra heavy brass. The feed water can be obtained from three independent sources, and by the arrangement of the pumps and injectors and their connections, no accident can possibly cut off the supply of water from the boilers. The feed water entering the building from these various sources, passes through the main heaters, where it is raised to a temperature of about 200° Fahr. by the exhaust steam from the engines; it then passes through an auxiliary heater (through which is carried the exhaust from the condensers and pumps), where the temperature is further raised; it is then passed through the economizer, where the temperature is again increased by the waste gases from the flue, until it finally enters the boilers at about 360° Fahr. The piping is so arranged that, were the entire system of heaters disabled, the water could be fed directly into the boiler.

The fuel is weighed on its arrival at the plant, on a platform connected with a set of Howe railroad scales, and is then shot



The New London, Conn., Electric Railway Power House. Plan and Sectional Elevation.

into a coal shed adjoining and alongside the boiler room doors.

Connected to each engine and placed in the basement under the engine room is a National feed water heater, manufactured by the National Pipe Bending Co., of New Haven, Conn. The condensers are of the Knowles vertical independent steam driven type, 12-in. stroke with one 10-in. steam and two 20-in. air cylinders, and the exhaust from the heaters can be led either into the condenser, or discharged directly into the atmosphere through the medium of an automatic relief valve. By this arrangement each engine is entirely independent, and can be operated condensing, or non-condensing, at will. The condensing water is taken directly from Shaw's Cove, in front of the station, into which it is discharged after using. The average temperature of this water is under 60° Fahr. and it has not to be lifted to any height, these two conditions being verey favorable for economical operation.

All the condensation water from the main steam pipes is returned to the boilers by gravity. Other water of condensation which will not flow to the boilers by gravity, is collected into a receiver, and forced into the boilers by an automatic pump.

The piping of this station is of special interest, and is arranged in the most complete, and yet simple, manner. The main steam piping is extra heavy wrought iron, and all fittings of extra heavy flanged cast iron of the best quality. It is supported on cast iron brackets fitted with expansion rollers, the brackets being securely bolted to the side walls of the building. All main valves are of Chapman heavy duty flanged type with outside screw and yoke, and by-pass. All connections with the boilers and engines are made with brazed copper bends and independent gate valves. Attached to the connecting pipe of each engine, is a Stratton separator, which collects all water of condensation, or possible overflow from the boilers, and prevents it from passing into the cylinders of the engines.

The complete system of piping was installed by W. H. Gallison, of Boston, and is covered with magneso-asbestos covering manufactured by the H. W. Johns Company.

ROLLING STOCK AND LINE CONSTRUCTION.

The company operates from 15 to 20 cars in summer, although a smaller number answers the requirements of the winter traffic. The road is 7.18 miles long, of single track with necessary turnouts, laid with 50 lb. "T" rail. Three-quarters of a mile is laid in paved streets, being supported on chairs; the balance being on macadamized streets, is spiked directly to the ties.

A line of five No. 000 feeders is led from the station to the different sections of the overhead line, while the track circuit is connected to the negative bus of the switchboard by four wires of similar size. A feeder of 400,000 c. m. capacity on the same poles with the overhead feeders follows the line of the rails and is connected to them at intervals of 1,000 to 1,500 feet; the rails in addition, being double bonded so that a very complete and even distribution of the current is the result.

The station was built under the supervision of Mr. E. J. Richards, representing E. H. Kitfield, the consulting engineer of the plant. The excavation and foundation work was done by Mr. George Prest, of New London, and Mr. W. A. Dean, of New London was the contractor for the building and stack, above the foundations.

The plant is under charge of Mr. E. W. Havens, as chief engineer, with Mr. A. Crocker as assistant and James Latham and Andrew Stewart firemen.

The officers of the road are Walter Learned, president; W. A. Tucker, treasurer, and L. Bentley, superintendent; and under their able management the road in four years has become a very valuable property.

PROPOSED MUNICIPAL OWNERSHIP OF STREET RAILWAYS.

Senator McNulty has introduced in the New York State Senate three bills, carrying out the ideas of Edward M. Grout, of Brooklyn, as expressed at a hearing before the Greater New York Commission, regarding municipal ownership and disposal of public franchises. The first bill provides as follows:

"Any city of the first class may establish, construct, or acquire by condemnation proceedings, under the provisions of the Condemnation law, street railroads within its boundaries, whether operated on or below or above the surface of the street, and may issue bonds therefor, and may conduct, manage and operate such railroads by means of its Department of City Works, or other like department, under the supervision of its Common Council, or other legislative bodies."

The second bill provides: "Hereafter no franchise or right to use the streets, avenues, parkways, or highways of any city of the first class shall be granted to any person or corporation for a longer period than twenty-five years; nor shall the same be so granted for less than the best possible terms obtainable therefor, and the action of all officials of cities of the first class in relation to the granting of such franchises shall be reviewable in the courts."

The third bill provides: "Any city of the first class may establish, construct, or acquire by condemnation proceedings under the provisions of the Condemnation law, a plant for lighting by gas or electricity its streets and public buildings and for supplying such light to its inhabitants, and may issue bonds therefor, and may conduct, manage and operate such lighting works by means of its Department of City Works or other like department, under supervision of its Common Council or other legislative body."

INSTITUTE DISCUSSION ON HORSELESS VEHICLES.

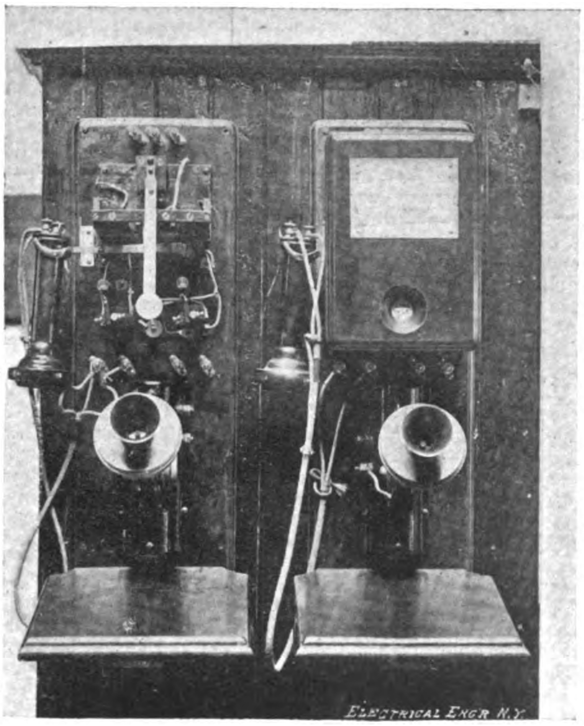
In spite of the extreme inclemency of the weather, there was a fair muster of members of the American Institute of Electrical Engineers at the up-town headquarters on Wednesday night, January 20, to discuss the topic of "Horseless Vehicles." No regular paper was presented, but the discussion was opened by Mr. A. L. Riker, who has done so much good pioneer work in this field, and who now stated briefly the condition of things. He insisted chiefly on the need for great improvement in the storage batteries used. They were built for lighting and other "quiet "uses, but a stronger type was needed for motorcycles. President Duncan also dwelt on the battery limitations and their effect on the travel and speed of the vehicles. Mr. Reckenzaun held that the difficulties to overcome were so great that storage batteries must "take a back seat" for the present. Mr. Adams said that the Electric Carriage & Wagon Company had a carriage that would go 35 miles on one charge. It had made over 1,000 miles without a single accident. It took 20 or 30 amperes at 9 or 10 miles an hour, the battery weighing about 800 pounds. Mr. H. B. Coho related some dismal experiences with storage battery cars that had to be helped home, and suggested the need of carrying a meter that would tell the driver when his current was running short. Mr. Corson said he had seen such a meter in use indicating the point of exhaustion. Mr. Joseph Sachs made an able presentation of the other important features pertaining to motorcycles outside the motor and the battery, such as brakes, wheels, structural material, steering, control, etc. Mr. Riker stated that he was building a carriage with 36-inch rear wheels and 32-inch front wheels, to make 40 miles an hour if need be. It would weigh about 1,400 pounds. He was trying a device like the back gear on a lathe so as to run with due economy on a grade or in overcoming obstacles. He emphasized the importance of simple and effective steering gear. In reply to a question from Mr. Coho, he said that under normal weather conditions he found Belgian block and asphalt to be about equal and slightly better than a good macadamized road. Wooden wheels with plain radial spokes were bad, as the strain always twisted them to pieces. The metal wheels with tangential spokes of wire, and pneumatic tires were preferable. Mr. Sachs having cited other powers, and the Serpollet boiler, Mr. Riker stated that the Count de Dion, who had done so much with other forms of vehicles, was now working on an electric carriage. As to a single motor, it was better than two on the grounds of less cost, greater efficiency and diminished weight. Mr. Van Hoevenbergh made a happy little speech in which he suggested horseless vehicles not running on tracks, but taking current from overhead wires by means of extensible trolleys. Mr. Duryea, the well known builder of gasoline carriages, expressed an opinion against putting the mechanism on the trucks or axles. He defended gasoline vehicles on various points. Even the smell, which was less objectionable than that of the horse was now being rectified, and in any event it was behind the passengers instead of in front of them. The trouble with electricity was its difficulty and slowness of resupply. Gasoline could be picked up almost anywhere and a little went a long way. The great goal and desideratum for a horseless vehicle was light weight, which the electric carriage did not give. Mr. Riker replied to some of these points, and went on to criticise, the storage battery again, although expecting great improvements. He had tried that day an excellent cell which had charged up in 3½ hours and discharged in 2¾ with an efficiency of 65 per cent. The discussion, which lasted until after 10 p. m., was brought to a close with some felicitous remarks from secretary Pope, who pointed out some fields of usefulness and commented on the present cost of handling goods in transit through or about cities.

TELEPHONY AND TELEGRAPHY

RECENT IMPROVEMENTS IN PARTY LINE TELEPHONE SYSTEMS.

THE desirability of obtaining a satisfactory party line system or one in which more than one subscriber's telephone may be connected to the same metallic circuit, has long been recognized by telephone companies, and has resulted in considerable study and experiments. Many systems, each more or less workable, have been prepared and some of these are now in operation. Few, however, have realized the full economy that should result from the increased earning capacity of a circuit without detriment to the subscribers' service. It is evident that no system, though permitting a reduction in rates, would be generally acceptable to the subscriber if accompanied by a loss of privacy in conversation and the annoyance of having his bell rung when another on his line was being called.

A satisfactory system would, with all the economy of a party line system, give to the subscriber all the advantages of a private line. A system fulfilling these conditions to a high degree has recently been brought out by the American Telephone and Telegraph Company (long distance). Without attempting a detailed description of the central office equipment or the mechanism of the subscribers' telephone sets, the system may be described as follows: The switchboards in the exchange differ but little in general appearance and method of operation from ordinary telephone switchboards. Each line terminates in its springjack and corresponding line drop. Each operator's position is equipped with the usual number of pairs of cords and plugs, with their corresponding listening cams and clearing-out drops. Instead, however, of a pair of ringing keys for each pair of cords, there are in the party line boards a single group of ringing push bottons, a "locking" and an "unlocking" button for each operator's position. By depressing its corresponding listening cam, these push buttons may be cut in upon either the calling plug, or by also depressing a shifting cam upon the answering plug of any pair. The push buttons are so wired to a battery in the central office that each, upon being depressed, forms a particular relation between the battery terminals, the ground, and the two wires of the metallic circuit, terminating in the springjack to which the active plug may be connected; each push button giving a current combination different for all the others.



PARTY LINE INSTRUMENT OF THE LONG DISTANCE TELEPHONE CO.

The subscriber's telephone apparatus also has the usual outward appearance, as shown in the accompanying engraving. The difference lies mainly in the small box above the transmitter which usually contains a magneto hand generator and a polarized bell, but which in the party line apparatus conceals a few simple devices. One, slightly different in each of the stations on the line, controls the subscriber's telephone bell and responds only to the current combination furnished by its corresponding ringing push button, thus enabling the operator to ring up any subscriber without ringing the telephone bell of any other on the same line.

Another device having its counterpart in each subscriber's telephone apparatus responds to currents from the locking and unlocking buttons, enabling the operator by depressing the former to lock out, that is, cut off all the subscribers on the circuit from access to it, preventing them from listening to, or interrupting, the conversation of any subscriber to whom the operator may release the line, and by depressing the latter button to unlock, that is, give all subscribers access to the line. A third device furnishes the operator with the means of unlocking the telephone of the subscriber she rings, without unlocking any other on the line; and still another device whereby the subscriber may call central.

On the front of the box cover is a plainly printed card giving the subscriber a few simple directions in regard to the use of his telephone and below the card a small circular window, behind which a signal actuated by the locking mechanism appears when a subscriber is using the line, informing each subscriber on the circuit that the line is in use.

A subscriber desiring to call central—the "line in use" signal not being in view—does so by simply removing the telephone receiver from its hook. This act sends an impulse of current over the line throwing the line drop in the switchboard. The operator seeing it fall, immediately connects her talking set to the subscriber's line jack with an answering plug and cord and listening cam, locks out the other subscribers on the line by depressing the locking button and takes the subscriber's order.

If the subscriber desires to converse with one on another party line, the operator connects the two lines together through a pair of cords, and through trunking circuits, if necessary, locks out all subscribers on the line and depresses a ringing button corresponding to the telephone of the subscriber wanted. This sends a current combination out over the line which, without affecting the locked condition of the telephones of the others, or ringing their bells, rings, and at the same line unlocks the telephone of the subscriber wanted. The desired subscriber having answered the call, the two on different party lines can converse with the same degree of secrecy as though each had a private line.

Upon finishing their conversation, each hangs up his receiver. This sends current impulses over their lines and gives the operator the disconnect signal. Seeing it, she assures herself that the conversation is ended and then depresses the unlocking button, sending current out over both lines in the proper manner to unlock the instruments of all the subscribers on both.

If he desires it, the operator may connect a subscriber with a party on his own line, or she may, through the medium of trunking circuits give him connection with any local or long distance points operated on any telephone system.

OPPOSITION TELEPHONE EXCHANGES WEST.

A special dispatch of January 19 from Fort Wayne, Ind., says: To-day 43 representatives of independent telephone companies of Indiana met in this city for the purpose of discussing the advisability of forming a State organization to compete with the Bell Telephone Company. Charles McCulloch welcomed the delegates to Fort Wayne. Judge R. S. Taylor followed with an address. Mr. Taylor is principal counsel for the Government in the Berliner patent cases, and he was subjected to many questions. E. H. Andress of Lafayette, president of the Indiana Mutual Association, presided. There was a general sentiment in favor of some united system, but it was determined to first secure legislation which would protect the independent companies against the Central Union. An executive committee was appointed as follows: W. J. Hazey, Fort Wayne, chairman; L. A. Frazee, Connersville; E. C. Bickel, Elkhart; Charles S. King, Wabash; John D. Pugh, Shelbyville; Jasper A. Gauntt, Marion; J. L. Stone, Rushville; C. A.

Reeve, Plymouth, and E. H. Andress, Lafayette. Judge James N. Thomas, of Chillicothe, O., president of the Ohio Independent Telephone Association, invited the Indiana delegates to attend their State meeting at Columbus January 26. An effort will there be made to form a company in the States of Indiana, Ohio and Illinois.

THE PACIFIC CABLE PROJECT.

A dispatch of Jan. 22 from Washington says: James A. Scrymser and Edmund L. Bayliss were before the House Committee on Interstate and Foreign Commerce to-day in the interest of the Pacific Cable Company of New York. They both argued upon the merits of the Scrymser bill over the Spalding bill of the New Jersey Company. Mr. Scrymser stated that his company would want eighteen months after the passage of the bill to complete the cable to Hawaii and one year more to complete it to Japan. In case of war with England cable communication with Europe would be cut off by this plan. Mr Patterson (Dem., Tenn.), said that it had been charged that the Scrymser company was in sympathy with or had connection with England and English interests. Mr. Scrymser said that of course his company would expect to do English business. Mr. Patterson said that there should be inserted in the bill a provision that the cable company should not come under British influence.

Mr. Scrymser referred to the statement that Japan wanted no other cable connection as ridiculous. The Spalding company, he said, would build to Hawaii and stop. His line to Japan would save the people of that country more than a million dollars in tolls. "The Japanese," he said "are flocking into Hawaii now. This country is going to have a contest with the Japanese or some other power to control Hawaii. It is necessary to have a cable line there as soon as possible."

Mr. Scrymser did not like the idea of leaving the matter of contract with the Postmaster-General. "The present Postmaster-General will not have time to act, and we don't know who the next Postmaster-General is or what he will do," he said.

The discussion among members of the committee developed that there is yet a wide difference of opinion on the subject of the cable.

TELEPHONE RATES IN NEW YORK STATE.

In the State Assembly Mr. Cain has introduced a bill regulating telephone charges so that New York subscribers shall pay a rental of $85 per annum, Brooklyn $75 per annum, cities of less than 500,000 and more than 100,000, $48 per annum; cities of less than 100,000 and more than 20,000, $36 per annum; cities of less than 20,000 and more than 8,000, $30 per annum, and all cities and places of less than 8,000 inhabitants, $27 per annum. The pay station tolls are to be 10 cents for the first five minutes' conversation and 5 cents for every five minutes thereafter. The measure also provides that the Controller, Attorney General, State Engineer and Surveyor shall constitute a board to examine and regulate the affairs of telephone corporations, and that they shall be recompensed for all moneys paid for clerical assistance.

JERSEY COAST TELEPHONE LINE.

It is now possible for Division Inspector Holland, of the New Jersey Life Saving Service, to talk by telephone from his office at Point Pleasant, a few miles south of Sandy Hook Light, to the life saving crew on duty at the station on Cape May Point, a distance of nearly 200 miles. The line has been partially operated for several years, but was not made complete until recently, because of the failure of the government linemen to sink cables successfully beneath the inlets along the coast, some of which, Great Egg Harbor, for instance, are quite wide.

Finally, all obstacles were overcome, and the system made complete. All of the stations on the coast are now connected, and the life saving service will be benefited greatly thereby. The Atlantic City station has been made the central office of the coast system.

PUNISHING TELEPHONE TRICKSTERS.

A MOVEMENT has been set on foot in Missouri to secure additional legislation at the coming session of the State Legislature to correct some of the abuses of the telephone system. It is well known that the business and professional men of St. Louis are frequently made the dupes of telephone pranks perpetrated by unknown persons, or the victims of schemes of irresponsible parties who use the telephone in carrying out their work. At present there is no system whereby the culprits can be detected, and the present movement is to secure legislation to that end.

There is a law in Missouri making it a crime to send false messages over the telephone or telegraph wires. Several convictions have been secured under the statute, which is known as section 2728 of the Revised Statutes of Missouri. It reads:

"If any officer, manager, agent or operator of any telephone or telegraph line operating in this city, or any other person, shall knowingly transmit by such telephone or telegraph line any false communication or intelligence with intent to injure any one or to speculate in any article of merchandise, commerce or trade, or with intent that another may do so, or shall knowingly send or deliver any dispatch that is forged or not authorized by the person whose name purports to be signed thereto, shall, on conviction thereof in the court having criminal jurisdiction in the proper county, be liable to the same penalty as provided in section 2725."

The section referred to makes the penalty $200 for every offense. A conviction was had in St. Louis under the law several years ago, when a hackman was fined $20 for sending a false message to a rival. The victim of the trick had his cab stationed at the most advantageous point at a public stand. His rival went to a near-by telephone and sent in a call for a vehicle. The victim was told that his cab was wanted at a point about three miles away. After he had driven off his rival took his place. When the man found out the hoax he complained to the telephone company, and an investigation was made. It so happened that the subscriber of the telephone from which the "fake" cab call had been sent remembered the occurrence, and a warrant was issued against the culprit, and he was fined $20. It is safe to presume that he never sent any more "fake" messages.

One of the remedies suggested for the abuses of the telephone and telegraph system is to make the penalties on a line with the postal laws, which are very strict, and which summarily deal with tricksters. Another suggestion is to inaugurate a system of checking all telephone calls from public telephones. In this way a line could be kept on all messages, as the subscribers of private service would be held to account for messages sent from their boxes.

Many physicians can tell of hurried trips they have made in response to urgent calls over the telephone, only to find that the number given was a vacant house or an empty lot. The police every now and then are summoned on "fake" riot calls, lawyers are sometimes called away from their work on "fake" appointments, and there is hardly a large business house in St. Louis which has not been victimized by sharpers or "jesters."

Several years ago a man went to a lumber office on Clark avenue, St. Louis, and telephoned to fifteen undertakers in rotation, notifying them that a certain well-known citizen in the West End had died, and that the body should be embalmed at once and removed to the undertaking rooms. In less than an hour there were fifteen undertakers' wagons at the number given, but each undertaker, in turn, found his supposed subject a very lively corpse, and mad as a hornet. The excitement in the neighborhood was intense. The undertakers departed, but before doing so they held an indignation meeting on the street corner and decided to investigate the matter. The telephone company was notified, and an investigation was begun. It happened that the operator remembered that a certain telephone box had called up nearly every livery stable in town, and with that as a starter the matter was traced to the man who did the telephoning. For some reason or other, however, there was no prosecution, although the telephone company was anxious to make an example of the fellow.

NO MENTAL DISTRESS DAMAGES FOR A DELAYED TELEGRAM.

Among the decisions handed down by the Appellate Division of the New York Supreme Court last week was one in the case of Curtin vs. The Western Union Telegraph Company, in which the Court holds that there can be no recovery on account of mental distress occasioned by the failure to properly transmit and deliver a telegram. In this particular case there was such a delay in the delivery of a dispatch announcing the death of the plaintiff's brother that she was unable to attend his funeral. The precise question has been determined the same way in other States, and yet the view that damages ought to be recoverable under such circumstances has been earnestly maintained by some law writers and judges. Messrs. Shearman and Redfield in their well known treatise on the law of negligence say on this subject: "Delay in the announcement of a death, an arrival, the straying or recovery of a child, and the like may often be productive of an injury to the feelings, which cannot easily be estimated in money, but for which a jury should be at liberty to award fair damages." The authors cite a Texas decision, however, as authority for the proposition that the receiver of a telegram is not entitled to recover damages for mental suffering alone.

MISCELLANEOUS

ELECTRICITY IN NAVAL LIFE.—XV.

(Concluded.)

BY LIEUT. B. A. FISKE, U. S. N.

DIRECTION OF FUTURE PROGRESS.

IT would require an inspired prophet to foretell this exactly, but it would require only a man of observation to predict certain phases of it within a small probability of error.

At the present time in various branches of engineering we see the use of electrical appliances gaining so rapidly on hydraulic and pneumatic appliances and on auxiliary steam apparatus, that he must shut his eyes and close his ears very tightly who cannot see and hear the approaching triumph of electricity. Can we then not feel it as an absolute certainty that electric power will soon be used in all our warships—and merchant ships also—for auxiliary engines? There is a predilection in the minds of a few officers in favor of hydraulic apparatus; and many officers like steam. Doubtless there may be some who prefer pneumatic apparatus, but they are few in number and hard to find. The only important difference of opinion, therefore, seems to be between steam and electricity; because steam has the undeniable advantage of saving weight and space and money; but how there can be any question between the relative advantages of electricity and hydraulics, it is difficult to imagine. Whatever faults electric power on shipboard has (such as the necessity for a generating plant, the increase of parts, etc.), hydraulics has in at least an equal degree. And it may be iterated and reiterated that every advantage which hydraulics possesses, electricity possesses in an equal degree; and for every disadvantage which electric power possesses, hydraulics possesses another at least equally great. Yet electricity possesses many advantages which hydraulics does not possess, and hydraulics has many disadvantages which electricity has not. The whole trend of engineering professions is away from hydraulics and towards electricity. This is true even in ship work, for many people now understand what it means to keep valves and joints from leaking under high pressure, and recall the fact that in the Maine and the Benbow the water simply froze everything stiff and tight, and put the ships absolutely hors de combat.

The electrical arts are certainly younger than the hydraulic arts, and yet it is time to cease to regard electricity as a species of illusion or humbug, and to cease to look on an electrician as a species of fakir or magician. As a matter of fact, in all the colleges and electric companies of the country we find men of the highest order of intellect and education engaged in the study of electricity from both a scientific and an engineering standpoint, and the amount of money invested in it is many times greater than that invested in all our ships put together.

So, in deciding between hydraulics and electricity for auxiliaries in ships let us not be blind to the fact that if we decide in favor of hydraulics, we shall take a step backward as judged from engineering progress broadly considered, and place ourselves in the position of the only sensible juryman out of twelve.

Let us hope that we soon shall see a civilized modern ship, in which there shall be a fine large dynamo room, like those under the great New York hotels, where power will be generated for lighting the ship, making the signals, hoisting the ammunition, turning the turrets, operating the telephones, hoisting the boats, ringing the bells, weighing the anchor, sounding the alarms, running the launches, firing the guns, steering the ship, etc. And why should we not have a neat electric galley, such as are frequent in New York, where the meals of all can be prepared in cleanliness and quiet, with only a fraction of the fuss and confusion now attending the getting of the food and the coal and the heating of the water? And why should not both officers and men, when they go on night watch, frequently in the wet and rain, be given a light repast, cooked on an electric stove, the size of a quart pot? Would the lookouts, or the quartermasters, or the officers, do their duty any less vigilantly if each had half a pint of hot coffee and a piece of nicely browned toast in his stomach? But whatever will be the exact paths that electrical progress will pursue, it is unquestionable that it will strengthen the hands of the commander and give him better control of his forces both material and personal. This does not mean that a commander—either of a fleet or ship—will be expected to attend to all matters from the conning-tower, because that would overwhelm and overpower him with details which had better be left to subordinates; but it means that he shall be instantly informed of everything that happens, and that he shall be able instantly to give such instructions as he shall think best; it means, in other words, that he shall be able to direct affairs instead of being helplessly directed by them. The real end and aim of discipline is not to put men in the brig or to make them touch their caps, but to give a commander control of the forces under his command, some of which are at a distance. And above and beyond all questions of comfort, and of routine, and of detail, and of beauty, and of the nature of auxiliary engines, and of etiquette, is the question of the control of the ships, and of the various factors, offensive, defensive and directional, which give the ships their fighting value both singly and when combined in squadron. This means that signaling in its broadest sense—signaling both among the parts of a ship and among the ships of a fleet—must be improved, and then improved again and again, with never a rest in the onward march.

SIGNALING AT SEA.

The electrician and the inventor recoil in despair before the difficulties which this problem presents. Guns, armor, hulls and engines change from year to year, but when we wish to signal by day we do the same things that Nelson did at a time when electricity and steam were almost unknown outside the "Proceedings" of scientific societies. Yet there must be a way to signal across the water; the question is, "Where is the way?" If we can talk with ease from New York to Chicago, over a distance of 1,000 miles; if we can telegraph over the same line 200 words a minute and receive the message printed on a page; if we can photograph the interior of the body of a living animal; if we can telegraph under all the oceans, and send news to and from all quarters of the world—why—why—can we not signal half a mile over the water from ship to ship?

The solution of the problem lies probably in the direction of electric induction, the transmitters and receivers being so constructed, and so adjusted relatively to each other in resistance, inductance and capacity, that they will be in sympathy, or resonance, with each other, in which condition the receivers will be at their maximum sensitiveness to vibrations propagated from the transmitter.

Many experimenters have attacked this problem, but each, in turn, has been put to rout, "horse, foot and dragoons." Among others, the writer in 1887 essayed his feeble powers, both at the New York Navy Yard and the Stevens Institute. In one experiment he used the U. S. S. Atlanta as the transmitter and the U. S. tug Nina as the receiver, wrapping them horizontally with many turns of wire. The Atlanta's wire was coarse and traversed by the dynamo current; while the Nina's wire was fine and in circuit with two telephones. The Atlanta then formed the largest electro-magnet ever constructed, and she still holds the record; but the experiment, like all the others, was a failure in a practical sense, though signals were transmitted over, say, a hundred feet. On other occasions, the writer, amplifying some experiments of Prof. A. Graham Bell, signaled by means of electric currents propagated through the water. Fairly good signals were sent a hundred yards, but they could not be induced to go any farther. It is to be said, however, that all these experiments in signaling were conducted by the various experimentrs in a desultory fashion, and before the laws of electrical sympathy or resonance were well understood. And it is the belief of the writer that, if some competent person were given proper facilities by the government, or by private parties, he could develop a system of signaling which would be equally good by day or by night, in clear weather or in fogs. Until then we shall have to be as happy as we can with the Ardois system and electric wig-wags; unless some good magician, with a wave of his wand, will bring into being some simple and beautiful discovery or invention, the like to which we do not dream of now.

CENTRAL STATIONS.

The problem of insuring rapid and sure communication among the various compartments of a warship has brought about the same solution as a similar problem has brought about in modern cities—a "central station"; and the more the subject is considered, the more plain it becomes that a central station is the only thinkable solution in a city, a large building, or a ship. And not only this, but in a warship the solution is the more complete, because, added to all other conditions of the problem, is the important one that the means of communication and the operators must be as much protected as possible. It is an admitted fact that the problem of where to put the conning-tower and how to arrange it has not yet been solved, but the central station below the water-line comes pretty near solving it, because much, if not all, of the complicated apparatus heretofore put in the conning-tower can now go in the central station, and the captain needs only a telephone or large speaking-tube connecting him with his aide in the central station. The conning-tower being thus relieved of most of its apparatus, can be made smaller, and for a given weight, covered with thicker armor, so that it will be extremely hard to hit and almost impossible to destroy.

It has been proved in service that speaking-tube communication, or even telephone communication, is very inefficient between the conning-tower and those parts of the ship, such as the battery, turrets, engines, etc., in which there is much noise; and that it is utterly useless for communicating simultaneously with several persons under the conditions of action or even general quarters. But telephonic communication can be made perfectly satisfactory betweeen two people, one in the conning-tower and the other in the central station; because a central station can be made quiet, and because the two people, say the captain and his aide, can keep their telephone receivers on their heads all the time and become accustomed to each other's voices and modes of intonation. Then from the central station reach out the various visual signals for silently telegraphing ranges, battle orders, directions to the helm, engines, etc.; and there is received news from all parts of the ship for transmission to the captain. The central station should be as near the conning-tower as possible, for obvious reasons; but even if in some ships it should have to be at some distance, yet the telephone will put matters in the same condition as if the captain and his aide were absolutely in the conning-tower together and holding verbal communication. Aside from the value of protection for all the interior signaling apparatus, both for sending and receiving, the advantage of having all the operators in a quiet place, where they will be as free as possible from exciting and disturbing causes is clearly of paramount importance.

It is to be hoped that the tremendous advantages to be derived from a central station properly situated and equipped will be more and more fully recognized, and that in the original designs of our new ships the central stations will be really properly situated and equipped. It would seem that the principle governing the arrangement of electric apparatus in ships should hereafter be the same as in large establishments on shore, viz., that all apparatus which is delicate, or which requires great skill in its operation, should be confined to the central station, and that the apparatus placed elsewhere should be of the simplest character as regards both its construction and its manipulation.

If this plan were adopted, we could get rid of the armored tube with its multiplicity of chains and wires, a blow on which from a heavy shell would paralyze all means of communication and leave the captain helpless. We might even get rid of the conning-tower itself, because all that would be needed would be a strong steel post, or bar, behind which the captain could stand, like a sharpshooter behind a tree; with perhaps a quartermaster near him, to direct the helmsman in the central station.

It is now proposed that the executive officer shall be stationed in the central station in action, in order that, if called upon to take the captain's place, he shall be au courant of what is going on. If this be done, why should not the executive officer be the gunnery officer of the ship, and charged especially with the matters relating to her fighting efficiency, her guns, turrets, electrical mechanism, etc? Then he would, if called on to assume command of the fighting machine, do so with an intimate knowledge of all her fighting factors, instead of with an intimate knowledge of liberty lists. But, as Rudyard Kipling would say, "That is another story."

THE MAKING OF ELECTROZONE IN PHILADELPHIA.

Dr. William H. Ford, president of the Philadelphia Board of Health, in speaking of the action of the Building Commissioners in prohibiting the manufacture of electrozone in the basement of the city hall, said the commissioners were led to take that action because some of the fluid, which had been left in a tank through the mistake of an employé, accidentally leaked out and ran over the electrical wires, eating away the insulation, and, when they made an investigation, they learned that some of the electric power was utilized in making the disinfectant.

"We can manufacture electrozone there ourselves at a very light cost," he said, "and as it is an absolute necessity, it would save the city thousands of dollars were we allowed to continue. The disinfectant is very necessary to the health of the city during the warm weather, the only time we manufacture it. It is in liquid form, and is placed in the gutters, inlets and other places from which bad and dangerous odors emanate and from which many disease germs come. It neutralizes the odors and destroys the germs. If we are compelled to purchase it from manufacturers it will cost us fully double what it is costing us now. I think it is probable that the order will be rescinded."

UNIPOLAR MACHINES AND THE "CUTTING LINES OF FORCE" THEORY.

BY PROF. W. A. ANTHONY.

In your issue of January 20, page 79, is described "Another Unipolar Machine That Will Not Work," and the author's claim that the theory of "cutting lines of force" fails to explain why.

Referring to their figures, illustration, Fig. 1, all the lines of force, according to the theory, go across the space from the pole, S, to the pole, N, through the core, A. The wire passing through the hole, B, in the core, must, therefore, cut those lines just as much as the wires on the surface of the core.

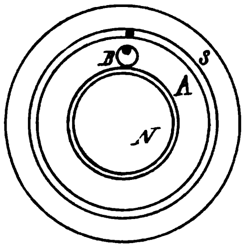


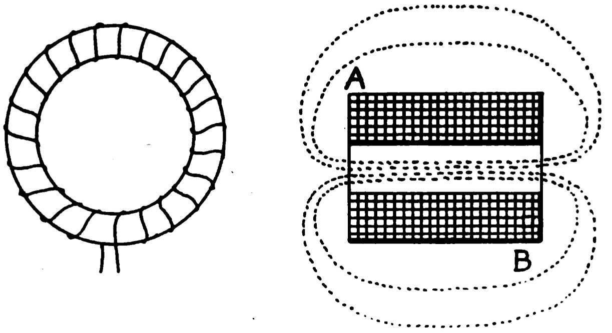
FIG. I.

There being the same number of wires through the holes as on the outside of the core, the E. M. F.s developed would exactly neutralize each other and the result obtained by the experimenters should have been expected. Indeed, this scheme for cheating the magnetic field was proposed to the writer some ten years ago, and he then pointed out the fallacy by reference to the "theory of cutting lines of force."

If a single wire, either on the outer surface of the core, or through the hole, B, were connected at the two ends to sliding ring contacts, a difference of potential would be found between those rings when the armature was rotated, and this difference of potential would be the same in amount and direction whichever wire was used.

This is what the line cutting theory teaches, and is what experiment would prove.

While I am upon this subject I wish to refer to another case that often turns up as a stumbling block. In the simple transformer, in which the magnetic circuit is a closed circuit, all iron, as in the sketch, Fig. 2, it is often stated that there can be no cutting of lines of force where the current is reversed.



FIGS. 2 AND 3.

But it must be remembered that by the theory the lines of force are always closed curves. They are never broken and never present any loose ends. When a current flows through the wire around the iron core in the figure, no one doubts that lines of force exist in the core and form closed curves. If the current be broken those lines of force disappear.

What becomes of them? How do they get out of the core? They cannot break in two and gather themselves up into nothing. We are obliged to assume that the closed curves simply expand into outside space, and that when the circuit is again closed lines come rushing in from outside space—as it were, a series of circumferences, rapidly contracting until they gather into the core. According to this view, these lines must cut the wires as they appear in and disappear from the core. In Fig. 3, let A B represent a section through the axis of a solenoid carrying a current. Lines of force exist, as shown by the dotted lines. Suppose the current to be reduced in strength, there will be less lines through the coil. What becomes of those that disappear? We cannot assume that they are broken in two and pulled out endwise, for, upon the theory, lines of force are never broken. There is no way for a closed curve, such as is represented by the dotted lines, ever to get in or out of the coil, A B, except by cutting the wires that form that coil. There is, therefore, force, cutting in these cases, exactly the same as when the wires of a dynamo armature are swept through the field.

X-RAYS—APPARATUS AND METHODS.[1]—I.

By ELMER G. WILLYOUNG and H. LYMAN SAYEN.

THAT Prof. Röntgen's discovery of the X-ray has initiated many lines of thought promising to greatly extend our knowledge of physical phenomena as well as to revise many of our previously accepted views, is generally admitted. That the practical results accruing to humanity by virtue of the applications of this discovery in surgical and medical practice are of even greater promise and value is equally conceded. The writers have been engaged for a number of months past in developing apparatus and methods for practical work with especial reference to the needs of the physician and surgeon. Your programme committee has thought that some of the results secured might be interesting in view of the fact that very little literature regarding the technique of X-ray work has thus far been published.

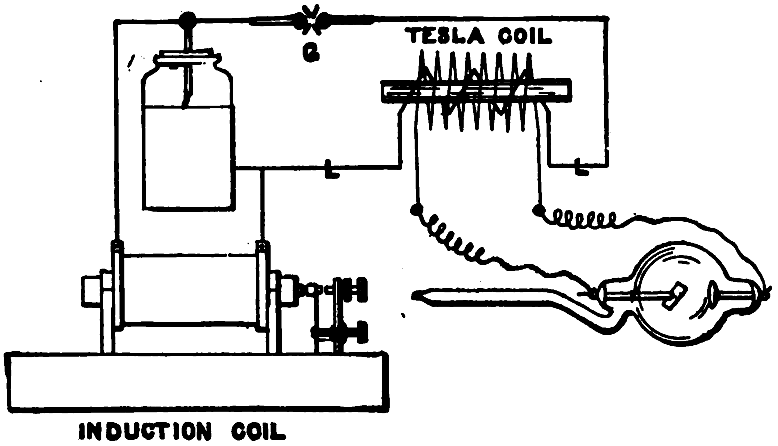


FIG. 1.—TESLA COIL ARRANGEMENT.

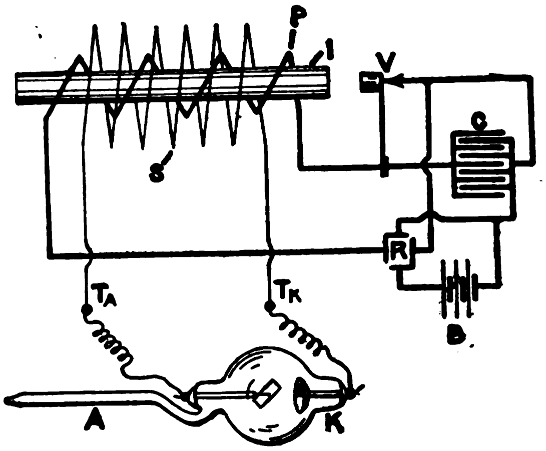


FIG. 2.—ORDINARY INDUCTION COIL ARRANGEMENT.

For conciseness, we divide the matter under discussion into a series of subordinate heads, each of which we shall briefly treat.

Two arrangements of the induction coil are advocated. The one is known as the Tesla or "high frequency" coil, and the other is the direct and old-fashioned use of the simple induction coil in which the high secondary e. m. f. is delivered direct to the terminals of the tube.

The High Frequency Coil.—Fig. 1 shows the diagram of the Tesla combination or "high frequency" coil. It consists, as will be seen, of two induction coils, the induced secondary current of the first being used to charge a Leyden jar. The primary of the second coil is joined, in series with a spark gap, to the two coatings of the Leyden jar. When the Leyden jars are fully charged they discharge across the air gap, this discharge being, by well known laws of electrical circuit flow, an oscillating one of exceedingly high frequency, millions or more oscillations per second. We thus have the primary of the second coil excited by an alternating current of exceedingly great voltage and frequency so that its secondary produces a discharge of still greater e. m. f. and of this same high frequency. So great is this final e. m. f. that it is generally necessary to immerse the entire second coil, primary and all, in a tank of oil, since no solid insulation has yet been found capable of standing these great e. m. f.'s without breakdown.

To excite the Tesla coil, we may use either an interrupted direct current or an ordinary alternating circuit joined directly to the primary of the first coil. But the final result is, in either case, an alternating, high potential, high frequency current. In the tube, therefore, we also have an alternating discharge.

The Induction Coil.—We show, in Fig. 2, the scheme of connections of the simple induction coil. The primary must be excited by an interrupted direct current which may be supplied by primary batteries, storage batteries, or a commercial circuit, as convenience and inclination may elect. The secondary is joined directly to the tube terminals. About the primary is joined a condenser. At break this condenser charges, thus preventing the extra induced current due to the large self induction of the primary, but being short-circuited by the primary at once discharges about the iron core in a direction opposite to the regular "make" current, thus reducing (if correctly proportioned) the magnetic intensity of the iron core to zero. All this takes place so quickly that the practical effect of the action is merely to assist and intensify the dropping off of the core's magnetism; to shove it along, hasten it. Considering the secondary, now, we find that we shall have at "break" an induced discharge of greatly higher e. m. f. than the discharge at "make," owing to the falling off of the core's magnetism at "break" being greatly sharper than its growth at "make." The effect of this is to give secondary discharges in one direction only at all times when the necessary spark gap is not greatly shorter than the maximum spark gap for that particular condition of running the coil, the "make" induced current at such times being of too small e. m. f. to get across the gap at all. This is always the condition when X-ray tubes are used. A further function of the condenser is to suppress burning at the "break" terminals or points of interruption by their taking up of the magnetic discharge of the coil.

In the construction of the induction coil, a number of points may be noted. Our secondaries are wound in sections ⅛ inch thick (according to the plan originally proposed, we believe, by Ritchie). These sections are separated from one another by a large number of discs of paper of a brand especially selected as free from carbon particles and baked at a temperature a little below charring point for some time immediately before use, this to drive out moisture. These sections are then assembled and immediately immersed in a special insulating composition having a very high melting point and some slight viscosity at all temperatures. Paraffine we absolutely prohibit as being too apt to crack and absorb moisture. After cooking for some time in the insulation so as to drive out the last traces of moisture the stack of sections is subjected to a further treatment, by which it is finally cooled. This we consider a point of the highest importance as air present anywhere in the secondary becomes electrified and bombards to and fro, gradually softening the insulation and eventually breaking down the coil. (See Tesla's writings on "High Frequency Phenomena" for confirmation of this point). With this plan of construction we have no static leaks of energy or small direct leaks within the coil itself and deliver the full energy of discharge at the secondary terminals.

We find ourselves able to secure in this way a full inch of spark in all sizes of coils with considerably less than one pound of wire. No. 34 B. & S. We believe that, more than anything else, the large quantites of wire required to produce a given spark length, with many of the coils now in use, is due to the presence of air, and consequent loss of energy by static bombardment, in the secondary. As regards the insulating composition used by us, we may say that we find its power of resistance to spark discharge to be four or five times that of hard rubber. In the arrangement of our secondary we separate it from the primary by a heavy hard rubber tube and, in addition, by a tube of this composition.

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[1] Abstract of paper read before the Electrical Section of the Franklin Institute, Philadelphia, December 1, 1896.

The Adjustable Condenser.—A coil is working to best advantage when there is a certain definite relation between its primary current, secondary spark distance, and condenser capacity. Speed of break must also be considered. As coils have heretofore been built, however, the condenser value has been fixed once for all and admits of no change, albeit both spark gap and primary current may be so changed. To remedy this, we have devised the form of switch shown in the diagram, Fig. 3, by means of which the condenser capacity may be shifted, at will and instantly, by simply turning the switch. The effect upon the secondary discharge is very marked both volume and musical note of the spark changing with the position of the switch. We find this idea exceedingly convenient in general experimental work with alternating currents, indeed, it being possible with it to alter condenser capacity as quickly and as readily as we may self-induction or resistance. (We have made some experiments in the use of a condenser in parallel with the primary. The volume and vigor of the secondary discharge seems, in many cases, to be greatly increased).

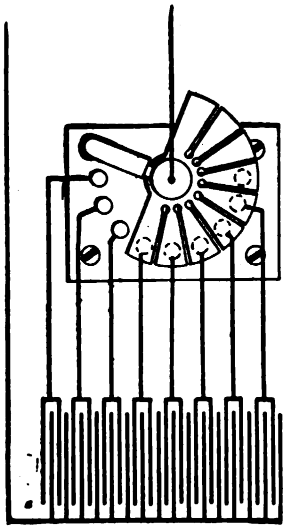

FIG. 3.

In arranging coils to operate from few or many cells of battery it is, of course, merely a matter of winding the primary of coarse or fine wire, the number of ampere turns being kept the same. It is interesting to note, as we have noted experimentally many times, that the larger the primary e. m. f. the smaller must be the condenser capacity employed and vice versa. This is, of course, only to be expected since capacity and self-induction are inverse functions of one another.

Primary Current.—This may be either from primary batteries, storage batteries, or from a commercial direct current circuit. Primary batteries have too high resistance to give sufficient current for coils of much size, say 4 inches and over, unless joined in parallel and then we need a number of such groups to secure the requisite e. m. f. They are a nuisance to attend to, soon run down and are expensive to operate. Storage batteries are exceedingly satisfactory, are comparatively inexpensive to operate, and require practically no attention. Changing them is more or less of a nuisance, however, especially where they must be sent out of the building, as they usually must, besides throwing the entire apparatus out of use while the changing is going on unless one have a reserve set of batteries.

The utilization of a direct commercial circuit, such as the Edison 110 volt, where such is available, is in every way the most convenient and satisfactory. Until Prof. Röntgen's discovery no method of operating large coils upon such a circuit had been developed. Recently, however, several methods have been brought out, notably that of the "air break" with air blast to blow out the spark as used by Dr. Wm. J. Morton, Dr. M. I. Pupin and others. In Fig. 4 we show the form of apparatus devised by us to accomplish this purpose. A Lundell 1-12 horse-power motor is supported upon a base with its shaft vertical. A casting, attached to the motor, supports above the latter a copper can made up of two concentric cylinders joined by a ring below so that the shaft passes up through the inner cylinder and thus avoids the necessity of a stuffing box. From the shaft is hung, well within the can, a heavy brass wheel having stretches of insulating slate let into its periphery. A hard rubber lid fits over the top of the can. Mounted upon this lid are two brushes, one bearing against the wheel periphery and the one against the shaft; suitable springs and screws allow the brush tension to be varied. From the commercial circuit leads are brought to these two brushes the current being first passed through the primary and a rheostat in series.

Before the lid is put in place, the can is filled with distilled water; ordinary hydrant water will answer, although its usual impurity causes the water to soon dirty besides allowing a certain amount of electrolysis during use. With distilled water the break may be run for a number of hours without change of water and very little heating takes place. The real function of the water is not so much to drown the spark as to prevent heating, although it does, of course, also assist in quenching the spark. But a condenser is the real spark extinguisher and this we connect around the break just as we would around an ordinary vibrating break.

The advantages of this break over all forms of vibrating break thus far known and over other forms of rotary break are: (a) Convenience: Mere throwing of a switch being all that is required to start and stop the apparatus. (b) Noiselessness: Only the drowsy hum of the motor being heard. (c) Reliability: No chance of sticking as with vibrating breaks. (d) Variable rate of break: Secured by adjusting rheostat in base of motor. (e) Smooth unvarying fluoroscopic images by reason of the large number of breaks per unit of time.

Two milled heads at top of can permit its lid (carrying brushes) to be withdrawn. A similar head at top of shaft loosens the break wheel and two heads at bottom of can allow it to be lifted away for cleaning and renewal and replenishing of water.

We use three makes and three breaks per revolution and find best results at from 1,200 to 1,400 revolutions per minute equal to 3,600 to 4,800 interruptions. We may secure as many as 2,000 revolutions (6,000 interruptions) per minute by cutting out the motor regulator.

In operation the brush bearing upon break wheel should be positive so as to prevent any electrolysis of the break wheel. We have often broken between fifteen and twenty amperes through this wheel for a considerable length of time without any overheating or overwear of the wheel. Should the wheel wear in time to an undesirable degree it may be removed and turned down. Provision is also made for replacing the brushes when desired.

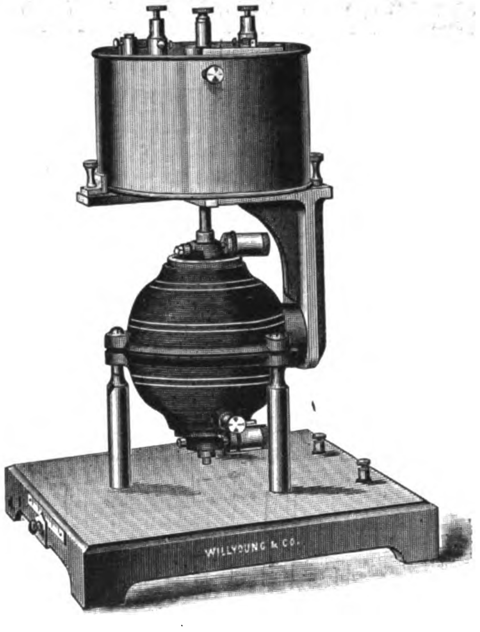

FIG. 4.

General Considerations Regarding Break Frequency.—The question as to whether there is a certain best frequency of break for a given coil or tube or both has puzzled not a few. Very little has been experimentally determined regarding this point. It is certain, however, that, with a given coil or tube, shortness of exposure is not exactly inversely as the number of breaks. Indeed it is often far from being so. Some of the best X-ray pictures that have been taken have been by use of the old "hammer" break of Ritchie and four or five clicks of the break have sufficed. Using the same tube and coil, but a rapidly vibrating or rotary break required forty or fifty breaks to accomplish the same results. It would appear, hence, that the energy of X-ray radiation per break is a function of the number of breaks per unit of time.

We are inclined to believe that this is a matter purely of the "time constant" of the coil. The iron of the core requires a certain time to magnetize and demagnetize. With the breaks few, ample time is given for this process, but when the breaks become rapid this is no longer possible so that the secondary e. m. f. falls. This may easily be verified by observing the maximum spark length of any coil. With single breaks, few and far between, we get much longer spark maximum than if the breaks are frequent. If, however, we increase the primary e. m. f. for the more rapid break we may bring up the secondary spark length to the value given by the single breaks. We should thus be able to shorten the exposure as much as we please by merely increasing the rate of break and the primary e. m. f. at the same time; but here we are limited by the tube which cannot dissipate more than a certain definite amount of energy in a given time and will break down if overdriven. We see, therefore, that whether we use slow breaks or fast breaks, the actual time of exposure remains practically the same, the few breaks requiring to be distributed over the same time as the much larger number of rapid breaks. All this, of course, applies to the photographic plate. For fluoroscopy we require rapid breaks in order to escape the otherwise distressing flickering.

In the above connection particular attention is directed to one point; the rate of break must not be too great. If it is, the iron no longer has time to magnetize and demagnetize. The result is an alternating secondary discharge instead of the direct discharge derived and this means blackening of the tube, rapid fluctuations of the vacuum, and general deterioration of the tube. We doubt whether with any coil of size suitable for X-ray work a rate of break greater than 5,000 per minute should ever be employed.

GROWTH OF POWER TRANSMISSION.

By JOHN McGHIE.

IN the issue of The Electrical Engineer of January 20 an article was published, written to show the extraordinary growth in the use in the United States, of electrical apparatus for power purposes during the past four years. By this is meant electrical machinery used for driving mills, shops, etc., the machinery in mines, and for transmission purposes, over both long and short distances, as distinguished from apparatus used for purely lighting or railway purposes. The figures given were taken from the report of one department of the General Electric Company, the Power and Mining Department, which kindly consented to their publication.

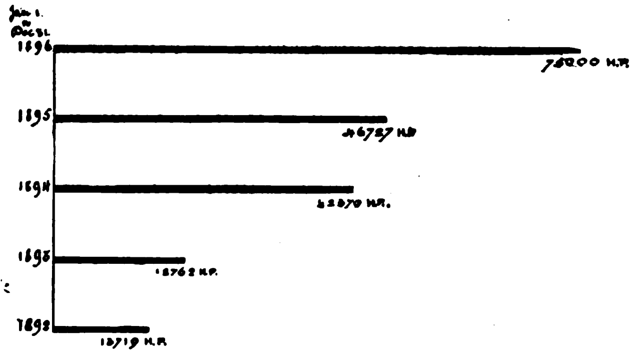

FIG. 1. AMOUNT IN H. P. OF GENERAL ELECTRIC POWER APPARATUS SOLD EXCLUSIVE OF LIGHTING AND RAILWAY APPARATUS.

In order the better to realize the tremendous growth, of which mere perusal of the figures does not convey a fair idea, I have drawn a curve and endeavored to show this growth graphically. Fig. 1 shows the extent of the sale of power apparatus year by year, beginning with the last year of the Harrison administration and continuing through the years '93, 94, 95 and '96.

It will be seen that in spite of the terrible business depression the demand for power apparatus made a bound during 1894, and while not repeating the leap, maintained its position during 1895. The first months of 1896 were months of a gradual restoration of confidence, and if detailed figures were at hand, it could be shown that until the full significance of the presidential nominations came home to the people, the demand for electrical power apparatus increased month by month. It diminished somewhat in the Fall during the preoccupation caused by the electoral campaign, but rose again as soon as the popular will had found expression. The sum total, however, of the year's business reached the very respectable figure, expressed in horse-power, of 75,000. Compared with the business in 1895, and in view of the depression, this showing is extraordinary. From January 1 to July 31, 1895, a period of seven months, the aggregate orders received for power apparatus amounted to 25,737 horse-power. During the same period in 1896, the amount was over 48,000 horsepower.

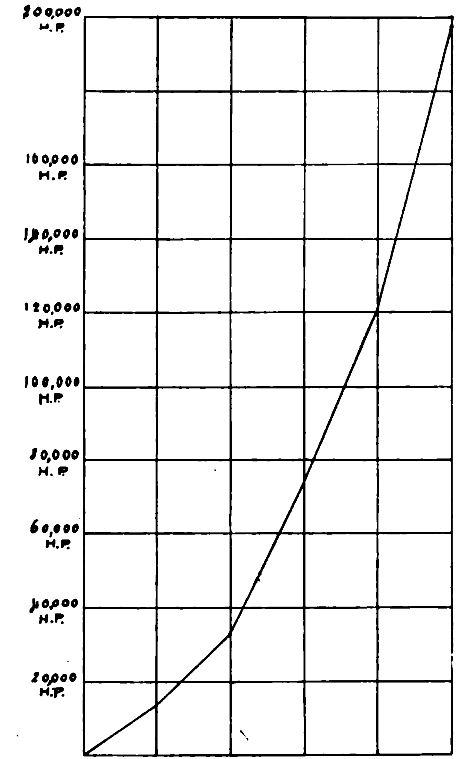

FIG. 2. CURVE SHOWING GENERAL ELECTRIC POWER APPARATUS SOLD FROM 1892 TO 1896.

Fig. 2 shows the total growth of the power business, also expressed in horse-power. It reached with the end of last year 196,587 horse-power. If to this figure were added the aggregate of the power apparatus sold by the many other manufacturing companies in this country, the total would reach so remarkable a figure, as to give good reason for the repeated observation that this country is truly becoming an electrical country.

The power business during 1897 opens well, with the extensive contract for electrical machinery involved in the utilization of the Falls of St. Anthony at Minneapolis, and all signs point to a largely increased use of electricity during the year in mills, mines, factories and for the transmission of power.

NIAGARA POWER FOR THE GRAIN ELEVATORS.

The Electric Grain Elevator Company has been incorporated to conduct a general elevator business for the storage of grain and to buy, sell, and deal in grain in Buffalo. The capital is $350,000, and the directors are Edward W. Eames, Buffalo; Yale Kneeland, Franklin Kneeland, Ormsby M. Mitchell, and Ruleman Muller, New York. The Messrs. Kneeland said last week that they were not ready to talk of the scheme. They will have an elevator with every modern adjunct, and the motive power will come from Niagara Falls.

THE FALLS OF ST. ANTHONY TRANSMISSION.

As already announced in these columns the contract for the electrical utilization of the Falls of St. Anthony at Minneapolis has been awarded to the General Electric Company. It will be remembered that the St. Anthony Water Power Company, and the Pillsbury flour mills and elevator lines were merged into the Pillsbury-Washburn Flour Mills Company, which controlled not only most of the developed water power of the Falls, but also the undeveloped water power below the Falls. A dam to utilize this power was constructed and the total available is calculated at 10,000 h. p.

The water will pass through turbines of Stillwell-Bierce Smith-Vaile manufacture, seven of which, each of 1,000 h. p. capacity, will form the initial hydraulic equipment. The electrical equipment will consist of a plant comprising both direct current railway apparatus for the needs of Minneapolis, and three-phase apparatus for transmission of part of the power to St. Paul, ten miles distant.

The direct current portion consists of two 70 k. w. General Electric multipolar generators, with a speed of 130 revolutions per minute, furnishing current at 600 volts, and two 100 k. w. exciters for the three-phase alternators.

The three-phase generating plant consists of five 700 k. w. alternators, with a frequency of 35 cycles, and an initial voltage of 3,450 volts. This pressure will be raised to 12,000 volts in six step-up transformers of the well known air blast type, and at this voltage the current will go to St. Paul either by overhead or underground wires. This has not yet been settled. At St. Paul the pressure will be reduced in fifteen step-down transformers, when the current will be led into the rotary converters of special type. Of these there will be five. They will resemble in appearance those which the General Electric Company has installed in the power house of the Buffalo Street Railway Company, to take care of the power transmitted from Niagara Falls. They are 8-pole machines, each of 600 k. w. capacity, running at 520 revolutions and turning out direct current at 580 volts. They are designed to operate in parallel with each other, or with the generators now driven by steam in the existing station.

The water power development and the electric plant completed by the Pillsbury-Washburn Company will be operated by the Twin City Rapid Transit Company, a lease having been made between the two companies to that effect. The street railway company will send to St. Paul about 3,000 h. p., leaving 4,000 h. p. to be used at Minneapolis.

When the new power is set to work running the street cars the street railway company will dismantle the Thirty-first street power station, using the room for other purposes. They will continue the main power station at Third avenue north and Second street, and also the power station in St. Paul. These will be kept ready for emergencies, such as a breakdown, a sudden call for extra power and similar occasions. In case there is water enough and conditions are favorable there are still three more units to be installed at the dam.

LITERATURE

ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By D. C. and J. P. Jackson. New York, D. Macmillan Company, 1896, 729 pp., 5 x7½. Price, $3.50.

This book forms Vol. II. of the Text Book on Electro-magnetism and the Construction of Dynamos, the first volume of which treated of continuous current machinery. Looking at the volume broadly we must say that the writers have made a most valuable text book on a subject which is not unaccompanied by difficulties. The science of alternating currents, as applied to the construction of dynamo electric machinery can hardly be said to have crystallized into a shape applicable to class room instruction more than a few years ago, and yet in that brief space of time much has been done to bring the science close up to that of the continuous current in exactness.

The authors have constructed the work much on the same basis—and happily so, we may say,—as are the standard text books on other engineering subjects, such as those on the steam engine, hydraulics, etc., and have brought together an enormous amount of matter which has heretofore been scattered in technical periodicals, and elsewhere, and thus entirely unavailable for general instruction purposes.

The authors begin the subject by a discussion of the electric pressure curve and the effect of style of winding on the pressure. This is exemplified by an excellent table, showing the relative dimensions of continuous and alternating current dynamos, including the conductor lengths of the armature wire per pressure generated. The authors point out that with a fixed size of armature and depth of winding it is apparent that an alternating current armature will carry only about one-half as much wire as is carried by a similar continuous current machine. Hence in order to gain an equal output from the machines it is necessary to increase either the size of the alternator armature or its speed. The latter expedient has largely been used in the past, though we are rapidly coming to direct connected alternators of large size. This is followed by a chapter on the various types of armature windings for alternators, illustrated by numerous diagrams, which, however, are intended to illustrate principles, rather than to give a series of working diagrams. We here also find a discussion of induction alternators, and their construction; insulation, and the method of building up armature coils, etc.

In a work of this nature, treating of a subject involving induction phenomena at every turn, naturally much space would be occupied in the discussion of these effects, and we therefore find much attention given to the treatment of self-induction and its counterpart capacity. In this part of the work the authors define briefly the terms discussed, and treat successively of the laws underlying inductive pressure; the units of self-inductance accompanied by various examples of inductances, together with the effect of the angle of lag, of capacity and similar effects; the methods of measuring self-induction of alternating current power, etc., are also discussed. This is followed by a chapter devoted to graphical, analytical methods of solving problems in alternating-current circuits.

These chapters lead naturally to others relating more to practical construction, and include the magnetic circuit of alternators, in which the losses are defined, and in which we find rules for the determination of the number of armature conductors, the self-inductance of the armature; the field windings, etc.; characteristics, regulations, and efficiencies of alternators. Methods of testing in the laboratory, as well as shop tests, round out this part of the subject in a very practical way.

The transformer next claims our attention, and their treatment in general follows closely that adopted in the preceding part of the work, special reference being had, of course, to the nature of the principles and actions underlying the transformer. Polyphase conducting systems and the measurement of power in polyphase circuits form the subject of a brief but very practical chapter, in which special reference is made to methods actually employed in practice. Under the head of alternating current motors, we find a very extended discussion of the various principles involves in this class of apparatus, and there is no part of the subject which seems to have been neglected, though, of course, in a work of this kind little more than a general outline can be given of the topics treated. A chapter on polyphase transformers closes the work, which has a number of short appendices on electrical resonance, oscillatory discharges, etc.

We believe this is the only text book on the subject worthy of the name, and it is, in our opinion, a matter of congratulation that the student has at last at his hand something adapted to his needs. Of course no work can be expected to give the student a complete knowledge of all that has been done in the department to which it is devoted. The authors have designedly, and we think with great advantage, omitted all descriptions of machines and apparatus, except where such descriptions were absolutely necessary for a clear understanding of the text, but they have very wisely assisted the student in these studies by numerous references to original articles in periodicals, and other works, which treat specifically of the topics to which they refer.

Where there is so much of merit it would indeed be ungracious to offer criticism on minor points, and we can only repeat our expressions of satisfaction at the appearance of so meritorious and timely a work.

FROM A WESTERN COMPANY.

"It is with pleasure that I ask you to send us the bill for the subscription to your paper for 1897, and by so doing testify to our appreciation of it as a newsy, up-to-date journal. For the past four or five years we have taken nearly all the American electrical publications, but since your connection with The Electrical Engineer, it has stood at the head of the list."

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico	per year.	$3.00
Four or more Copies in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies		.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, JANUARY 27, 1897. No. 456.

BREAKBACK BURDENS.

IN addressing its constituents, our new and excellent contemporary "City Government," which has been doing good work towards the creation and adoption of better methods for managing municipal affairs, remarks very sententiously: "You must be a wise man to be a city official." This is neat and true, but it generally escapes acceptance, and, in the current passion for making the municipality do everything, appears to be entirely forgotten. Whoever turns over the valuable pages of "City Government," filled with data of all kinds, realizes at once how wide the scope of municipal affairs has become; but the paper itself clinches the matter in a cogent appeal for support in which, by the way of illustration, it enumerates some twenty distinct and separate matters which any modern mayor or alderman is expected by his constituents to know all about. This list is by no means exhaustive, for we could easily double it ourselves; but it includes such trifles as electric and gas lighting, trolley travel, police, franchises in general, parks, paving, garbage, sewers, libraries, education, water supply, systems of taxation, saloons, the social evil, fire, handling public securities, building up a city, and a few other like trifles of no consideration.

But, seriously, is not such a list in itself one of the explanations why city government so often breaks down, and why it is unwise to increase the burdens—or the temptations—of those who are entrusted with the management of the city's affairs? Strive to master these subjects as they may, and even with the aid of such admirable guides and mentors as the paper we have named, the mayors and other elective officers can but often break down or fall short in their efforts to keep up with the mass of miscellaneous duty heaped upon them. These duties require expert skill or knowledge, not only in those who carry on the departments, but at least to some extent in those who are the legislative body; and if the masters are ignorant, the servants are not likely to remain either expert or honest in the long run. Whether the city be regarded as a small state or as a business corporation of the citizens, this increase in number and variety of functions is a startling menace to good administration of affairs in general.

Analogies from old times are not necessarily safe and sound, but it does seem to us that, as in old Rome, the dangers of coming social disintegration increased about in proportion to the degree in which the government absorbed all the functions involved in preserving, punishing or pleasing the citizens, so in our modern tendencies toward centralizing all kinds of heterogeneous management and ownership in the city, we are running risks that are perilous for future social welfare. The assumption that everything goes well and cheaply the moment a public functionary assumes it, or is paid for doing it, is based on a blind disregard of all the teaching of history and all the observation of current events. The more a state or city engages to take care of its citizens the more helpless those citizens tend to become; the latest proof of which is seen in the fact that the new laws of Austria and Germany compelling universal insurance have been followed by an alarming increase in the number of accidents. And so it goes. One man wants a state church, another advocates a national theatre, a third favors public prizes for horse races, a fifth wants a city printing office, the next fights to set up a city bakery, and every one has designs, good and bad, on the purse that can only be filled out of the ever growing burden of heavy taxation. People have literally been going crazy in their zeal for taxing other persons in support of their hobbies and whims, and we need not have very strong prejudices in favor of leaving a few things to individuals or corporations—such as lighting and street railways—if we should venture to express a hearty sympathy with the movement just started in far New Zealand for personal liberty and against having the state or city government choke every impulse for freedom and initiative out of its people. If the Liberty League fails, and the majority insists on being governed by its minority in uniforms, we hope to be able to move on to Mars.

INCANDESCENT LAMP AND CENTRAL STATION.

THE central station operator is inclined to look upon the supply man as a necessary evil, whose sole desire it is to sell him something, the exact value of which he can not determine until it is too late to claim a rebate. There has been some justification in the past for the existence of this sentiment, but there ought not to be any room for it at the present time, or in the future, since every central station ought to be equipped with the means of testing the supplies purchased by it. Yet, on the other hand, it cannot be denied that manufacturers have constantly given their customers good advice and points worth noting. Of the latter order are some of the hints contained in the admirable paper read by Mr. F. S. Terry before the Northwestern Electrical Association. It cannot be too often repeated that one of the essential factors in the life of incandescent lamps is uniformity of pressure; and yet how many central stations are there, particularly among those of the alternating type; which have the means of knowing the pressure at all points of their distribution system; or, having the means, maintain the pressures constant? With this condition of affairs, of what avail are the guarantees of lamp manufacturers as to the life of incandescent lamps? This brings us to the question of the much-talked-of 2½ watt lamp. As Mr. Terry correctly points out, such a lamp would require even closer regulation that the present 3.1 watt lamp in order to give at all satisfactory results as to life, and hence even if such a lamp were commercially available it would, under existing conditions of central station operation, prove impracticable. This whole question of life and efficiency of lamps must sooner or later receive the attention it merits; indeed, we know of scarcely any other industry where goods are bought and sold on so little knowledge of their intrinsic value. As recently pointed out in these columns, a step in the right direction has been made in Germany, where manufacturers and central station operators have combined to draw up a set of specifications to which lamps must conform, and in which an adequate number of lamps from each package are subjected to a regular test, upon which the purchase or rejection of the lot depends. We see no good reason why a similar agreement should not be arrived at in our own country, and the German arrangement even improved upon. Thus a stipulation might be agreed to by which lamps not coming up to the full standard, but not bad enough to reject entirely, would entitle the purchaser to a rebate; while, on the other hand, lamps exceeding the standard performance would entitle the manufacturer to a bonus. Such an arrangement would be equitable to both sides, and no manufacturer having faith in his products would, we think, object to it. Of course, an agreement of this nature would require the equipment at central stations—where such equipment did not already exist—of a photometric room and standard measuring instruments, for without such, no comparative tests of any kind would be impossible. This feature of the case does not present the difficulties that it would have done ten years ago, since to-day direct reading electrical measuring instruments can be obtained whose indications can be relied upon to within a fraction of 1 per cent., and which can be readily calibrated. The only weak spot would still be the photometric tests where the standard of light as well as the personal equation might be disturbing factors; not sufficiently great, however, to render the object aimed at nugatory. We throw out these hints in the hope that they may be discussed and their practicability or non-practicability determined.

THE NORTHWESTERN MEETING.

THERE was some pretty plain talking at the convention of Northwestern Electrical Association, and on no subject was there a freer exchange of opinion than on that of municipal ownership of electric lighting plants. That many of the members are sorely troubled about the situation of affairs is evident, but the remedies suggested to counteract the evil were not many. Among them we note the suggestion that central stations should institute what amounts practically to a boycott of those manufacturers of electrical and steam apparatus who equip municipal plants. We do not believe in boycotts under any circumstances, and in the present case fail to see what particular object would be gained by such a course. If persisted in it would surely turn the boycotted companies into pronounced enemies of the private lighting companies, where now they at least profess to deprecate the establishment of municipal plants. As to the origin of the municipal plant agitation, it was truthfully pointed out that much of it is due to the over-bonding and capitalizing of many of the early plants. Still there is something to say on the other side of this question, having in view the uncertainty and risk involved in the establishment of a new industry, which required a strong incentive to enlist capital. To our mind, the only proper and feasible way to counteract the present tendency is to inaugurate a campaign of education, to take up each case individually and, by the dissemination of authentic information as to the actual cost of operating central stations to municipalities, place every voter in a position to form his own judgment in the matter. There are enough precedents of failures of municipal plants already available to back up the anti-municipal arguments, and we have sufficient faith in the fairness and judgment of the American voter to let him decide the question for himself. We are convinced that many of the municipal stations erected in the past were the result of misinformation as to the true conditions involved, and that if the question were to be submitted at the present time to the same voters a tidal wave of opinion in the other direction would probably be noted. We do not ignore the fact that individual municipal plants have shown good results, but it can be readily shown that such instances are due to special circumstances and conditions which cannot be depended on to obtain in even a small fraction of the cases which have arisen in the past or may arise in the future; and even in the cases referred to there is no telling when the conditions, now so favorable, may turn the other way.

"ONE SIDED REPORTS."

UNDER the above caption our esteemed contemporary, the American Machinist, dilates to the extent of two columns on the large predominance of the human element in technical reports, which calls for the assignment of a high value to the personal equation of the writers of such reports. Our contemporary is moved to make these remarks by the appearance in our columns of the record of a test of an electric mine pumping plant as compared with a compressed air plant, which Mr. Lewis Searing, a mechanical engineer, contributed to our columns recently. It would seem that our compressed air friends do not like the prospect, and Mr. Searing has also been criticised abroad for alleged errors of commission as well as omission. The answer to an English critic which Mr. Searing makes in another column, shows that he stands on safe ground and is well able to take care of himself. We must confess to some amusement at the bland statement of the American Machinist that it has no interest in the one greater than the other, that is, electricity and compressed air, and that it will gladly do what it can to secure adequate representation for each. This is very kind of our contemporary, but we note on the very editorial page which criticises Mr. Searing's tests an editorial note on compressed air cars in New York, which could hardly be called unfavorable to compressed air—indeed, which some critics might term distinctly encouraging to the promoters of those enterprises. On the other hand, we think we have discerned a marked tendency on the part of our contemporary in the past to show up electricity in as little favorable a light as could be done consistent with established facts. Perhaps this may have been an illusion, but no one who glances through the pages of our valued contemporary's last two issues would consider it inimical to compressed air.

TELEPHONE VS. STREET RAILROAD.

WE note that the old fight between telephone exchange and street railroad has cropped up again at Canton, O., where the Central Union Telephone Company wants an injunction against the Canton Light, Heat & Power Company because the latter has recently so handled its generating plant as to cause a fearful inductive buzzing in the adjacent telephone lines. The trouble is sufficient to make several subscribers order out their instruments. Such a situation should be easily remediable, and we hope it will be. In the meantime it is interesting to note how steadily Cincinnati has remained a double trolley wire city, and a recent number of the local paper "Chic" quotes a number of very pretty things said about the roads and their service by distinguished citizens. This satisfactory state of affairs we can perhaps trace to the influential presence of telephonic interests in the street railway management, in the person of Capt. G. N. Stone, so worthily associated with Mr. John Kilgour. We note that Capt. Stone in some recent remarks gave the railroad company credit for no less than 200 miles of single track, with 7 electric power houses, 3 cable houses, 23 car barns, and 1,183 cars. These are striking and splendid figures, but as indicated above, the things that strike us most are the successful use and increase of the double overhead trolley wire and the harmony between telephone exchange and street railway. Long may the state of peace continue! But as to the double trolley it is funny that nobody else seems able to make it go or wants it. The passenger in Cincinnati rides 14 miles for 5 cents.

DIRECT DRIVEN UNITS.

THIS is certainly the day of big units in power house practice, but a tendency exists perhaps to exaggerate the extent of such work. A well known mechanical engineer remarked to us recently that he doubted whether in electrical work there were to-day in this country a full hundred direct driven generating units of 1,000 h. p. each, and that he was confident a large proportion of them ran nearer 600 h. p. half the time. He thought there was plenty of work to be done in the field up to 500 h. p., and that for a long time to come the bulk of work and improvement would lie there. It must be confessed that these remarks betray a shrewd observation of the actual conditions. Another engineer in the steam industry informed us of his belief that the direct driven unit, no matter what size, was a delusion as to economy, and that he could beat it, especially with a rope-driven combination of engine and dynamo each of the greatest possible economy and efficiency for the specific employment. All of which is very interesting—if true.

IT is generally the little thing that helps bring home a great fact to every body, and so within the last few days the swallowing of a pin badge by tiny Tommy Madden, its skillful location in his throat by Dr. W. J. Morton with the X-ray, and its successful removal by surgery, have interested and excited all New York. Such a thing has done more than anything else to show that the knife and lancet can now be safely guided, and that the means of rescue from internal dangers have been vastly augmented. We do not wonder at the enthusiasm shown in the clinic by the surgeons and students. Dr. Morton's success and accuracy of location with so large and clear an X-ray plate serves to mark and emphasize the new departure, and in this respect again he proves himself a worthy son of his great father. The X-ray hasn't done much outside of surgery, but there it is already known to be an inestimable boon to mankind in its practical applications.

THE success of the Niagara power enterprise on the American side of the dividing waters, has naturally provoked some jealously on the Canadian side, and we regret to see a clamor raised in several Dominion newspapers for a non-extension of the privileges granted on their side to the Canadian Power Company, which consists virtually of the same men as the American company. What good will a forfeiture do Canada? The Dominion is to-day getting $25,000 a year for absolutely nothing, and if the franchise terminates, that stops too. Absolutely no one will be benefited by lapse. On the other hand, to maintain the present status will in time bring power on their side. This big work takes time and money, and meanwhile, for our own information, we would like to inquire how many Canadians are ready to go to Niagara, as Americans have been, to use the power that can be generated? We venture to express a modest conviction that the men interested would need very little such inducement from would-be users of their power anywhere within reasonable reach.

ELECTRIC LIGHTING

THE ENCLOSED ARC LIGHT.[1]—I.

By L. B. MARKS, M. M. E.

THE unprecedented industrial utilization of the enclosed arc light in America during the past two years has aroused the attention not only of American electricians and engineers, but of scientists the world over. Although some of the earlier inventors in this field achieved a modicum of temporary success, every attempt to introduce the enclosed arc lamp commercially eventually met with decided failure.

Before going into the details of the subject or presenting a sketch of the earlier history of the art of enclosed arc lighting, it may not be amiss to point out the characteristic distinction between the ordinary arc and the enclosed arc. The ordinary arc, commonly known as the open arc, is generally enclosed in a globe more or less tight at the top and bottom. This is also the case with the enclosed arc. In the former, however, the arc depends for its efficient operation upon an excess of air or oxygen-bearing gas, while in the latter, provision is made for the partial or total exclusion of the atmosphere. With this preface I shall now revert for a few moments to the earlier forms of enclosed arc lamps.

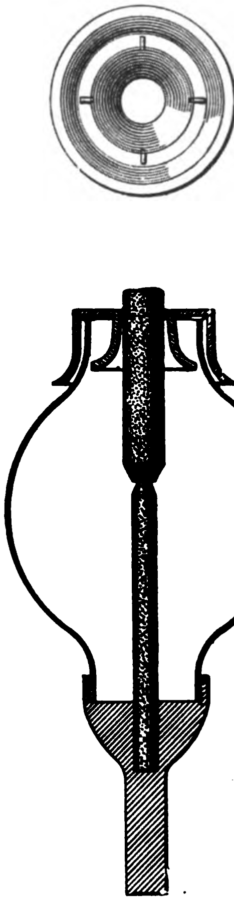

FIG. 1.—VENTILATED ENCLOSED ARC.

HISTORICAL SKETCH.—The history of the art may be said to date back to about 1846, when Wm. E. Staite first produced an enclosed lamp in which one carbon was supported on a rod passing through an air-tight bushing into a globe, and the other carbon mounted in a tube projecting through the base of the globe, and fed by a rack operated by clock-work. In this lamp the arc was struck by pushing the carbons apart by hand. At that early date Staite pointed out that "the more rarefied or de-oxygenated the air around the point of ignition is, the more continuous and brilliant the light, hence may be deduced the propriety of enclosing the electrodes in a vessel of small dimensions hermetically sealed from the external atmosphere, but with a valve in it for the escape of the included air when the expansion begins to exceed those limits which experience may show to be compatible with the safety of the apparatus."

About a year later Staite improved this lamp in various details. Instead of springing the arc by hand, it was done automatically by an electro-magnet. The arc was enclosed in an air-tight globe and the regulation effected by electro-mechanical means.

After Staite's experiments there followed a period of inactivity in this line, and it was not until the '70's that the work was again zealously taken up. In 1878, F. H. Varley brought out a lamp containing an air-tight chamber in which carbon powder was allowed to fall from one electrode to another as from an hour glass, the carbon being heated to incandescence in transit. The mechanism of the lamp was so arranged that the carbon, after falling through the arc space and becoming incandescent, was again returned by suitable carriers to go through the same operation. In 1879 George G. André devised an electric lamp in which the carbons were enclosed air-tight in a large globe, no provision having been made for egress or ingress of gases. The oxygen of air in the globe gradually combined with the volatilized carbon, when the lamp was in operation, until finally the electrodes burned in an atmosphere consisting largely of carbon gas.

About this time there was considerable activity in the production of enclosed arcs of a different type, viz., the semi-incandescent arcs. In this form, the carbons or other electrodes as the case may be, are in imperfect contact, the point of juncture being heated to a state of incandescence when the current is passed. Such was the lamp of Brougham in which the carbons were enclosed in a receptacle from which the atmosphere was excluded; no arc was sprung in this lamp, the light emanating from the incandescent points. Following closely on this, in the year 1880, André and Easton produced a lamp similar to the older type already described, but differing from the latter in that the movable carbon was maintained in contact with the negative in a closed chamber, and was fed upward as the carbons burned away, the feed being effected by a weight released by a magnet acting on a friction disc. The same type of lamp is also described by Hedges, who substituted a metal disc for the metal carbon, the positive carbon feeding and continuously bearing against this metal disc and heating the joint to incandescence.

The well known lamp of Werdermann, which was brought out in 1882, is another type of the typical incandescent arc. In Werdermann's lamp the carbons were enclosed in an air-tight globe. A thin carbon pencil was propelled against a large negative electrode by a spring; the pencil passed through a block of magnesium or other refractory substance and a considerable length of the electrode between the block and the contact was rendered incandescent. After the lamp was started the oxygen contained in the globe quickly combined with the carbon, the residual gases thus consisting of nitrogen and carbonic oxides. Among other lamps of the same type, in which no true arc was sprung, were the earlier forms of Jansen in 1875 and Scott in 1878, and subsequently those of Rapieff, Nordenfeldt, Pilloux and Quesnot.

The record of development between 1880 and 1884 shows that a number of lamps of the enclosed type in which a true arc was sprung were produced. The principal ones were that of Varley, in which the arc was enclosed in a glass globe or shade filled with carbonic anhydride, or hydrogen, or dried nitrogen; those of Wallace, Brewer and Menges; that of Beardslee, in which the arc was enclosed in a small globe, air-tight at the bottom and having a contracted neck at the top through which the movable carbon passed; that of Baxter, in which the entire lamp mechanism was enclosed air-tight, provision for the egress of heated gases under pressure being made by suitable valves connecting the enclosure with the outer air; and that of Short, similar to the last. Besides these there were several others, differing from those cited only in detail.

The Enclosed Arc in America.—In America the first attempts to utilize the enclosed arc in commerce date back to the early eighties, when Beardslee produced an enclosed arc and Wm. Baxter experimented with long-hour enclosed lamps. Baxter's experiments and tests covered a period of years but resulted in failure. From time to time other inventors took up the subject, but as the ground covered by them differs very little from that of earlier efforts, it will not be necessary to dilate here upon the various schemes attempted since the original presentation of the Beardslee and Baxter lamps, respectively. This brings us to the time when Howard took up this line of work in conjunction with me about five years ago.

Most of you are familiar with the tests reported by me in a paper read at the International Electrical Congress at Chicago in August, 1893. That paper was hastily prepared to present a subject which, in the opinion of those who had witnessed the trials, was deemed worthy of the fullest description possible at the time. The arrangement of parts disclosed in the lamp referred to in the paper at Chicago was rather unique in some details, but in principle did not differ essentially from earlier forms.

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[1] Read before the Société Internationale des Electriciens, Paris, France, Jan. 20, 1897.

It was thought at that time that the enclosed arc would have a large field on constant current circuits and an attempt was made to equip existing lamps with the enclosing device. This device, which was very crude, consisted of a cylindrical glass receptacle clamped by discs which pressed tightly against its upper and lower edges respectively, the lower end being closed air-tight and the upper end provided with an opening through which the positive carbon passed. In this equipment the negative electrode was made of metal. I shall have occasion to allude to this metal negative later on; also to point out the prime cause of failure in this, as well as in many of the other forms of enclosed arc herein referred to. Subsequently another device was used which consisted simply of a small bulb fitted practically air-tight at the bottom and closed on top by a valved cap through which the upper carbon fed. This appurtenance could be attached to any arc lamp. The negative electrode was in this case made of carbon. A circuit of lamps of this type was tested in the winter of 1893 and early part of 1894 at Buffalo, N. Y. The report and discussion of the tests were published in the electrical journals of the time, also in the Transactions of the National Electric Light Association, Washington, D. C., Convention, 1894.

We come now to the ventilated enclosed arc which was devised by me a few years ago and described in some of your technical journals. You will note in Fig. 1 that the enclosure is provided with means for directing the path of the ingress of air and the egress of gas. You observe that the bulb is pressed tightly against a practically air-tight bottom and is closed at the upper end by bell-shaped cap or plug wherein resides the novelty of the equipment. This plug is made of metal and is shaped so that the rim is brought closely adjacent to the exterior wall of the envelope, thus providing a narrow annular passage for the outside air into the envelope by reason of which the entering air is highly heated in transit before reaching the interior of the bulb. You will also see that the tubular opening through which the upper carbon feeds is conical in shape, the opening at the top being only a little greater than the diameter of the electrode so as to permit a free feed of the latter and afford an obstructed egress for the gases from the envelope. As the closure touches the glass only at four points, shown in the engraving, the tendency of this arrangement is for all egress to take place by way of the central tubular opening and of ingress by way of the bell-shaped chamber. In other words, the convection currents naturally formed by the heat of the arc are taken advantage of to secure a steady and uniform circulation of oxygen-bearing gas in the enclosure. By the use of this equipment the life of the electrodes was prolonged three or four times, the lamps being operated on a constant current circuit under practically the same conditions as to current and voltage, as the open arcs. In practice it was found that the ventilated enclosed arc had many shortcomings and could rarely be operated under favorable conditions on commercial circuits.

INCANDESCENT LAMP IMPROVEMENT.

BY JAMES CLEGG.

THE possibilities of improvement of the incandescent electric lamp can only be in the emissivity of the filament and in the maintenance of a high vacuum in order to prolong its life. Metallic oxides, such as the rare earths, as used in the Welsbach lamp, cannot be employed by themselves alone, because they are not electrically conductive and they cannot be intermixed with, or used as a covering for, carbon, because their expansion by heat differs so greatly from that of carbon. If carbon and metallic oxides are mixed together they swell and crack when heated. If the oxides are made to coat the carbon, neither will they hold together when heated. The Welsbach mantle consists only of metallic oxides.

It has been universally accepted by lamp authorities that only a filament of carbon, and the more graphitic the better, will work efficiently in an incandescent electric lamp, and referring to Mr. Howell's letter in The Electrical Engineer of January 13, I have found that the more homogeneous and solid, and more even and uniform is the surface, the greater the efficiency and length of life at a given candle-power. Tests which I have made have proved again and again that a filament with a smooth surface of a light color of the least porous graphite will emit 16 candles of light at a lower temperature, and consequently with a higher efficiency and longer life, than a filament of a dark shade and a rough surface. This is a simple law of light emissivity of all bodies. A white body with a smooth surface is the most emissive of light.

The best incandescent lamps have the greatest homogeneity of structure and evenness of surface with a coating of the least porous graphite deposited on them at the highest temperature, and these results will be obvious to all incandescent lamp makers if they will examine the product under the microscope, and then compare the emissivity and life with that of other different filaments.

INCANDESCENT LAMPS.[1]

BY FRANKLIN S. TERRY.

THE subject of the incandescent lamp has been so many times and so ably treated from a scientific standpoint that I could add little that would be new and I will, therefore, confine my attention principally to those points which will be of practical interest to the central station.

The making of an incandescent lamp requires more than thirty distinct processes, most of which affect its quality rather than its appearance. The character of the filament, the way it is flashed and the exhaustion may generally be said to have most to do in determining the quality, but the defect in a lamp may be traced to a defect in either the filament, the glass, the platinum, even the base, or due to poor workmanship in any one of the several processes in putting them together.

As light is the only useful product, the incandescent lamp may be said to have a real efficiency of from 3 to 5 per cent., the rest being wasted in heat. An incandescent lamp may be operated at such a low voltage as to give heat but no light. The filament that will stand the greatest degree of heat without vaporizing, other things being equal, is the best.

It is customary to state as the efficiency of an incandescent lamp the watts of energy required to produce one candle of light. By increasing the voltage we increase the light more than in proportion to the increase in the energy consumed and the lamp is then said to be more efficient. For example, a lamp giving 16 candle-power of light at 100 volts pressure and consuming 56 watts of energy we would call a 3½ watt lamp. If we should increase the voltage to 110, the candle power would be increased to 28, the energy consumed to 70, the watts per candle would then be 2½ and we would call it a 2½ watt lamp. There is no difference in the lamp itself between what is termed a 2½ watt lamp and what is termed a 3½ watt lamp.

As lamps are operated at a higher efficiency, their defects become more apparent. If one is satisfied to operate a lamp at an efficiency of 6 or 7 watts per candle (and such lamps are made and sold), what is in reality a very bad lamp may give a customer good satisfaction.

The life of an incandescent lamp will be shorter as it is operated at a higher efficiency, or in other words at a higher voltage. For example, if at 3½ watts a lamp would have a life of 2,400 hours, at 3 watts it would perhaps have a life of 1,000 hours and at 2½ watts a life of 350 hours. It is not correct to take the life of an incandescent lamp as the measure of its quality. The practice of asking for guarantees of life has been nearly discontinued. The absurdity of such a guarantee is apparent when we consider that the conditions governing the life are under the control of the one operating the dynamo, and further, the life of a lamp is a factor of small relative importance in determining any economy in incandescent lighting. Every manufacturer can make long life lamps and those that are inferior in quality will usually be found to have a long life.

The decline in candle power is due to an increase in the resistance of the filament; consequently it then requires a higher voltage to produce the same amount of light as at first. Every incandescent lamp will decline in candle power after a certain number of hours burning. If operated at a higher voltage or efficiency the decline will be more rapid. The difference between different makes of lamps as to the rate of decline is due principally to the filament used and the exhaustion, and when operated at the same efficiency this rate of decline is the correct measure of their relative quality.

Sometimes central stations raise the voltage that they may give customers a better light or in order to burn out the old lamps. This is bad practice as it will result either in burning out new lamps or reducing the candle power until they will no longer give a serviceable light. Lamps should be "smashed," as it is now usually termed, when they have ceased to give a satisfactory light and should be replaced by new lamps of full candle power.

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[1] Abstract of a paper read before the Northwestern Electrical Association, January 20, 1897.

If a lamp bulb has become black, it is almost a sure indication that the lamp has been subjected to a higher voltage than was intended, or has been burning a good many hours. Blackened lamps should not be complained of as defective.

Probably there has not been an article written on the operation of incandescent lamps without calling attention to the importance of maintaining a uniform voltage and still this is not fully appreciated in many central stations. The trouble is sometimes due to incorrect station voltmeters, sometimes to large pressure loss on the lines; and on alternating circuits may be due to poor regulation of transformers. A fluctuating voltage must always result in an unsatisfactory lighting service. If it would be an advantage to the central station to have a higher efficiency lamp, the first step to take in that direction is better regulation, which will result in the lamps being of higher efficiency when operated at the normal voltage.

In a paper read at your last year's meeting, Mr. Buckley recommended the use of 2½ watt lamps, "and 2 watt lamps if you can obtain them." You all have 2 watt or 2½ watt lamps in your stations now. Just increase the voltage at which they are burned until the energy consumed divided by the candle power of light gives you 2½ and you have a 2½ watt lamp. If you are using the best lamp you will have the best 2½ watt lamp that can be made. Mr. Buckley gave some figures showing the saving made by using 2½ watt lamps. The figures given exaggerated the saving as no allowance was made for the more rapid decline in candle power of the 2½ watt lamps which in practice will soon lose from 40 to 50 per cent. of their candle power. The customer that wants a light of 16 candle power will not be satisfied with one that gives but 8 or 10 candle power, even if it may cost less to operate.

The 2½ watt lamp would not do at all on most central station circuits, as they are now operated. When overrun in voltage they would be immediately burned out or the candle power would afterwards be so low as to make the light unserviceable. A high voltage will injure so-called high efficiency lamps more than those of lower efficiency. With better regulation you can use higher efficiency lamps and it is profitable to operate lamps at as high efficiency as will give satisfaction to your customers. Probably a 3½ watt lamp will give the best satisfaction in most moderate sized stations as at present operated.

One difficulty in furnishing lamps to central stations is the lack of knowledge of how the station is operated. Often the voltage is higher or lower than is stated, due perhaps to an incorrect voltmeter and lamps made for the voltage as ordered would not be satisfactory. Again the voltage may be irregular and a lower efficiency lamp would be more suitable. If all central stations were operated the same it would be much easier to furnish a lamp that would always give satisfaction. This will perhaps explain how it is that a certain make of lamp is considered the best at one station and the worst at another.

Lamps can be obtained of from 4 candle power to 500 candle power. In this country the 16 candle power lamp is the standard and is the lamp mostly used in both stores and residences. In some of the foreign countries the 8 candle power lamp is the standard. In store lighting a bright light is wanted and I predict that in the near future the standard for that service will be higher than at present, perhaps 20 candle power. In residence lighting the demand is for a certain number of separate lights and that the monthly bills shall not exceed a certain amount. There are many places in residences where the smaller candle power lamps, consuming less energy, will give as good satisfaction as the 16 candle power. In decorative lighting and in sign work a small candle power lamp, even as low as 4 candle power, will give quite as good an effect as the 16 candle power, and with about one-third the cost for energy.

As the purpose of the business of central station electric lighting is to make a profit and pay dividends to the stockholders, every intended economy must be judged by its effect on the profits or dividends.

Sometime ago I obtained from a number of electric lighting central stations statistics showing the capital invested and the results of their operation, and from an average of these I have made up some figures that I believe fairly represent the results that will be obtained in the average station.

We will take for our example a station having an investment of $100,000. I found the average gross receipts of the stations above referred to was 26½ per cent., of the investment, or this station should have a gross income of $26,500.

The average price charged customers for energy was 15 cents for 1,000 watt hours, which would be equivalent to ¾ cent. per lamp hour for a 50 watt lamp. The electrical energy that this station would supply to customers in a year would, therefore, be 175,666 k. w. hours. Operating expenses, including general expenses, taxes and ordinary repairs for the year, $14,700, or about 8⅓ cents per k. w. hour.

If the business is profitable the earnings should be sufficient not only to pay dividends, but in addition provide for a reserve or sinking fund in order to return to the stockholders their original investment at the end of the natural life of the business and the smallest amount that should be laid aside for this purpose is 5 per cent. of the capital annually, or for this station the sum of $5,000, or about 3 cents per k. w. hour for the energy delivered to customers. This would leave a sufficient amount to pay dividends at the rate of about 6½ per cent., which certainly is not too large, considering the character of the investment.

Now let us see what part of the cost of operating expenses is the item of lamp renewals. A 50 watt, 16 candle power lamp we will assume will have a life of 600 hours, or the total consumption of energy of this lamp during its life will be 30,000 watt hours. If the cost of the lamp is 18 cents each, this will be equivalent to 6-10 cent per 1,000 watt hours, or 7 2-10 per cent. (about 1-14) of the operating expenses, or including the reserve fund, which is a legitimate item of the cost of operating, the cost of lamp renewals will be 5 per cent. (or about 1-10) of the total cost of energy. What effect would one cent difference in the cost of each lamp have on the dividend rate?

Taking the total energy generated for the station referred to above, 176,666 k. w. hours, and dividing by 30 k. w. hours, the energy consumed by each lamp during its life, we find that this station would annually consume 5,888 lamps.

A difference in price of one cent per lamp would, therefore, amount in a year to $58.88, or 1-17 of 1 per cent. of the investment, or it would take seventeen years for one cent added to the price of lamps to equal 1 per cent. of the capital stock.

Now let us turn to the question of quality. Are all incandescent lamps practically the same? Considering for a moment the lamp to be a device for generating heat, we would certainly expect to find that two different makes would differ from each other at least 1 per cent., or if one lamp transformed 95 per cent. of its energy into heat, we might reasonably expect another would transform 96 per cent. into heat. These would not then differ from each other very much in their general conditions, but one would transform 5 per cent. of its energy into light and the other 4 per cent., or in the amount of light produced for the same consumption of energy they would differ from each other 20 per cent. I have stated it this way to show that such a difference cannot be considered absurd.

What is the value of this difference to the customer? If the customer pays ¾ cent per lamp hour and a lamp burns 600 hours, he pays for the energy consumed for that lamp during its life $4.50, and as light is the only product that is useful to the customer, a difference of 20 per cent. in the amount of light obtained from two different lamps would be a difference in value to the customer of 90 cents. I have seen tests of different makes of incandescent lamps showing even a greater difference than that stated above.

I believe that it is a well established rule of business that those business enterprises are in the end most prosperous where the customers' interests are most carefully considered. I remember several years ago being informed by one who had made a study of the operation of a number of large central stations, that those stations that were the most liberal in their lamp renewals were the most prosperous. The use of a lamp that is inferior, I believe will always result in reduced profits to the station even if the lamp should cost nothing.

Large expenditures are made to obtain economical generating apparatus for the purpose of converting electrical energy into light and the device that must be depended upon to make the final conversion—the incandescent lamp—is often almost disregarded as a subject of careful study and investigation, although the result of the investment that has been made largely depend upon its operation. Its importance has been very appropriately referred to in an article in The Electrical Engineer, from which I quote: "The incandescent lamp is the very essence, the soul, of incandescent lighting, around which all other details of current production revolve as satellites to a central sun."

LIMA, O.—The Lima Railway Company now has a capital of $200,000. Mr. C. Currie, the general manager, informs us that it now has seven miles of road, regular gauge, sixty-six pound rail, with nine motor cars and two trailers, of the General Electric system. The other officers are: E. W. Moore, president; Edwin Stone, vice-president; superintendent, A. B. Lambe.

PROTECTIVE DEVICES FOR TRANSFORMERS.[1]

BY HERBERT C. WIRT.

THE transformer itself is a protective device, as it was introduced to permit the operation of incandescent lamps from high voltage circuits, with safety to human life. It has so well accomplished this purpose, that there are in operation in the United States four million 16 candle-power lamps, which are supplied with energy by means of transformers. A large number of transformers were introduced ten years ago, at a time when experience with electrical machinery, for operation on high voltage circuits was limited, and therefore many transformers were not properly constructed, and the failure of insulation may be laid in part to faulty design. The object of this paper is to call attention to several protective devices, which have been designed to render the transformer absolutely safe, and to suggest some precautionary measures that should be used by managers of central stations.

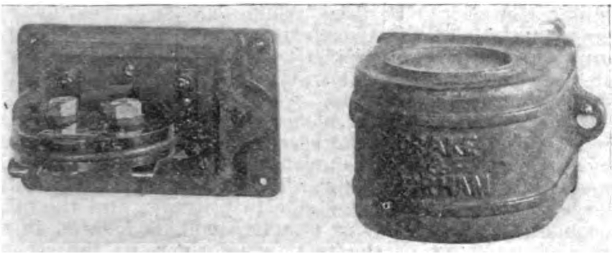
ELECTRICAL ENG'R N.Y.

FIG. 1.—CARDEW EARTHING DEVICE.

The cases which have occurred where the primary current has passed to the secondary wiring are comparatively few, but still sufficiently numerous to warrant the taking of greater precaution to prevent the possibility of fatal accidents. This subject is receiving careful attention on the part of the Underwriters, and many central station managers are looking into the question. Very little information has been published on this subject. Mr. William H. Merrill, Jr., electrician of the National Board of Fire Underwriters, has issued very valuable and interesting reports relating to fires of electrical origin, and during the past three years sixty-two cases have been mentioned by him, where the primary current has passed to the secondary wiring, and which have been considered only as a fire hazard.

The author then cited a number of cases of converter burn outs which had been investigated, all of which had occurred in converters not insulated with oil.

You will note in every case, the electrical discharge ignited the gas. It is easy to see the cause of this. The current passes from the secondary wires to the fixture, and then across the insulation in joint to the gas pipe system and to earth, forming an arc at the insulated joint, thus setting fire to the gas. If, however, insulated joints were not used, the path to earth from the secondary wires would be made easier, and probably a greater number of breakdowns would occur.

Note that all these accidents occurred in transformers that were not insulated with oil. Note also that many of these breakdowns occurred during a lightning storm, proving conclusively that most transformers are burned out, not by the alternator current, but by electrical discharges, due to disturbances of the atmosphere. It is, therefore, necessary to have a transformer insulated to stand such discharges, rather than to stand the alternator potential.

In the early days of transformer construction, the insulation was not designed to stand any definite voltage in excess of the alternator voltage. A transformer was supposed to be properly made if it did not burn out when tested on the standard current for which it was designed. Transformers of early design will just stand a high potential test of 3,000 volts.

The majority of transformers manufactured during the past year are made to stand a test of 5,000 volts between primary and secondary windings. One manufacturer has brought up the standard of insulation on his transformer sufficiently to stand a 10,000 volt alternating current test between primary and secondary.

The insulation of transformers should always be measured by high potential current, rather than by an insulation resistance test, in which a moderate voltage is used. Even 500 volts is not sufficient to properly test transformers, for it is easily seen that a small gap or break in insulation may be great enough not to be bridged by a 500 volt current, but the normal alternator potential of 1,000 or 2,000 volts will immediately start an arc across the defective insulation.

Oil should always be used to insulate transformer windings, as a high potential current will jump a space in air five times as great as in oil. The oil keeps the air from the coils, and prevents oxidation of the insulation material. The air in a transformer not insulated with oil, is heated and expanded from the coils, and when the transformer is cooled, air containing moisture can be drawn into the coils.

A number of automatic devices have been designed to be connected to the secondary wiring of transformers, so that in event of the high tension primary current passing to the secondary wiring, it will be automatically connected to the earth, thus preventing any danger of a shock, or the possibility of causing a fire. The most prominent devices are those designed by Prof. Elihu Thomson, in this country, and by Major Cardew, electrical adviser of the Board of Trade in England.

The Cardew earthing device, Fig. 1, consists of two metal plates, separated and insulated from each other by ¼-in. air space. The plates are held in a horizontal position. A thin strip of aluminum foil, about 3 inches long and ¼ in. wide, is flexibly attached at one end to the upper plate, which is connected to the secondary wiring, and the other end is supported near to, but normally not in contact with, the lower plate, which is connected to a good ground. If a difference of potential of about 300 volts exists between these two plates, the aluminum foil is attracted to the lower plate and will remain in contact with it until the primary fuses are blown. This, therefore, automatically grounds the secondary whenever there is a difference of more than 300 volts potential between secondary wires and earth.

Several thousand of these devices are in use in England, as such apparatus is required by the regulation of the English Board of Trade.

On the three-wire system, the device is connected to the neutral wire. With small transformers it is connected to only one side of the secondary circuit, and with large transformers one is placed on each secondary wire. It should be mentioned that most of the primary wires are run underground in England, and the transformers are not, therefore, subjected to atmospheric discharges of electricity.

Prof. Elihu Thomson has invented several protective devices. The "film cut-out," so called, is quite similar in its action to the Cardew earthing devices, the only difference between the two being that the plates are separated by a thin film of paper, which is pierced by a potential of 300 volts, making a good connection, and thus permitting the primary fuse to melt. The device was first commercially used in 1890. The transformers at that date were so poorly insulated that it was found that the primary current passed to the secondary wiring so frequently their use had to be abandoned.

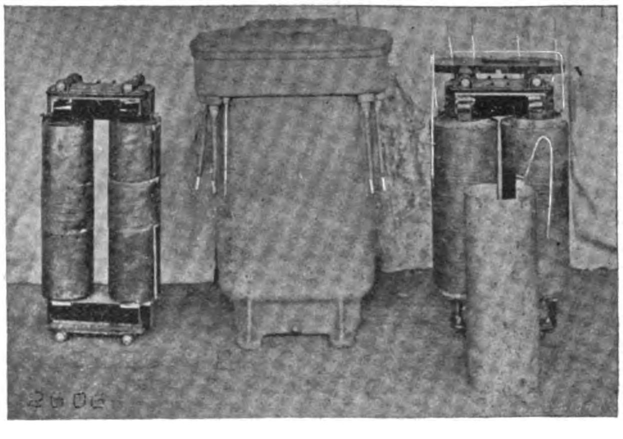

FIG. 2.—GROUND SHIELD OF TRANSFORMERS.

Prof. Thomson's most prominent protective devices, developed in 1885, are known as the ground shield and grounded secondary. The ground shield, Fig. 2, consists of a sheet metal covering, placed in the transformers between the primary and secondary windings in such a way that it is impossible for any current to pass from the primary to the secondary windings without connecting with the metal shield. The shield is connected to a good ground, and therefore the primary current will not pass to the secondary wiring. The grounded secondary is shown in Fig. 3.

The most notable installation in this country of transformers with ground shield, is at Elizabeth, N. J. The transformers were constructed to stand a 10,000 volt high potential test from primary to secondary, and 5,000 volts from primary to ground shield. There are 225 transformers installed, and they have been in operation about three years, and the total number damaged by lightning has been seven.

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[1] Abstract of a paper read before the Northwestern Electrical Association, Jan. 20, 1897.

The lines are protected by sixty line arresters and an equipment of station arresters of an approved type. The engineer reports that whereas the ground shield seems to create more of a tendency for the lightning current to burn out the transformer, it has prevented the primary current connecting with the house circuit and thereby endangering life.

In the grounded secondary system, the house wiring is permanently connectly to ground. This connection may be made from either side of the secondary, or carried from the middle point of the secondary winding in the transformer. In the latter case there is a difference of half the potential of the secondary system existing between the secondary wires and the earth. If only one of the secondary wires is grounded, there exists a difference of potential between the earth and the other secondary wire equal to the full secondary voltage. These systems, therefore, are objectionable from an insurance standpoint, as it has not been thought desirable to have the secondary system grounded, on account of the danger of leakage of the secondary current.

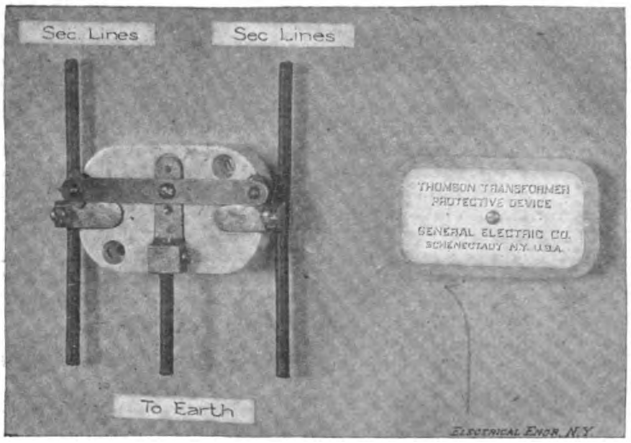

FIG. 3.—THOMSON PROTECTIVE DEVICE FOR TRANSFORMERS.

The film cut-out and Cardew earthing device have an advantage over permanently grounding the secondary, as there is less liability of a leak from wires to ground, except at the time when the devices are short circuited.

A large installation in the town of Suncook, N. H., has been in operation during the past year, with a grounded secondary. The installation consists of 2,000 lights, located in several mills, and about 500 in the town. The generating station is located six miles from the town and mills; primary 2,500 volts. A three-wire secondary system is used—100 volts on each side. The neutral wire is grounded. The lines are well protected by lightning arresters, which were not of the short gap type.

Two transformers have burned out, but after a careful examination, the conclusion was arrived at that one of the transformers at least had been injured by water, as the transformer box had been opened during a heavy rain storm. If the short gap lightning arresters were used, there would be less liability of the transformers burning out.

It will be seen from the above, that the lightning arrester is a very important protective device, as we must depend upon arresters to conduct the lightning discharges to the ground. If we did not use arresters, it would be almost impossible to construct a transformer that would not burn out. We might use a protective device, to prevent any danger from the current passing to the secondary wiring, but we would frequently have transformers burn out. Arresters have heretofore been designed solely for the purpose of preventing the dynamo current maintaining an arc after the passage of the lightning discharge. A new arrester has been designed, which affords an easy path to ground for the lightning current.

A careful test of the various arresters on the market to-day shows that 1,000 volt arresters require from 3,000 to 4,500 volts, and the 2,000 volt arresters require from 6,000 to 9,000 volts potential to cause the current to pass from line to ground across the gaps.

The necessity of a short gap arrester has undoubtedly been known to many experimenters, but until recently no method was devised to permit the short gap arresters to be used on high voltage alternating currents. We are pleased to say that an arrester has recently been designed so that but one gap of 1-32 inch is required for a 1,000 volt arrester, and two gaps of 1-32 inch each for a 2,000 volt arrester, requiring 2,000 and 4,000 volts, respectively, for the current to pass across the gaps. It is believed that these arresters will afford protection to transformers provided with insulation that will stand a 5,000 volt potential test. This arrester consists of large metal cylinders, separated by short air gaps in series with which is placed a low non-inductive resistance to limit the current at short circuit. The arc is cooled so that upon the reversal of the alternating machine current, it is extinguished.

Transformers having defective insulation between primary and secondary should be immediately disconnected. The only way to discover a transformer of this kind is to make insulation tests, and therefore it is apparent that periodical tests should be made of the insulation between primary and secondary of all transformers.

As a high potential current is necessary, a small step-up transformer should be used, which can be carried around to the points where the transformers are located. This transformer should have a capacity of at least 2 kilowatt for testing transformers of 30 kilowatt capacity and less, in order to supply the capacity current.

In making a test, the house transformer is disconnected from both the primary and secondary wires. The primary of the test transformer is connected to primary lines, which are energized by the alternator. The secondary is connected to the house transformer; one side to primary, and the other to secondary. A rheostat, or re-active coil, is located in series with the primary of the test transformer, so the secondary voltage may be varied between the limits of 2,500 to 10,000 volts. A fuse should be located in the primary circuit, to open when the insulation is punctured.

The high potential current should be applied for 60 seconds, and any transformer that will not stand a 3,000 volt test should be scrapped. It will be found that the transformers that have poor insulation, also have very high core losses, and are not economical, for in many cases it will be found that the revenue obtained from the transformer will not be sufficient to pay for the coal used in generating the current to supply the iron core loss. Therefore, it will be most economical to scrap such transformers.

This test should be made as frequently as possible, and at least once a year. When making this test, the secondary should be connected with the iron core, as this acts as a condenser and a high potential current would be generated in secondary wires, which would burn out the insulation between secondary wires and core.

Transformers are not generally tested for leakage between primaries and secondaries, and as they are isolated on the line, there is no means of testing for leakage at the central station without extra wires. It is apparent that it is necessary to make frequent tests of this kind. An interesting method of testing transformers has been in operation at Great Falls, Montana, for the past two years. The secondaries of half a dozen transformers are connected to a common test wire, Fig. 4, which is run to the central station, and tests are frequently made there between this test wire and each side of the

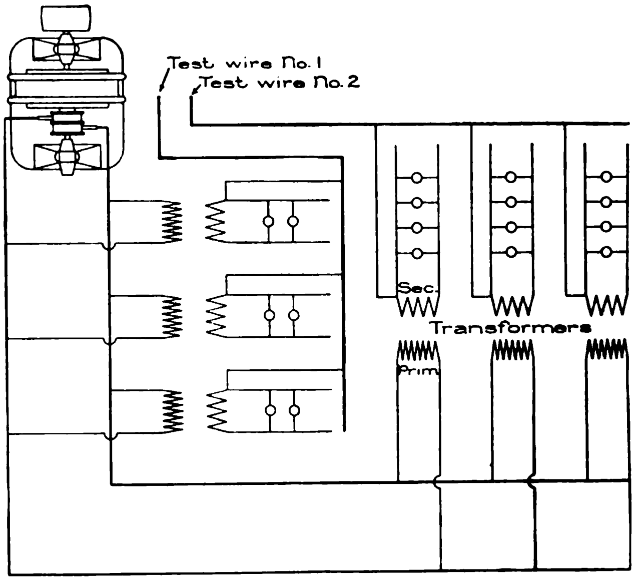

FIG. 4. CONNECTIONS OF TRANSFORMER TEST WIRES FROM CENTRAL STATION.

primary circuit. The normal primary current of 2,080 volts is used for testing. Since using the test wire, the system has been operated without accident and a great saving of time has been effected by means of the test wire. It would seem that there might be many cases where this system would be of advantage.

A fatal accident can only occur when the following connections are made: 1. A ground on one of the primary wires. 2. A leak between primary and secondary on the opposite side of the system on which the ground is located. 3. A person in circuit with the secondary and ground. As the majority of lamps are installed in locations where it is impossible to get a connection to ground, many chances of receiving fatal shocks are avoided. If the primary lines are kept free from grounds, no shock can be obtained. It is, therefore, essential to use the most approved appliances at central stations for indicating grounds on primary wires.

The most common ground detector in use at present consists of a transformer, the primary of which is attached to the line to be tested and the ground. The secondary winding of the transformer is in circuit with an incandescent lamp. The ground is indicated by the brilliancy of the lamp. This seems to be a very crude method of indicating grounds, as there is an opportunity of error, and the detector is connected only at stated periods. It has been said that alternating lines always have a slight ground, as the ground lamp always burns at a dull red. This is due to the capacity effect of the lines, and not to actual leakage of primary current.

The transformer system can be greatly improved in the following manner:

1. There should be used at the station and on outside lines, short gap lightning arresters that will permit the passage of the current across the gaps, before the insulation of the transformers will be broken down.
2. Transformers operated on 3,000 volt circuits or less, should be constructed to stand a high potential test of 7,500 to 10,000 volts for 60 seconds between primary and secondary windings.
3. A safety device should be used in connection with transformers, that will prevent any difference of pressure in excess of 300 volts between secondary wires and ground.
4. Transformers should be filled with oil.
5. Transformers should be periodically tested for insulation between primary and secondary, with high potential currents.
6. A ground detector which will positively indicate a leakage of current from primary wires to ground should be used at the central station. It should not be affected by the capacity effect of lines and it should be designed to be left permanently in circuit.

ON MUNICIPAL AND OPPOSITION OWNERSHIP.[1]

BY H. L. DOHERTY.

Your committee finds a large field of work, and the association probably acted none too soon in recognizing the growing sentiment of municipal ownership. The municipal wave passing over this country is widespread, and numerous central stations are threatened. Each municipal plant installed incites the neighboring city to do likewise, and no central station can consider itself safe from this evil. Investigations warrant the statement that this is the most important subject for the attention of central station men, and every member of this association should feel responsible in aiding the work of demonstrating to the public that the municipal scheme is not practical, and the majority of municipal plants if carefully investigated will prove to be gross failures.

We were instructed to confer with the electrical manufacturers and obtain their promise of co-operation in preventing the misrepresentation as to cost of installation, operation and results obtained from municipal plants. All of the large manufacturers claim to co-operate with us, but in spite of their statement to that effect, they are not all supporting us. The opportunity offered them to hide behind the efforts of electrical engineers, makes it possible for them to agitate and abet the installation of municipal plants without openly showing their hand. We therefore think the best evidence of good faith they can furnish the central station men of the country is to let this branch of the business alone. We therefore suggest that the committee carrying on this work be instructed to report at each meeting the number and locations of municipal plants installed, and the names of the manufacturers furnishing the steam and electrical apparatus. Persons in the electrical business who guide their opinions by observations of municipal operations cannot honestly claim that municipal ownership is apt to prove beneficial to the municipality, and hence, the advocates of this scheme must be regarded as either lacking the ability of observation, or else self-interest prompts their motives. All advocates of municipal ownership must be regarded as the natural foes of central station men and others who desire the welfare of the business as a whole. Central station men should patronize their friends, and they should satisfy themselves that their manufacturers are not aiding and agitating the establishment of municipal lighting plants and thus wrecking the property of some fellow central station owner.

We endeavored to obtain the co-operation of the National Electrical Association, but were unsuccessful. We regret the fact that they cannot see the advantage to be gained by both by a consolidation of our interests as we are each endeavoring to accomplish the same end.

We have also written the General Electric Company, the Westinghouse Company, and the Fort Wayne Corporation, requesting to know the number of municipal plants established throughout the Northwest during the past year where private stations already existed, and also the names of the manufacturers furnishing the steam and electrical apparatus. We hope to have their replies in hand so we may incorporate them as a portion of this report.

We have had four appeals from central stations which were threatened with municipal ownership. As this is a public report, we think it well to withhold the names of all but one of these, which is Negaunee, Mich. In this case we did all possible to protect the central station owners from having their property rendered useless to them, but the matter has progressed to such an extent where apparently nothing could help them except the courts, and we understand that the matter is now pending a decision of the Supreme Court.

At Madison, Wis., the establishment of a municipal plant was attempted, but failed to be erected as sufficient votes could not be secured in the council to warrant the issue of bonds necessary to cover the purchase price of the plant. However, they went as far as they could in the matter; accepted the bid of the Fort Wayne Electrical Corporation for a plant complete, and later on gave a second reading to an ordinance granting the Fort Wayne Electrical Corporation a contract for putting in a plant on the installment plan, as the lack of funds was all that prevented its installation. This last ordinance was never brought up for final passage, as it was apparent that the parties interested could not secure sufficient votes for its passage, and the city made a one year's contract with the local lighting company.

We have endeavored to investigate the results obtained in the municipal plants already established, but find that this cannot be properly done except by sending a capable representative to these municipal plants. We have written for regular city reports, and have sent out blanks requesting answers to a number of questions asked. We find that in the majority of instances, the expense report as covering the cost of electrical lighting does not cover such cost, as is evinced by finding electrical light expenses charged under separate heads, and in but few instances does the city figure anything against the plant for interest, depreciation, taxes, water rent, office rent, management, fire insurance, employers' liability insurance and general risk. It is needless to say that without including but a portion of the expense of conducting an electrical light plant, they can send out reports that look very inviting to other cities who are paying a fair rate for lighting their streets and houses.

In regard to the information gathered, we consider it advisable to hold this as confidential for the use of our members and such central station men who are threatened with this form of opposition. By making the facts public nothing can be gained, and it allows the advocates of municipal ownership to avoid quoting the plant that they know we have evidence with which to disprove their assertions. We also think it best not to disclose our manner of obtaining information on the failure of municipal plants as this would give our competitors an equal footing provided they have not already availed themselves of the same avenue of information.

POWER TRANSMISSION DATA WANTED.

Mr. Charles Renwick, C. E., Government Engineer, Montego Bay, Jamaica, West Indies, wishes to receive catalogues and data relating to the development of power from water and the transmission of that power to motor pumps which can raise the water from the reservoirs into which it flows after reaching the plains from the mountains. Mr. Renwick will be glad to receive full information that will enable him to decide on the feasibility of such work in the island, which has well watered mountains with numerous towns in the adjacent plains.

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[1] Report of a committee of the Northwest Elec. Ass'n.—Abstract.

SOCIETY & CLUB NOTES

FIFTH ANNUAL CONVENTION OT THE NORTHWESTERN ELECTRICAL ASSOCIATION AT MILWAUKEE, WIS.

THE convention was called to order at 11:40 a. m., Jan. 20, at the club house of the Pfister Hotel, Milwaukee, Wis., by Mr. H. C. Higgins, second vice-president, the president, W. B. Baker, being absent, owing to illness.

Secretary T. R. Mercein read his report, which was highly praised by the members.

The programme committee then presented its report, which was adopted unanimously.

The secretary then read a list of twenty-eight applications for membership in the association; all applicants were elected. Various communications were read offering facilities for the next meeting of the association.

On motion Messrs. Bebell, Copeland and Hanley were appointed as committee on adjustment of secretary's salary.

Mr. F. S. Terry, of Chicago, then read a paper on the subject of "Incandescent Lamps."[1]

A vote of thanks of the association was unanimously tendered to Mr. Terry for his excellent paper.

On motion the representatives of the press were invited to attend the banquet.

WEDNESDAY AFTERNOON SESSION.

The convention was called to order at 3:50 p. m. by Second Vice-President Higgins. The Electrical Exchange of Chicago, and the Charles E. Gregory Company, of Chicago, were elected to membership.

A paper was read by Mr. H. C. Wirt, of Schenectady, N. Y., on "Protective Devices for Transformers."[2]

MR. F. McMASTER inquired how the grounding core is arranged so that there are no losses from induction in the protective device.

MR. WIRT: The shield is a sheet of copper and the ends are insulated so that there is no current passing in the shield. If you made a complete loop around the core, of course there would be current wasted in the shield.

MR. S. PIERCE inquired what kind of a device he recommended to have permanently left in the circuit in order to show the ground, which would not cause trouble in some other way.

MR. WIRT replied that a static instrument could be used something like Lord Kelvin s static voltmeter. Each line would form a coil and the capacity effects of line would balance and if there were a leak the difference would be measured by an indicator. In the course of six weeks, he said, such an instrument would be on the market.

PROF. W. M. STINE inquired if there were any scientific connection between the high core loss and the low insulation in the second wire.

MR. WIRT replied that there was no scientific connection between the two. He merely wanted to make it as easy as possible for the gentlemen to take off their old transformers. (Laughter and applause.) In the case of a transformer supplying his house, which has been in operation 16 months, Mr. Wirt had taken the bills for 16 months and measured the core losses and found that the central station had made just enough money to pay for fuel for core losses, to say nothing of the energy lost in supplying the lights.

MR. CARYL D. HASKINS thought that there might be some connection between the poor insulation and core losses. Poor insulation might result in heating which might very readily break down such insulation, as is used in insulating the plates of the core one from the other, and that would cause increased current losses; he thought Mr. Wirt's point very well taken.

A paper on "Insurance as Affected by Electrical Construction," was then read by Mr. George S. McLaren, of Milwaukee.

MR. P. H. KORST inquired if when electric light is used it was considered a better risk than kerosene lamps.

MR. McLAREN considered correctly installed electric light equipment as far better in every way than a kerosene lamp outfit. If a building had had its premium rate increased on account of the use of kerosene lamps and then they are removed and a correctly installed electric light plant put in, the premium rate would be correspondingly reduced. No increased rate was added for the common use of gas. First-class electric light installation was the safest there is. There was no real difference in the rate.

Mr. McLaren, in reply to a question said that the insurance people did not consider the use of water proof wire inside of buildings at all. Rubber covered wire, with good braid, was the only satisfactory insulation. He believed the correct place for cutouts was not in a canopy, but in a properly made cabinet so arranged that one could tell just where a difficulty lies in case one arises. Mr. McLaren stated further that in some special factory buildings where coal oil lamps are used in Milwaukee, there is an increase in rate, but where they are taken out of such buildings and electricity put in, rates are reduced. But in general business buildings there is no rate added at all for the use of lamps of any kind.

MR. F. C. McMASTER thought it would be for the benefit of all concerned if those engaged in construction work were examined and licensed like plumbers.

MR. McLAREN thought the only way to get at that would be for the association to get an act passed by the legislature requiring an examination for all electrical workers. He thought such a law could be passed.

MR. GEORGE L. THAYER stated that the insurance inspectors of the eastern district of Iowa last year sent a man out on a tour of education, and he had with him a draft of an ordinance prepared, which he asked all central station men to see that the city council put through, and the ordinance provided that all contractors doing wiring should take out a license and should pay a fee of $20 a year for their licenses; and there were several different schemes for the examination of the contractors. It depended upon the size of the town and the amount of wiring done. Through the adoption of that scheme they were getting a better system of wiring done throughout the territory.

MR. H. L. DOHERTY thought that might be a very nice thing for the insurance companies, but it certainly curtailed the rights of central stations, which, as things stood now, could have the work done by any one and could protect themselves, by refusing to turn on current on poor wiring.

MR. DEBELL was of the same opinion.

MR. McMASTER agreed with what had been said, but in a large number of towns the stations were selfish in a way and would not, if they could possibly help it, allow a man to go in and do any work.

MR. DEBELL thought that any central station would be working very much against its own interest if it adopted any arbitrary measures of that kind to keep out any particular wiring man. He did not think that legislation or anything else would help such a station at all.

MR. CUTTER believed that the association should not approve any action looking to legislation, as contrary to its best interests. They already had disturbing elements enough. They had got the insurance underwriters telling them what to do, and now the politicians were to tell them what to do. (Applause.)

PROF. JACKSON: One aspect of this affair strikes at the root of the matter, and if properly considered by the central stations, would practically remove most of the trouble. I have found through all this State and all through the Western States, and largely in the Middle States, that not only do a large proportion of the contractors for wiring in small towns at least know very little of the details of the underwriters' code, but even the employés of the central stations that have the inspection of the wiring after the contractors put it in, knew little of the code in many cases. If that code were thoroughly drilled into the minds of the contractors by central station people and into the minds of the employés of the central stations, I doubt very much whether we would have much complaint regarding the dangers of electric wiring. The trouble is largely due to the lethargy of the central station managers themselves, though I do not want to attack them.

MR. PLINY NORCROSS thought that further discussion of the subject would be useless. The fellows that were on their trail were the insurance companies and they did not let up on them. Twelve years ago the only wire he adopted was the underwriters' wire, and more miserable wire was never invented. (Applause.) The underwriters' rules of five years ago were no more the rules of to-day than black was white.

MR. COPELAND: I am interested in a plant (not electric) on which sometime ago I had an insurance with a premium rate of 3 per cent. The insurance company informed me that if I would change from a shingle roof to a metallic roof they would reduce the insurance rate; and if I would put in water sprinklers they would make a further reduction; that if I would put in a larger supply pipe they would make a further reduction. My rate, however, is still 3½ per cent. (Great laughter and applause.)

MR. BEAN inquired why the insurance companies charged as much where coal oil lamps were used as they did where good wiring is done..

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[1] See page 111.

[2] See page 113.

MR. McLAREN replied that in certain classes of buildings they charged more if lamps were used, but not in all buildings. If they were charging a rate of 10 per cent. for using a coal oil lamp if you took out the lamp and put in an electric plant they would take off the 10 per cent. But in many cases they did not charge for the lamps. If they are using oil lamps they may be only using a few and the insurance company might not consider the matter dangerous to a sufficient degree to increase the rates in all cases. Matches were dangerous, but they did not charge for the use of matches in buildings.

MR. R. F. KOUNTZ stated that he began in the early days to use underwriters' wire as recommended by the New York and Philadelphia Board of Underwriters, and had not changed yet, and did not know that he ever would. (Applause and laughter.)

It was moved and seconded that the statistics referred to by the secretary in his report as being obtained from the various central stations be printed in pamphlet form and a copy sent gratis to each central station that had furnished the information and to each member of the association, without names, but with a key. Unanimously adopted. Mr. Kountz contributed $5 toward the expense of printing the pamphlet.

MR. DOHERTY, chairman of special committee on municipal ownership then read the report of the committee.[1]

MR. DOHERTY stated that he had essayed to obtain the co-operation of the National Electric Light Association, but that correspondence he had had with that end in view had not turned out satisfactorily.

MR. COLEMAN then continued the report of the committee on municipal ownership of lighting plants.

MR. W. J. BUCKLEY said he had been identified with the Fort Wayne Corporation ever since it was started, and he was very glad indeed of an opportunity to say that the Fort Wayne Electric Corporation, as well as himself, took the position that municipal ownership was a fallacy and a failure; that a majority of all the municipal plants that had been erected were failures in that it had cost the cities that had built them more money to operate per light than the local companies offered to give them light of equal service for. It was not in the province of this association, nor was it in the province of the central station manager whose station and whose property were jeopardized by this municipal ownership idea to attack the manufacturers of apparatus or to directly look to the manufacturer of apparatus for the cure of the disease that threatened them. A city wishing to buy a plant usually wanted arc lights. In that case they could get bids from but three companies, the Brush Electric Company, the General Electric and the Fort Wayne. If they wanted incandescent lights then of course they must include the Westinghouse Company. He was sure that prices on apparatus were such, and the profit in their business was so small, that they could not afford to do anything that was so diametrically opposed to the interests of their various organizations as to sell to any municipality that was going to deprive them of the revenue from the central station men. Mr. Buckley suggested that a central station manager ought to become acquainted with and cultivate the city council men. He believed that Massachusetts had set the best example of any State in the Union for the handling of this question. The various central station managers there combined together, formed a purse, sent their representatives to the legislature, and the legislature made an enactment whereby any municipality that wishes to purchase its own electric lighting plant must first receive and consider the proposal of a local company for such parts of their apparatus as may be applied to a city plant. If they refuse that proposition, or do not accept it, stating that the price is not right, then the city selects an arbitrator, the central station man selects an arbitrator, and those two fix the price, and the municipality is compelled by this enactment to pay the local lighting station the price fixed by the arbitrators for such part of their apparatus as may be utilized. He advocated the following of a like plan in Wisconsin.

MR. COLEMAN: The fact is, this business itself is responsible for the distrust that has come upon it among the people, because the installation of some of the plants through this country has been most stupendously fraudulent. I know of those things to my own personal knowledge, as an attorney, and I can tell you of a plant where not more than $50,000 was invested, which plant was bonded for $400,000, stocked for $400,000, and its notes were out for another $100,000. (Laughter.) I say we are at fault in this business, and we have got to put this matter before the people in the right way, in a clean handed way, in an open way, as a business proposition, and not sneakingly showing them that we have got something to cover up and intimating, "We will give you Hail Columbia if you don't do it." If the people understand thoroughly the exact situation, how much expert and careful work it takes to make the two ends meet, to say nothing of paying dividends, then, gentlemen, we are not going to have a great deal of trouble in regard to this municipal lighting business. Let us clean our hands and show them clean and keep them clean to the people, and this municipal lighting business will be a success. (Applause.)

MR. BEAN: The gentleman remarked that we ought to get better acquainted with city councils. With all due deference to him, if reports are true, I do not want to get acquainted with common councils like the Fort Wayne Company has. (Applause.) We do not fool with councils that way. Our propositions are plain and clean cut and we do not want to get in with councils, because we all know them in the cities and have a personal acquaintance with them before they are elected. (Laughter and applause.)

The report of the committee was referred to the directors with power to authorize and furnish means for the committee to carry on their work on the lines that they had been following so far.

MR. F. S. TERRY suggested that the members write the Gas and Electric Light Commission of Massachusetts, at Boston, for their report containing interesting matter in regard to regulating competition, etc.

The committee on secretary's salary recommended that the salary of the secretary for the ensuing year be fixed at $150, and that $50 in addition to that amount be allowed as extra compensation for the last year's work.

The association then adjourned to meet January 21, 1897, 10 a. m., same place.

In the evening the convention assembled to listen to a lecture on and demonstration of "Röntgen Ray Phenomena"[1] by Mr. Caryl D. Haskins.

THURSDAY MORNING SESSION.

The convention was called to order by the second vice-president, Mr. Higgins, in chair.

Mr. Pierce, of Negaunee, Wis., was then requested to address the convention on the subject of the municipal lighting plant at Negaunee.

MR. PIERCE: I live in the Upper Peninsula, which Wisconsin rightfully claims as part of the State of Wisconsin, and in which place the municipal ownership idea is prevailing somewhat. As regards the plant in Negaunee I will give you the facts of the matter and then you can see who is to blame. About a year ago Mr. Pingree made a visit to the Upper Peninsula and came to Negaunee. Mr. Kirkwood, mayor of Negaunee, is a great admirer of Pingree, and thought by following out Pingree's Detroit example in Negaunee money would be saved for the city. Through Pingree they engaged Mr. Rae who was to give them an estimate of what it would cost to operate 30 street lights and 1,000 incandescent lights. The figures he gave were somewhat of a fairy nature, that is, they were to run 30 street lights on a dark night schedule and 1,000 incandescent lamps (that is, what they would use regularly) on less than 300 tons of coal per year (!). This was of much interest to the council and they thought that by putting in this plant right away, that is, providing they could put it in for less than ten thousand dollars, they would go ahead, and his figures pointed out where they could make 60 per cent. profit on the plant.

Mr. Pierce then detailed the reasons why several of the councilmen were opposed to the electric light company, all on purely personal grounds, and then continued. At a meeting they discussed the subject and came to the conclusion that they would advertise for bids. Bids were advertised for, and there were three or four bids. He thought the Fort Wayne, the Westinghouse and the Western Electric Companies all bid on the electrical apparatus. There was only one bidder for the engines, which was the Russell Company. The contract was let by the three hostile aldermen with whom they had had these difficulties. They were the members of the electric light commission and they let the contract to the Fort Wayne company through Mr. Rae's suggestions.

They went to work in such a way that the people throughout the town were somewhat disgusted with their operations, and there was an injunction got out on the ground that they were spending other people's money without the consent of the tax payers of the town. The injunction was made permanent and that required an election in the State of Michigan. In the council at the present time there are only two tax payers.

A VOICE: The same as elsewhere.

VICE-PRESIDENT HIGGINS: There is none in ours. (Great laughter.)

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[1] See page 115.

MR. PIERCE: After the election we found out that we had lost and then proposed to bid on the plant ourselves, and the General Electric Company said they would bid. We thought that it was right that if the municipality was determined to put in this plant that we ought to have some recognition, that is, that they should buy our machinery, as we would have a fair plant lying idle. There was a meeting of the council after that in which they decided to readvertise for bids. In the second asking for bids there were three bidders, ourselves, the street railway company, the Fort Wayne Company and the General Electric Company. We bid on a complete plant. The Fort Wayne Company bid on the electric apparatus and the Russell Engine Company bid on the engine; and they were somewhat combined, I guess. The General Electric Company bid on the electric apparatus alone. Our bid was $2,000 lower than the Fort Wayne's, that is, the complete bid. The General Electric Company was about $250 lower than the Fort Wayne bid for electric apparatus. There was an executive session held, in which Mr. Rae was asked to take part. Nobody else was there except the aldermen and Rae, and we could easily tell that the thing was all cut and dried before they went upstairs. But when they came down everything was let to the Fort Wayne Company the same as usual, they being the highest bidders. (Great laughter and applause.)

After these bids were let, another injunction was gotten out on the grounds of fraud, illegal election and that the outlying lands were not properly taxable for the purposes of municipal electric lighting. The case was tried at the circuit court and the injunction was dissolved, but the matter has been appealed to the supreme court and only a few days ago the supreme court granted a stay of proceedings, which really means another injunction from the supreme court. The point that they are bringing out is that of the outlying lands not being taxable for the purposes for which they were taxed. That point is this: The plans are drawn up, the lights are located and the city of Negaunee in order to raise taxes enough for the support of the city government is obliged to annex more property to the city. Some of this property is at least two miles from the city; and these people objected to paying the tax for electric light purposes. So that is the way the matter stands at the present time, and the case is to be heard on February 2. A few days ago some of the Fort Wayne machinery arrived. And a few 15-foot poles. (Laughter.) There were a few 30-foot poles, I think, about 6 or 7, and the rest of them were 15-foot poles. The plans and specifications call for 35-foot poles, while we have put in in our plant 40, 45 and 50-foot poles. On the way up the Fort Wayne representative was given a note by Mr. Rae, asking the city council to pay over to the Fort Wayne Company half of the contract price, which was $3,250; that everything was O. K.; and it was signed by the engineer. The city council refused to pay it, and in some of their discussions they have come to the conclusion that Mr. Rae and the Fort Wayne Company are working in conjunction with each other. Every thing shows that. I think from what I have seen and heard up there that they are getting somewhat tired of the engineer right along from the way he is acting in regard to the money and other things that are happening there right along.

MR. SCHUETTE, of Manitowoc, then read a paper on the "Defects and Dangers of Municipal Ownership."

Mr. Schuette added, after concluding the reading of his paper, that at the present time as the law stood, any city in Wisconsin could build its own municipal plant, operate it and sell light to private individuals; but not unless the owner of the existing plant did not want to sell his plant; that is to say, that they must condemn those plants if there are any; but if the owner is not willing to sell then they can build a plant in opposition to him. He advocates assessing electric light companies 10 cents per kilowatt capacity, to maintain a representative at the State Capital to watch legislation.

The election was then proceeded with and resulted as follows:

President H. C. Higgins, of Marinette, Wis.; first vice-president, G. L. Cole, of Beloit, Wis.; second vice-president, J. H. Harding, Laporte, Ind.; secretary and treasurer, T. R. Mercein, Milwaukee, Wis.; directors, Messrs. Debell, Rand and Bean.

A paper was then read by PROF. W. M. STINE, of Chicago, on "Safety Devices for Electrical Circuits."

Prof. Stine added that if one buys from a supply house a spool of fuse wire stamped 15 amperes, that really meant nothing except that for four inches in length in that sized wire that would be the fusing point of that wire; but that was not a commercial length. What should be the duty of a supply man in this matter? He should accompany that wire with such a curve as that indicated in the diagram embodied in the paper, or the results indicated in a table. Since publishing his first paper on this subject, a fuse company in Chicago had undertaken to do this. PROF. KLINE also briefly discussed the paper.

The selection of a meeting place for the next convention was left to the Board of Directors to report upon later.

The meeting then adjourned until 2 p. m.

THURSDAY AFTERNOON SESSION.

MR. SCHUETTE again brought up the subject of the association being adequately represented at Madison, to guard its interests in the legislature, and after some debate a resolution was passed that a committee be appointed and the necessary funds for them to carry on this work be raised by the Ways and Means Committee by assessing the stations in the State of Wisconsin pro rata by kilowatt or otherwise, sufficient to cover the expense necessary.

After a lengthy discussion as to the work of the Protective Committee in States other than Wisconsin, MR. KOUNTZ moved that the Protective Committee under the laws and regulations of the association attend to the legislation within its jurisdiction, and that the plants in the jurisdiction be assessed a reasonable sum to defray expenses, and that it be left to the judgment of the committee as to what portion should be expended in each territorial jurisdiction.

La Crosse was then selected as the next meeting place. Five applicants for membership were acted upon favorably.

The secretary then read a paper on "Gaseous Fuel as a means of Cheapening Electricity," by N. W. Perry.

Mr. W. W. Low, of Chicago, then read a paper on "Electrical Supplies." Mr. Low added during the reading of his paper that in regard to slow accounts, 75 per cent. of the central station accounts of that character were municipal accounts. Some were very prompt, but the majority were slow. He believed that between 30 and 35 per cent. of the orders that they received (and that included traveling mens' orders) have to be held until further information is secured, because the orders are not given explicitly.

Mr. George Cutter, of Chicago, then read a paper on "Electric Heating."

MR. LORD stated that in his water power plant at Waupaca he might increase his profits largely, if he could get a heating load on the plant which is now completely shut down at daylight, letting 250 horse-power run to waste all day. A discussion was also had on the advisability of utilizing and distributing exhaust steam for heating purposes. MR. THAYER described the Webster system of exhaust steam distribution.

MR. DOHERTY: We have one associate member on our committee who last year obtained eleven new members for the association. I refer to Mr. Christie. Mr. Mercein has also mentioned the matter in his report, but I think it is no more than proper to acknowledge Mr. Christie's services in some way.

The secretary then moved that a vote of thanks be extended by the association to Mr. S. E. Christie, of Chicago, for his zeal in securing new members for the association.

MR. DOHERTY suggested the establishment of what might become the "question box" from which questions might be taken to be discussed at meetings.

After a brief discussion on miscellaneous topics the convention adjourned sine die.

MUNICIPAL OWNERSHIP OF ELECTRIC LIGHTING PLANTS.[1]

If the municipal lighting movement is right, we gain nothing by kicking, but will be injured by reaction. If that movement is without proper foundation it must be met by facts and figures.

We have much to contend with in dealing with the people. They have good reason to be cautious in dealing with electrical matters. Probably the majority of electric plants today were installed on a fictitious basis. With the capital stock much above the actual investment and bonds issued to a vastly larger amount than the real investments.

This was the electric era of promoters. And was quickly followed by the era of assignments, foreclosures and receivers. The former fraudulent transactions have been shown up, the impression being left upon the public mind that electric light can be produced at a much less figure than is paid for it. We who are in the business know how far they are out of the way.

The third era of the business is now on, and the bondholder, the creditor, the purchaser at foreclosure sale and the honest investor are now on deck with the full understanding that only honest work will bring good results.

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[1] Supplementary Report, by Mr. E. Coleman, Northwest Elec. Ass'n.

We must meet the agitators for municipal ownership with open hands, and when they think judicially on all sides of the question the agitation will cease.

Water works corporations and lighting corporations are from their very nature quasi-public corporations. They cannot operate without a franchise from the municipality. That franchise when accepted becomes a contract between the city and the corporation, and carries with it obligations binding both. The city signs it for two reasons: First, that private parties shall put in the capital and produce the electric current to light the streets and public buildings, and, second, to light the houses and business places of the citizens.

If the company does its work well and in good faith, it has a right to expect good faith from the municipality. The company pays its taxes, furnishes good light, and is a booming card for citizens to boast of. Is it equitable on the part of the city to enter the field against such a company and as a competitor to it, merely because with its help the city treasury has become plethoric and it can build its own plant?

On the other hand if the company, after receiving its franchise has only played the role of a leech, then the city fathers should cause its franchise to be judicially annulled and proceed to build its own plant, or to do what is better; contract with a reliable company to furnish the city and its citizens with equitable but living rates.

The latter procedure is worthy of all honest commendation while the former can best be illustrated by the familiar story in song of a faithful mother who had borne and patiently reared to manhood an ingrate son, who when he thought her of no further use to him sent her over the hills to the poor house.

Your committee does not give an opinion that the municipality either has or has not a legal right to thus destroy the value of the local plant. That question must be settled by the terms of the franchise itself. All will agree that it has neither the moral or equitable right to do so.

It is therefore certain that the municipality should not be given the power to put in plants, unless (1) the existing companies shall be bought out, or (2) their stock bought up, or (3) if agreement of purchase cannot be made, that process of condemnation be had under power of eminent domain as in railroads. While hardships might come to some, these methods would all be fair and equitable.

The remaining questions are these: 1. Is municipal ownership practical? 2. Will it be remunerative?

The office of a town or city is not to dig our potatoes, cut wood, or chop our hash, or to do any of the ordinary work of life, excepting of course to furnish lawyers with lawsuits—but its office is to do for all its citizens such work as individuals or corporations cannot do for themselves such as furnishing protection, building and maintaining streets and furnishing water and lights and the two latter can better be done by the quasi-corporation in most cases than by the city itself, and these franchises are given to these corporations to relieve the city of an additional swarm of blood-suckers—both political and personal. When once the additional crowd has fastened its fangs on the body politic there is no such word as "Let go."

In the financial phase lies the greatest objection. 1. A commission (non-partisan, of course) must be appointed. 2. A manager must be hired. 3. An expert electrician must be had. 4. Duplicate machinery must be put in, for commissions, boards of experts and common councils, can keep no pace with electrical currents, machinery or men. 5. If the public plant furnishes electricity for private consumption the sucker citizen will forever be hounding the manager for rebates political, rebates special and rebates on general principles. 6. The manager and manufacturer will put their heads together to fool the board and the public bleeds at every pore. 7. If the ever alert central plant manager cannot keep pace with the rush of improvements where will the foregoing crowd be left?

Our hasty conclusions are, then, as follows:

1. That legislatures should grant no powers to municipalities to erect and maintain lighting plants for general use, unless where franchises have been given the owners of the same shall have been remunerated as herein set forth.

2. That honorable manufacturers will not sell to municipalities until these steps have been taken, and central station men cannot afford to deal with manufacturers showing themselves thus dishonorable.

3. That if we cannot show to municipalities that the business is unprofitable to a city including, of course, the item of taxes, lost interest on investment, depreciation, etc., then we should be silent.

CONVENTION AND EXHIBIT NOTES.

AMONG THOSE PRESENT at the convention and not mentioned elsewhere were: F. A. Brown, M. A. Burt, G. L. Cole, E. Colman, F. A. Copeland, Edward Daniell, E. Debell, H. L. Doherty, C. Faust, T. F. Grover, G. W. Hanley, J. H. Harding, H. C. Higgins, F. Kellog, L. E. Kerns, P. H. Korst, R. F. Kountz, J. D. McLeod, G. S. McLaren, M. Nippert, C. C. Paige, H. F. Pearce, O. M. Rau, J. Schuette, W. C. Smith, G. H. Strang, R. A. Willson, H. F. Boggis, J. J. Brenk, W. L. Church, H. H. Pease, F. H. Ford, A. H. Ford, P. H. Karl, W. H. Scholt, W. Goltz, Thos. R. Mercein, Prof. D. C. Jackson, Albert Smith, H. Jones, G. L. Thayer, J. P. Barrett, S. G. Coleman, W. H. Schott.

THE GENERAL ELECTRIC COMPANY were represented by B. E. Sunny, Western Manager and George K. Wheeler, Chicago, C. D. Haskins, Boston, H. C. Wirt, Schenectady, N. Y., Percy A. Clisdell, Chicago, Thomas Ferris, Milwaukee. They exhibited a nice line of supplies in Parlor No. 8, near the Convention Hall. A line of samples of the new Wirt alternating current short gap lightning arresters, were displayed, together with their new 3 ampere and 5 ampere long burning arc lamps, type H. transformer and Thomson inclined coil instruments, which were all favorably commented upon. The Bulletin of the University of Wisconsin, containing a report of the complete test of Modern American Transformers, made by Mr. A. H. Ford, was distributed together with other literature. The apparatus manufactured by the General Electric Company for generating X-rays, as shown by Mr. Haskins, was the hit of the convention and elicited universal favorable comment.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, showed a fine display of their incandescent lamps, which included not alone their regular product, but they also had on view some 220 volt, anchored filament street railway type, and some of their fancy lamps. They also exhibited specimens of the material out of which the filaments are made, showing it in different stages of its manufacture; first the liquid mass which greatly resembles in appearance and consistency a thick varnish; the threads in the second stage; and also the coils of material ready for forming and carbonization, the carbonized filaments ready for treatment. This portion of the exhibit attracted considerable attention, and Mr. A. C. Garrison, secretary and treasurer of the company, who was in charge, explained the process of manufacturing the filaments to interested listeners.

THE AMERICAN ELECTRIC HEATING CORPORATION, of Boston, had a line of their electric heating apparatus, which included a set of cooking utensils, sad irons, and other specialties of the kind, the whole being in charge of Mr. F. P. Leuther, manager of the Western department, Chicago.

THE ELECTRIC APPLIANCE COMPANY, Chicago, were to the fore as usual and showed a fine line of supplies which, although they were not all exactly electrical, had quite an electrifying effect. The visitors to room 2 in the Pfister were cordially welcomed there by Mr. W. W. Low, the president of the company, and his able lieutenant, Frank McMaster.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, showed a new alternating current ceiling fan operated at 100 volts and 7,200 alternations, and it is so designed as to operate at the same speed as direct current ceiling fans. It has ball bearings, which rest in a cup filled with oil to last under ordinary conditions of operation 18 hours per day for two years without replenishing. There is but one bearing which consequently does away with a great amount of friction. The blades are attached direct to the revolving field and can be set at any angle desired. The switching device is located slightly above the motor proper, and is operated by a handle, which is the oil cup for the bearing already referred to. The motor is started by turning the oil cup to the right, and is stopped by turning the cup again in same direction, a continuous turning having the tendency to turn the motor on or off. It takes between 120 and 125 watts to operate it. It is absolutely impossible to burn this motor out, and the Wagner Company guarantee that it will operate with ordinary care and attention for a period of one year from date of purchase, and can be adapted to any height of ceiling. It is the intention of the Wagner Company to make only a limited number of these fans this year, and as things appear it would indicate they will not have to wait long before the anticipated lot is sold, judging from the attention it attracted and the many favorable comments passed upon it. It is rumored that the Wagner Company have already secured a number of orders for delivery this spring. They also exhibited a 20 light standard type transformer with their latest "X. L."

fuse boxes. Their carbon break, polished knife switches also attracted considerable attention, but what appeared to interest the visitors chiefly was a quick break baby switch. The spring comprising the feature of the quick break is located in the front of the post, and the mechanical construction of this switch is much more rigid than that of any of the baby switches that are now offered. The Wagner Company also distributed amongst the central station men several of their handsome transformer ink wells as souvenirs of their visit. The interests of the company were looked after in a very able manner by Mr. Eugene H. Abadie, manager of the Sales Department.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, were represented by Mr. M. C. Wheaton, and displayed a long distance telephone as well as central exchange desk outfits complete, and also magnetos, signal bells, and the intercommunicating system for interior use.

THE MUNICIPAL DEBATE. The leading feature of the convention centered on the subject of municipal ownership and the electrical men are thoroughly aroused on this matter. A strong effort was made to suppress the agitation, but it is evident that nothing but a final decision on this matter will satisfy the central station men of the Northwest. Many central station men expressed their regrets that Mr. Doherty, the former chairman, was not reappointed as he certainly worked hard and earnestly on this subject. The committee, however, is well manned for the coming year, and it is hoped they will accomplish much.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY showed a two-phase motor of 5 horsepower with a speed of 1,800 revolutions; also a Shallenberger integrating wattmeter for alternating currents, and some of their transformers. The alternating current which supplied the motor and also ran the rest of the exhibits at the convention, was supplied from the junction box patented by Mr. Jacob Cloos, of Milwaukee, who represented the Westinghouse Company at the convention.

MR. W. R. BRIXEY was present in the interests of Day's Kerite, and was welcomed by many friends. His able Western representative, Mr. S. F. B. Morse, was unfortunately prevented from putting in an appearance as he had hoped to do, but Messrs. Crook and Earl were around also attending to the interests of the company.

THE PECKHAM MOTOR TRUCK AND WHEEL COMPANY were represented by Mr. W. H. Gray of the Chicago office, who distributed a very handsome souvenir in the shape of a long memorandum book enclosed in a leather case, and for which there was considerable demand.

MESSRS. F. S. AND A. S. TERRY were present in the interests of the Sunbeam incandescent lamps, Cutter switches and circuit breakers and Lakon transformers.

THE NEW YORK INSULATED WIRE COMPANY were represented by their Western manager, Mr. James Wolff, and to say that he did things up in fine shape is only doing him small justice.

MR. GEORGE S. SEARING was present in the interests of the Hart & Hegeman Manufacturing Company, of which concern he is Western manager. Mr. Searing is a well known man at conventions.

THE WESTERN ELECTRIC COMPANY, Chicago, were represented by Mr. C. D. Wilkinson, who displayed his usual activity for the good of his company.

MR. M. B. AUSTIN was on the scene as representative of the Safety Insulated Wire and Cable Company.

THE C. E. GREGORY COMPANY, and The Electrical Exchange were represented by two hustling members of the firms in the persons of Mr. A. L. Kuehmstedt and Mr. T. S. Leane.

DONLEY & BUNCE, Chicago, as representatives of the Sawyer-Man Electric Company, and several other concerns, had a busy time of it, and Mr. W. E. Donley, and A. C. Bunce, the latter being a conspicuous figure at the Northwestern conventions since their beginning, were hard on the go during the entire proceedings.

THE CENTRAL ELECTRIC COMPANY, Chicago, were very ably represented by Messrs. C. G. Burton and W. P. Upham.

THE LESHEN-MACOMBER-WHYTE COMPANY, Chicago, had Mr. George Whyte on hand, and to state that Mr. Whyte is a pusher would be to express the case very mildly.

GOLTZ & SINCLAIR, Milwaukee, showed some Bergmann arc lamps in operation.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, had Mr. Walter A. McKinlock on hand, who was very actively engaged in talking supplies, and on the merits of the Metropolitan oil filter.

MR. C. H. ROCKWELL, of the Buckeye Electric Company, Cleveland, O., was a visitor to the convention.

THE CHICAGO INSULATED WIRE COMPANY had their interests very ably looked after by Mr. W. M. Smith.

MR. CHARLES E. GREGORY, who was always a familiar figure at conventions up to a year or so ago, was on the ground again looking as fresh as ever.

THE PEOPLE'S ELECTRIC COMPANY, Madison, Wis., had Messrs. Burch and Ford around hustling after business for their concern.

J. C. WORMLEY & COMPANY were represented by Mr. J. C. Wormley, who was on the alert looking for lamp orders, and he added incidentally that his system of giving a discount off as he has advertised had borne good fruit.

A. O. SCHOONMAKER, New York, was represented by his Western sales agent, Mr. John Childs.

THE PRESS. The following representatives of the electrical press were present: L. L. Summers, "Electrical Engineering"; F. L. Perry, "Western Electrician"; W. P. Sullivan, The Electrical Engineer; J. V. S. Church, "The Electrical World"; W. R. Smith, "American Electrician."

THE FORT WAYNE ELECTRIC CORPORATION was represented by Mr. W. J. Buckley of their Chicago office.

MISCELLANEOUS. The following concerns also had representatives present: American Electric Heating Corporation, F. P. Luther, Chicago, manager; Diamond Electric Company, Peoria, Ill., W. Wilson; Chicago General Fixture Company; L. W. Kittwan; Ohio Brass Company, J. H. McGill, Western manager; A. L. Ide, A. L. Ide & Company; A. H. Pierce, Pierce & Richardson; Julian Roe, Sargent & Lundy; C. T. Gage, Washburn & Moen Manufacturing Company; D. G. McDonough, Washington Carbon Co.; W. D. Mahaney, M. A. Knapp; M. E. Baird, Eddy Electric Manufacturing Company; Jacob Cloos, Electrical Engineer, Milwaukee; Crouse-Tremaine Carbon Company; S. E. Christie, Dearborn Drug and Chemical Company; W. H. Grisson, Eureka Tempered Copper Works; A. Smith, Keelyn & Smith; J. Rohn, Rohn & Myer; F. J. Mocametz, Wisconsin Electrical and Construction Company.

NEW MEMBERS. Secretary Mercein furnishes the subjoined list of new members elected by the association: H. E. Shedd, Elgin, Ill.; J. Cloos, Milwaukee, Wis.; E. Reallic, Marquette, Mich.; W. Worth Bean, St. Joseph, Mich.; J. I. Case, Racine, Wis.; T. Ferris, Milwaukee, Wis.; W. H. Crawford, Milwaukee, Wis.; W. L. Church, Milwaukee, Wis.; M. E. Mayfield, Rockford, Ill.; E. Holcomb, Springfield, Ill.; W. L. Elliott, Chicago, Ill.; J. Bradshaw, Milwaukee, Wis.; Wagner Electric Manufacturing Company, St. Louis, Mo.; Columbia Incandescent Lamp Company, St. Louis, Mo.; G. L. Thayer, Belle Plaine, Ia.; A. S. Terry, Chicago, Ill.; W. P. Upham, Chicago, Ill.; Chapman Valve Manufacturing Company, Chicago, Ill.; Appleton Electric Light and Power Company, Appleton, Wis.; Westinghouse Electric and Manufacturing Company, Chicago, Ill.; F. B. Williams, South Milwaukee, Wis.; G. W. Harrison, Ashland, Wis.; J. R. Dee, Houghton, Mich.; A. H. McCorkle, Monmouth, Ill.; D. H. Pierce, Appleton, Wis.; C. E. Hay, Springfield, Ill.; C. T. Gage, Chicago, Ill.; Electrical Exchange, Chicago, Ill.; Kenosha Light and Power Company, Kenosha, Wis.; D. C. DeWolff, Chicago, Ill., and C. E. Gregory Company, Chicago, Ill.

THE ANNUAL BANQUET of the association was held on Wednesday evening in the banqueting hall of the Hotel Pfister, when some eighty people were present. At the conclusion of the banquet, and before the toasts were called, Mr. James Wolff arose as representative of the associate members, and made some very fitting and complimentary remarks in respect to the able and obliging manner in which Mr. Thomas R. Mercein, the secretary of the association, fulfilled the duties of the position. On concluding his speech Mr. Wolff presented Mr. Mercein with a very handsome gold badge, similar to the silver badge of the association, with the exception that the pendant from the gold circlet instead of being a tiny incandescent lamp, which is used, consisted of a large handsome solitaire diamond. Mr. Mercein responded in his usual inimitable manner, dilating at some length and with considerable feeling upon his appreciation of the compliment which had been paid to him. The following also spoke: J. C. Spencer, "The Great Northwest;" C. H. Hamilton, city attorney, "The Cream City;" George M. Hanley, "Marinette and Menominee;" L. L. Summers and F. L. Perry, "The Electrical Press." Prof. D. C. Jackson, B. E. Sunny, H. C. Higgins, W. J. Buckley. George Cutter, "Electrical Education." A band of music played during the evening. Mr. George Whyte favored the guests with a Scotch song, and Mr. F. McMaster went through his ludicrous "dwarf act" by walking around one of the tables on his haunches. The proceedings terminated at a late hour.

On Thursday evening the delegates attended at a vaudeville performance at the new Wihlein Theatre, which is one of the finest places of the kind in the West.

RULES AND REGULATIONS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

Messrs. Pettingell, Andrews & Co., of Boston, have got up a neat pocket edition of these important rules, enclosed in Russia leather covers. The front cover bears the legend "The Golden Rule: Use Interior Conduit and Okonite Wire." A copy can be had on application.

HEATING AND VENTILATING.

The American Society of Heating and Ventilating Engineers will hold its third annual meeting this week at 12 West Thirty-first street, when a number of interesting and valuable papers will be presented in that field of work. The sessions begin at 10 a. m. Tuesday and last until Thursday afternoon.

NEW MEMBERS OF THE INSTITUTE.

At the meeting of the Executive Committee on January 20 the following associate members were elected: Putnam A. Bates, student, Columbia University, residence 113 West Seventy-second street, New York City; John Louis Hermessen, chief of Data Department, Union Electricitäts-Gesellschaft, Kleist Strasse, Berlin, Germany; Ludwig Hommel, Superintendent of Construction, Standard Underground Cable Company, Westinghouse Building, Pittsburg, Pa.; Wm. R. Kenan, jr., chemist and electrical engineer, Australian Carbide Company, Sydney, N. S. W.; Willard H. MacGregor, draughtsman, 359 West Twenty-seventh st., New York City; Calvin Winsor Rice, consulting electrical engineer, 8 Easton street, Winchester, Mass.; Francis Arthur Rich, Consulting Mining and Electrical Engineer, Auckland, New Zealand; D. Franklin Stakes, electrical expert, The Fort Wayne Electric Corporation, 240 West Washington street, Fort Wayne, Ind.; Samuel G. F. Townsend, electrical engineer, 131 Fifth avenue, New York City.

THE OHIO TELEPHONE ASSOCIATION.

The Ohio Telephone Association met at Columbus, Ohio, on January 11 and 12 and it was found that the organization, which has for its object the perfection of an inter-municipal telephone exchange, will equip it with long distance circuits. There are now in operation in Ohio and West Virginia sixty-three independent exchanges and almost 12,000 instruments in use. The following officers were elected for the ensuing year: James W. Thomas, Chillicothe, president; D. J. Cable, Lima, first vice-president; George W. Beers, Fort Wayne, second vice-president; J. W. Hoyle, Cambridge, third vice-president; H. J. Critchfield, Mt. Vernon, secretary, and Edward Kibbler, Newark, treasuer.

LETTERS TO THE EDITOR

ELECTRICITY vs. COMPRESSED AIR IN MINING PLANTS.

In the London "Electrical Review" of December 25, 1896, I note a letter by Mr. A. L. Steavenson in which he makes several attempts at criticising my article on "Electricity vs. Compressed Air" appearing in The Electrical Engineer of November 25, 1896.

My object in writing the article was to bring before those interested in the subject, actual working data of the two plants operating side by side under similar conditions, and I believe that this is the first real comparative test ever published. The article is simply a rehearsal of facts as I found them, and it cannot be said that I attempted to hide any defects of the air plant, for the fact they are very clearly indicated. It must also be considered that the electric plant was working under disadvantages due to underloading of both engine and pumps. I have noticed that the air men are very ready with figures on paper to attempt to show that compressed air transmission is more efficient than electricity, but I have yet to find a man who will show records of a compressed air pumping plant where the efficiency is any where near 50 per cent.

Now, regarding the particular criticisms. I have no doubt that our critic has written many interesting and instructive (?) articles of which the one about "headless ones in charge of mines" is probably the latest and the best, but not having read his best I fail to see the application. Our critic states: "The description of the pumps with their pipes is so obscure in its wording that I do not attempt to unravel it, but——" and then he describes the situation exactly! If this can be done without an "attempt to unravel it," the description must certainly have been very clear.

He goes on to say, "Of course, it was no part of Mr. Searing's business to ascertain why the air plant was giving less than 9 per cent., when, as Prof. Unwin has shown, that under intelligent care it might have afforded from 44 to 51 per cent." As there was nothing in the article to show whether the cause of the inefficiency of the air plant was investigated or not, he is not justified in his assumption that this was overlooked. As a matter of fact the plant was in good working order when tested, as it necessarily had to be to do the work required, and both the chief engineer and general master mechanic of the Fuel Company were there to take part in the tests and no doubt were interested sufficiently in having their own work fairly treated to know "how the tests were conducted" much better than any air man could from "a copy of the diagrams."

Although Prof. Unwin may have shown (on paper) that air transmission may have an efficiency of from 44 to 51 per cent., has he proved this to be the case under working conditions and with a mine pumping plant? Assuming the 44 per cent. could be obtained under exceptional conditions, how is the evil effect of operating this plant at an altitude of 6,000 feet above sea level to be counteracted, as it would have to be in the plant described. Our critic makes no mention of this point, and has perhaps never encountered a problem involving high altitudes. Take Prof. Unwin's plant to an altitude of 6,000 feet and his efficiency of 44 per cent. would drop to about 37 per cent. At 10,000 feet, an altitude very common in Colorado, his efficiency would drop to 32 per cent. Give Prof. Unwin the direct acting pump universally used in the United States instead of a complicated and delicate air engine to operate with his compressed air, and his efficiency would be nearer 9 than 37 per cent.

To our critic's question, "Why was the air not cooled by water injection during compression?" I would answer because it was cooled by a water jacket, as described. The expense of constructing these water jackets which our critic states as being "of no value at all" was undergone by the compressor manufacturers just for fun, and although I have seen the compressors run so smoking hot as to cause a shutdown wherever the water pipes to the jacket clogged up, yet the "headless ones in charge of the mine" would persist in the pernicious use of these same jackets. Our critic's method of ascertaining the leakage in the pipes is unique, "let the engine stand and ascertain how long it required for the pressure in the pipes to drop to zero." Determining the leakage to be so many minutes, hours or days would be of little value considering the pipes were conveying air, and not minutes or clocks.

The "slip-shod" calculations which he says contain an error of 22 per cent. are perhaps not so "slip-shod" as his assertion proves our critic's limited experience to be, for he has evidently used imperial gallons, whereas in the United States we naturally use United States gallons. If he will go over his figures using United States gallons, he will not only find no error in my figures, but a mistake in his computed error of 9.1 per cent.

LEWIS SEARING, Consulting Engineer,
The Denver Engineering Works Company.
Denver, Colo.

PERSONAL

MR. JAMES F. CUMMINGS, of the Armorite Interior Conduit Company, of Detroit, has been in New York for the past few days and has consummated a few important deals for the use of his conduit in the East.

MR. YSLAS, director of the Federal Telegraphs of Mexico, has issued to his friends a very handsome engraved card of New Year wishes, the background of which shows the network of main lines in red upon the map of Mexico.

MR. E. G. BERNARD contributes to "Cassier's Magazine" for February a very interesting article on "Electric Ship Lighting," of which he has long made a special study. He installed in 1884 the Sawyer-Man plant on board the U. S. man-of-war "Omaha," which was the second ship in our navy to receive the electric light.

MR. H. McNULTA, of Chicago, has become superintendent of the Helena, Mont., Power and Electric Company, taking the place left vacant by the resignation of Mr. A. B. Elliott.

MR. NICHOLAS S. HILL, JR., engineer to the Baltimore Subway Commission, whose excellent report was digested in The Electrical Engineer of January 13, has now been appointed chief engineer of the Water Department of that city. Mr. Hill is a highly accomplished and thoroughly trained engineer, and the selection of him for the post is admirable.

MR. E. WARD WILKINS, of the firm of Partrick & Carter Co., the well known manufacturers of Electrical House Goods and general supplies, has started on an extensive Western trip stopping at many of the principal cities between Chicago and San Francisco.

MR. MAX OSTERBERG, of The Electrical Engineer editorial staff, has succeeded in taking two splendid X-ray pictures of Yvette Guilbert's hands, and is the proud possessor of copies to which she has affixed a couple of charming autographic sentiments. The bones are curiously long, fine and delicate—artistic, even.

Mr. LOUIS H. ORR, one of the managing partners of the publishing and printing house of Bartlett & Co., so well known for its artistic work of the highest order, has just been elected a governor of the New York Athletic Club, without opposition. Mr. Orr has a host of friends in electrical circles, is an accomplished athlete and bicyclist, and is popular everywhere.

PROF. A. M. BELL has changed his allegiance at last, according to the "Washington Times," and on January 12 became a citizen of the United States. He is the father of Prof. A. G. Bell, and was born in 1813.

PATTON-THRALL.—Invitations are out for the marriage of Mr. Edward Kendrick Patton, on Tuesday, February 9, to Miss Jeanne Thrall, of Cincinnati. Mr. Patton has been associated with the electrical business for years, more especially in late years with the incandescent lamp industry. At present Mr. Patton is manager of the Chicago office of the Perkins Electric Switch and Manufacturing Company, and is deservedly popular amongst the general trade.

MARRIED

HOWARD-PAYSON.

Charles T. Howard, secretary and treasurer of the Providence Telephone Co., and Miss Gertrude Payson, both of Harris, were married at the home of the bride's mother at Harris on January 5. The wedding was a quiet one, only the immediate members of the two families witnessing the ceremony, which was performed by Rev. C. H. Smith, pastor of the Phenix Methodist Episcopal Church.

BURKE-RYDER.

The marriage occurred on Jan. 14, at Salem, Mass., of Mr. Frederic Sherman Burke and Miss Bessie Ryder, daughter of Mr. J. Orme Ryder, secretary and treasurer of the Crown Woven Wire Brush Company, of which Mr. Burke is the manager. The ceremony was celebrated in St. Peter's Church and was largely attended by friends from Boston, Providence and New York. The happy pair received gifts both numerous and costly, and left for a prolonged wedding tour.

LEGAL NOTES

DAMAGES WANTED FOR TEARING DOWN NEW YORK WIRES.

The trial of a suit brought to recover $250,000 from New York City by the Electric Power Company for the summary removal of the poles and wires belonging to the company, pursuant to an order made in 1889 by the Mayor, was begun before Justice McLaughlin in the Supreme Court recently.

Roger Foster, counsel for the plaintiff, said the Mayor's order was the result of an attack upon the system of overhead wires in the city, but that the right possessed by the Electric Power Company to hang overhead wires could not be taken away without compensation. Not only, said counsel, did the city remove the plaintiff's wires, but sold about $10,000 worth of them and refused to give up the money. The company had, he said, invested $300,000 in the business, and would have made money but for the action of the city.

Assistant Corporation Counsel Connoly maintained that the orders of the Mayor were an act of the Legislature for the removal of overhead wires, and that they had not been taken down until subways were ready for them.

OBITUARY

LOUIS HART.

As we go to press, we regret to receive the news of the death from blood poisoning, consequent upon a former attack of grip, of Mr. Louis Hart, so well known in connection with "Heating and Ventilation," an excellent paper, founded by himself a few years ago with much success. Mr. Hart was an old railroad man; was at one time in the electrical field, and at the time of his death was secretary of the Society of Heating and Ventilating Engineers. He was a popular man everywhere and was still in the prime of life. He leaves a widow and one son. As he was a prominent Odd Fellow, his funeral is in charge of that organization.

EDUCATIONAL

UNIVERSITY OF NEBRASKA.

Prof. R. B. Owens, head of the electrical engineering department of the University of Nebraska, informs us that on January 8, under highly auspicious conditions, the Nebraska Engineering Society was organized at Lincoln, where its permanent home will be. The meetings will be held from time to time in different parts of the State. Professor Owens is on the Executive Committee.

Mr. B. J. Arnold, the well-known electrical engineer of Chicago, is to visit the University in February, to give a course of ten lectures on central station design and construction.

THE NOBEL SCIENTIFIC PRIZES.

ALFRED NOBEL, the engineer and inventor of dynamite, has left his fortune for the advancement of science throughout the world, to be administered by learned bodies at Stockholm. The will was drawn up at Paris on November 27, 1895, and was opened at Stockholm on December 30 last. After disposing of two or three million francs in bequests to about twenty persons, friends, relatives and servants, it goes on to say, according to "Le Figaro":

All the residue of my fortune that can be realized shall be disposed of as follows: The capital converted into safe securities by the liquidators shall constitute a fund, the income of which shall be distributed yearly to those who during the year preceding shall have rendered the most eminent services to humanity.

The income shall be divided into five equal parts, which will be awarded yearly:

The first to the person who shall have made the most important discovery or invention in the domain of physics.

The second to the person who shall have made the most important discovery or improvement in the domain of chemistry.

The third to the person who shall have made the most important discovery in the domain of physiology or of medicine.

The fourth to the person who shall have produced the greatest work in the ideal sense in the domain of letters.

The fifth to the person who shall have exerted the greatest or the best action for the fraternity of peoples, for the suppression or diminution of permanent armies and for the formation or spreading of Peace Congresses.

The first two prizes (Physics and Chemistry) shall be awarded by the Academy of Sciences of Sweden; that for physiological or medical works by the Carolus Institute of Stockholm; the literary prize by the Swedish Academy, and that for the spreading of peace by a committee of five members chosen by the Norwegian Storthing.

It is my express will that no consideration of nationality should be taken into account in awarding these prizes, so that the most worthy may receive the reward whether he be a Scandinavian or no.

Mr. Nobel's convertible fortune consists of real property in Paris and San Remo, but for the greater part of securities deposited in his house at Paris, and with bankers in London, Paris, Berlin, St. Petersburg and Stockholm. It will take some time to find out the exact amount of the bequests, but it is safe to say that it will amount to at least $10,000,000, and that each of the yearly prizes established by Mr. Nobel will be as large as $60,000. These are tne largest prizes that have ever been established. It remains to be seen what advancement of the objects which M. Nobel had at heart will be attained by so profuse liberality.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JANUARY 12, 1897.

Alarms and Signals:—

ELECTRICAL SIGNAL SYSTEM. R. Skeen, Madison, Ill., 574,953. Filed March 4, 1895.

Adapted for grade crossings on electric railways.

ELECTRIC SIGNAL. R. Skeen, Madison, Ill., 574,954. Filed May 11, 1895.

Self-locking means automatically operated by electrical connections whereby the signal will be locked, and also the switch mechanism controlling the signal.

RAILWAY SIGNALING SYSTEM. N. Henquin, Schenectady, N. Y., 575,065. Filed October 8, 1896.

Apparatus operated by the engine of a train at a starting station to signal and record on paper the time of departure and rate of speed of the train at stations along the route.

ELECTRIC BELL. J. W. Holdsworth, St. Louis, Mo., 575,156. Filed April 9, 1896.

A stationary electro-magnet is combined with a coil wound upon a vibrating armature.

Conductors, Conduits and Insulators:—

CLEAT. C. F. Adams, Trenton, N. J., 575,090. Filed May 11, 1896.

Embodies a groove for the reception of the wire, the groove being provided with teats placed at an angle to the direction of the groove and to the wire.

ELECTRIC CONDUCTOR. H. T. Richards, Brooklyn, N. Y., 575,170. Filed Nov. 20, 1896.

A conductor provided with a braided covering, one of the threads of the braiding being thicker than the other to serve as a distinguishing mark when used with other conductors.

Dynamos and Motors:—

MEANS FOR ADJUSTING COMPOUND WOUND DYNAMOS. B. G. Lamme, Pittsburg, Pa., 574,914. Filed Dec. 28, 1893.

Consists in varying its compound effect, while maintaining a constant resistance between its terminals.

DIRECT CURRENT DYNAMO ELECTRIC MACHINE. M. Hutin and M. Leblanc, Paris, France, 575,115. Filed Feb. 12, 1894.

Of the closed circuit armature type, provided with a commutator having a lesser number of segments than there are armature sections, and means for rotating the commutator at a proportionally higher speed than the rotor.

DYNAMO ELECTRIC MACHINE. G. L. Campbell, Kinsman, O., 575,210. Filed Oct. 8, 1895.

Comprises supports movable toward and from the armature, field magnets pivotally carried by the supports, and means for holding the field magnets in position.

STATIC GENERATOR. A. J. Gawne, Sandusky, O., 575,231. Filed Oct. 10, 1896.

Of the "Wimshurst" type.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. R. O. Hood, Danvers, Mass., 574,905. Filed July 6, 1896.

Comprises a mass whose expansion under the action of the electric current separates the carbons employed therein and a magnet in series with the arc for feeding the carbons toward each other when the current flowing across the arc is at a predetermined value.

GAS FIXTURE. E. A. C. Kaysel, New York, 574,907. Filed June 24, 1896.

The electric conductors are carried in the same pipe with the gas.

ILLUMINANT FOR INCANDESCENT LAMPS. A. De Lodyguine, Pittsburg, Pa., 574,002. Filed Jan. 4, 1893.

A filament composed of an incandescent metallic body and containing a conducting fillet of different material.

ELECTRIC CURRENT REGULATOR. W. Hawker, Windsor Mills, Canada, 575,235. Filed Sept. 25, 1896.

Adapted for use with incandescent lamps.

Miscellaneous:—

ELECTRIC CIGAR LIGHTER. J. W. Dawson, Louisville, Ky., 574,889. Filed Aug. 17, 1895.

Combines a cigar cutter, lighter and advertising device.

ELECTRIC CALENDAR CLOCK. G. W. MacKenzie, Beaver, Pa., 574,922. Filed Dec. 28, 1895.

Secondary clock, details of construction.

ELECTRIC VALVE APPARATUS. J. V. Stout, Easton, Pa., 575,045. Filed June 7, 1892.

Intended for steam valves.

BICYCLE ELECTRIC BELL. H. B. Ewbank, Jr., Baltimore, Md., 575,059. Filed May 18, 1896.

Means whereby all the parts may be mounted on the handle bar so that all shall remain immovable to each other.

ELECTRICALLY OPERATED PIANO ATTACHMENT. E. G. Simpkins, Toledo, O., 575,072. Filed Dec. 26, 1895.

An attachment whereby any particular key may be operated to give a predetermined tone, and at the same time the hammer mechanism may be controlled to give the desired volume of tone.

AUTOMATIC ELECTRIC MARINE SOUNDING APPARATUS. J. F. Babcock, Bangor, Me., 575,093. Filed March 11, 1896.

Details of construction.

MANUFACTURE OF CASTINGS. A. E. Hunt, Pittsburg, Pa., 575,115. Filed Sept. 21, 1896.

Consists in heating the metal by first passing a current of electricity through the conductive material of the mold and substantially through the entire length of the mold, and then progressively shortening the portion included in the electrical circuit.

APPARATUS FOR STOPPING ENGINES. G. W. Brown, West Newbury, Mass., 575,144. Filed Oct. 4, 1895.

Comprises a vent controlling valve, an actuator therefor, an armature serving as a detent normally restraining the actuator, and speed controlling means actuated by the power of the engine to displace the detent by the centrifugal force.

Measurement:

ELECTRIC METER. J. Hessberger, Niedersedlitz, Germany, 574,903. Filed Aug. 10, 1895.

Comprises means for producing a magnetic field, a bismuth conductor movable in the field and indicator connected with the bismuth conductor.

Railways and Appliances:—

ELECTRIC RAILWAY. L. Dion, Natick, Mass., 575,053. Filed Dec. 30, 1895.

Closed conduit system.

ELECTRICAL PROPULSION FOR RAILWAY CARS. L. Dion, Natick, Mass., 575,054. Filed Feb. 27, 1896.

Embodies a main electrical conductor having its upper surface grooved longitudinally, and a flexible, helically formed auxiliary electrical conductor adapted to normally rest in the groove of the main conductor.

TROLLEY HEAD FOR ELECTRIC CARS. W. S. Troutwine, Indianapolis, Ind., 575,080. Filed May 22, 1896.

A trolley head in which the wheel can be removed and a scraper inserted in its place, and to provide a scraper that can be quickly applied and that will be effective in removing ice and sleet from the wires.

TROLLEY STAND. J. E. Bishop, Indianapolis, Ind., 575,099. Filed Aug. 22, 1896.

Details of construction.

ELECTRIC RAILWAY. G. W. C. Lomb, Birmingham, Ala., 575,303. Filed Feb. 18, 1895.

The conductor is enclosed in an isulating tube and contact is had with the trolleys through contact-pieces embedded in the tube by the collapsing of the tube upon the passage of the trolley wheel.

ELECTRIC LOCOMOTIVE. William L. Silvey, Dayton, O., 575,314. Filed Nov. 7, 1895.

Details of construction.

Switches, Cut-Outs, Etc.:—

COMBINED RHEOSTAT AND REVERSING SWITCH. J. P. B. Fiske and C. P. Smith, Alliance, O., 574,896. Filed March 18, 1895.

Designed for controlling motors for propelling vehicles.

CONTROLLER FOR ELECTRIC MOTORS. H. P. Davis, Pittsburg, Pa. 574,885. Filed Dec. 3, 1895.

Controller of the commutator type especially applicable in crane and elevator work.

OVERHEAD ELECTRICAL KNIFE SWITCH. J. Menchen, Kansas City, Mo., 574,926. Filed Feb. 25, 1896.

A knife switch provided with pivotal terminals and retractile springs connected with each pair of pivotal terminals.

ELECTRIC QUICK BREAK SWITCH. A. H. Armen, Philadelphia, Pa., 575,047. Filed March 30, 1896.

Comprises a switch lever and push button working in planes perpendicular to each other, with a button arm auxiliary to the button and a spring working between the switch lever and button arm.

SYSTEM OF LIGHTNING PROTECTION FOR ELECTRIC CIRCUITS. A. Wurts, Pittsburg, Pa., 574,987. Filed July 19, 1893.

Combines a source of current, translating devices, and a line circuit provided at suitable intervals with underground inductive resistances, the resistances serving to dissipate static charges by transforming their energy into heat.

DEVICE FOR PROTECTING ELECTRIC CIRCUITS. A. J. Wurts, Pittsburg, Pa., 574,979. Filed Oct. 2, 1895.

The combination with a lightning arrester of a choke coil provided with a slotted strip of insulating material in contact with several of the turns thereof, a conducting strip of the insulating strip and an insulating covering for the parts.

Telegraphs:—

PRINTING TELEGRAPH. B. Hoffmann, Paris, France, 574,994. Filed July 17, 1895.

Comprises a transmitting keyboard, a receiving mechanism, a call bell, and a series of switches for effecting different circuit connections, the two stations being connected by a single line wire.

REPEATER. W. M. Chapman, Needham, Mass., 575,025. Filed Dec. 12, 1895.

"Non-interfering" repeater.

Telephones:—

TELEPHONE. C. C. Gould, Philadelphia, Pa., 574,901. Filed April 29, 1895.

Comprises a diaphragm, rolling electrode and a plate provided with outwardly projecting pointed arms having beveled edges for the accommodation of the rolling electrode.

SIGNALING APPLIANCE FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 575,131. Filed Nov. 4, 1895.

Comprises a plug circuit, a calling key in the plug circuit and a generator of signaling current having the terminals of its armature connected with switch contacts of the calling key, and a ground connection to the middle point of the active wire of the armature.

TELEPHONE SYSTEM. J. H. Weckel, Breakabeen, N. Y., 575,186. Filed March 7, 1896.

Means for connecting any one of a series of branch lines in circuit with stations on the main line either above or below the points of exchange.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JANUARY 19, 1897.

Alarms and Signals:—

RAILROAD SIGNAL. W. F. French, Omaha, Neb., 575,601. Filed April 23, 1896.

A railway track signal adapted to be sounded by the wheels of a train moving in one direction only, being idle when encountered by a train moving in the opposite direction.

PUSH BUTTON. C. O. Mailloux, New York, 575,528. Filed June 4, 1896.

Comprises the contact mechanism in a push button, a case enclosing the same, the circuit terminals of the mechanism located exteriorly to the case, and a removable face plate covering the terminals.

Batteries, Primary:—

TELEGRAPH BATTERY JAR. A. L. Werner, Delano, Pa., 575,449. Filed June 29, 1896.

Provided with an integral spout and having its rim formed into outwardly projecting hand grasp flanges which extend almost around the jar.

Connectors, Conduits and Insulators:—

WIRE COUPLING. W. Gerard and J. H. Lawrence, Bond Hill, Ohio, 575,641. Filed November 23, 1896.

Consists of a sleeve having a bore at each end, two serrated jaws in each bore adapted to engage the end of a wire.

Lamps and Appurtenances:—

INCANDESCENT LAMP SOCKET. R. B. Benjamin, Chicago, Ill., 575,322. Filed March 16, 1896.

Means for mounting the socket upon the conduit carrying the conductors.

CLUTCH FOR ARC LAMPS. E. Finkbeiner, Brooklyn, N. Y., 575,341. Filed July 27, 1896.

Details of construction.

ILLUMINANT FOR INCANDESCENT LAMPS. A. De Lodyguine, Pittsburg, Pa., 575,668. Filed April 10, 1894.

Consists in imparting the desired shape to a conducting fillet, immersing the fillet in a mixture of hydrogen and a gaseous chlorin compound of a refractory metal, and heating the fillet while so immersed.

Miscellaneous:—

ELECTRICALLY ILLUMINATED JUGGLERY APPARATUS. M. Cronin, London, England, 575,332. Filed October 30, 1896.

Consists in jugglery apparatus containing electric glow lamps and battery in the interior of a partly transparent outer frame.

DEEP-SEA ELECTRIC CURRENT METER. C. L. Berger, Boston, Mass., 575,455. Filed September 28, 1896.

Comprises a rotator, its shaft bearings therefor and electrical make-and-break devices, combined with an oil-well for the latter, the make-and-break devices being mounted in the upper portion of the oil-well and the latter having an extended lower portion open freely below the make-and-break devices.

FLOATING TRACTION DEVICE. T. P. Milligan, Cambridge, Md., 575,488. Filed March 26, 1896.

A rail adjacent to the surface of the water, a boat carrying a suitable motor, a traction device connected with the motor and provided with rolls arranged to grip the rail, and a suitable connection for towing the load.

APPARATUS FOR PURIFYING OR DISINFECTING. E. Hermite, Paris, France, 575,645. Filed January 17, 1894.

Consists of electrolyzing a solution containing chloride of magnesium and subjecting the material to be disinfected to the action of the electrolyzed solution.

ELECTRICAL CONDENSER. J. C. Lee, Brookline, W. R. Westcott, Cambridge and E. C. Robes, Medford, Mass., 575,653. Filed July 8, 1896.

Consists in winding strips of the material constituting the plates and of the dielectric, in layers onto a flattened roll, and in subjecting it to pressure whereby the material of the dielectric is caused to yield, and the strips constituting the plates and dielectric are brought into intimate contact and caused to cohere, thereby forming the roll into a thin, flat rectangular solid having rounded ends.

GALVANIC ATTACHMENT FOR EYEGLASSES. A. Mayer, New York, 575,658. Filed June 3, 1896.

Comprise contact batteries to produce a therapeutic current.

MAGNETIZING BOX. C. A. Hussey, New York, 575,679. Filed August 10, 1895.

A containing case having a metallic bottom and magnetized upturned ends.

Railways and Appliances:—

ELECTRIC RAILWAY. W. Grunow, Jr., Bridgeport, Conn., 575,346. Filed October 28, 1895.

An underground conduit for a conductor which employs a depressible rail on which the trolley bears so as to be brought into contact with the conductor.

ELECTRIC RAILROAD. W. Jens, Johnstown, Pa., 575,354. Filed June 30, 1896.

A portion of metal similar in nature to the metal of the bond-bar, integrally united to the rail and adapted to have the bond bar attached to it.

RAIL BOND AND CONNECTION. M. K. Bowen, Chicago, Ill., 575,388. Filed October 9, 1895.

A bond of relatively small cross section having enlarged ends in contact with the rail.

SERIES MULTIPLE CONTROLLER FOR ELECTRIC MOTORS. E. M. Bentley, Lawrence, N. Y., 575,454. Filed November 13, 1896.

Comprises a shunt for the two motors containing a resistance, an automatic circuit breaker placed in the series circuit between the two inner terminals of the shunts and dependent on the volume of current passing therein.

ELECTRIC MOTOR AND DEVICE FOR CONDUCTING CURRENTS THERETO. D. N. Osyor, Columbus, Ohio, 575,615. Filed October 17, 1889.

Adapted for use in motor cars in mine railways.

Regulation:—

ELECTRICAL CONTROLLER. W. H. Morgan, Alliance, Ohio, 575,366. Filed September 4, 1895.

Comprises an open main frame, an annular open frame within the main frame, and an annular series of resistance coils spaced apart and supported on the annular open frame.

ELECTRIC ELEVATOR OR HOISTING MACHINE. R. M. Hunter, Philadelphia, Pa., 575,479. Filed April 5, 1894.

MEANS FOR OPERATING ELECTRIC MOTORS. J. F. McLaughlin, Philadelphia, Pa., 575,490. Filed September 1, 1891.

Comprises a clutch for coupling the motor to the work, a brake for the motor armature, and connections between the clutch and armature brake for operating them in succession.

ELECTRICAL CONTROLLING APPARATUS. O. H. & A. F. Pieper, San Jose, Cal., 575,573. Filed December 19, 1895.

Adapted for controlling motors operating dental apparatus.

Telegraphs:

TELEGRAPHY. P. B. Delany, South Orange, N. J., 575,419. Filed April 21, 1896.

Feed mechanism for tapes in printing telegraphs.

Telephones:—

MAGNETO TELEPHONE. S. D. Field, Stockbridge, Mass., 575,394. Filed August 11, 1896.

Adapted to be used as a receiver.

COUNTER E. M. F. REGULATION OF ELEVATOR MOTORS.

A patent has just been issued to Mr. R. M. Hunter, No. 575,479, January 19, 1897. This patent, it is claimed, covers the method of controlling elevator motors by means of a counter e. m. f. device.

REPORTS OF COMPANIES

A WINTER CHILL.

It is well, on the whole, that a recovery should not go too fast, and for such a reason the slight irregularity and reaction in Wall street last week may be regarded with equanimity. Disquieting rumors were afloat as to some of the railroads, but nothing happened to justify them, and the undertone of the market in general was strong, the ease in money being reflected by the low rate for loans and the activity in the bond market. In industrial circles quietude and a waiting policy prevailed, though nobody seems to know why. Bradstreet's says that while trade is proceeding on conservative lines the volume is slowly increasing.

In New York, electrical stocks show a slight decline, General Electric having opened the week at 35½ and falling to 34⅛, on sales of 18,326 shares; while Western Union on sales of only 6,967 shares ranged during the week between 86 and 83⅞. In Boston, American Bell, however, showed a decided gain from 209½ to 213, but only 842 shares were sold, or less than 150 per day.

The New York Edison Co.'s annual report makes a most excellent showing, and is evidence of the general betterment of local companies. Its gross earnings for the year were $2,247,437, its net $1,080,156, and its gain in balance after providing for bonds, 6 per cent. dividends and depreciation, no less than $158,976. The gain in gross business over 1895 was $246,581, and in net $102,105.

REORGANIZATION OF THE ST. LOUIS EDISON CO.

The Edison Electric Company, St. Louis, which has long been burdened by the interest charges it had to pay on its $4,000,000 bonded indebtedness, is said to be seeking relief in the shape of a reorganization, of which the scheme is that the interest-bearing coupon, due February 1, is not to be paid. Each holder of a $1,000 6 per cent. bond is to be offered a new $500 4 per cent. bond, and 10 shares of preferred and 10 shares of common stock in the reorganized concern. This would reduce the bonded indebtedness by $2,000,000 and the annual interest charge from $240,000 to $100,000.

T. J. MURPHY & CO.—Schedules of T. J. Murphy & Co., manufacturers of electrical supplies at 511 West Thirteenth street, New York, show liabilities of $6,806, nominal assets of $10,293, and actual assets of $8,347.

W. C. WHITNEY'S COMPRESSED AIR COMPANY.

A certificate has been filed with the County Clerk by the Compressed Air Power Company, showing that one-half of its stock of $1,000,000 has been paid in. The directors of the company are: William C. Whitney, Thomas J. Ryan, Frederick S. Pearson, William W. Cook, and William L. Elkins.

ENCLOSING THREE DOLLARS.—A St. Louis reader is kind enough to write: "I have been buying your good-for-nothing, no account sheet from news dealers for over four years, and I intend to stop doing so. My reason is that I have become convinced I cannot get along without it, as I consider it the best paper for a street railway man. I herewith enclose $3 for one year's subscription. I can testify that the Engineer has been worth more to me than the $5.20 per year that I have been paying for it."

TRADE NOTES & NOVELTIES

ISOLATED LIGHTING PLANTS OF C. & C. 4-POLE COMBINATIONS.

THE combination of C & C dynamos and engine, illustrated in the accompanying engraving, is specially designed for small isolated lighting plants, such as steamer and house lighting, and wherever space and weight are important factors. Standard flange couplings connect the dynamo to the engine, the entire combination being securely bolted to a sub-base. Perfect alignment is thus insured, while at the same time this arrangement facilitates the repairing of both the engine and dynamo; in fact, they are absolutely independent of each other.

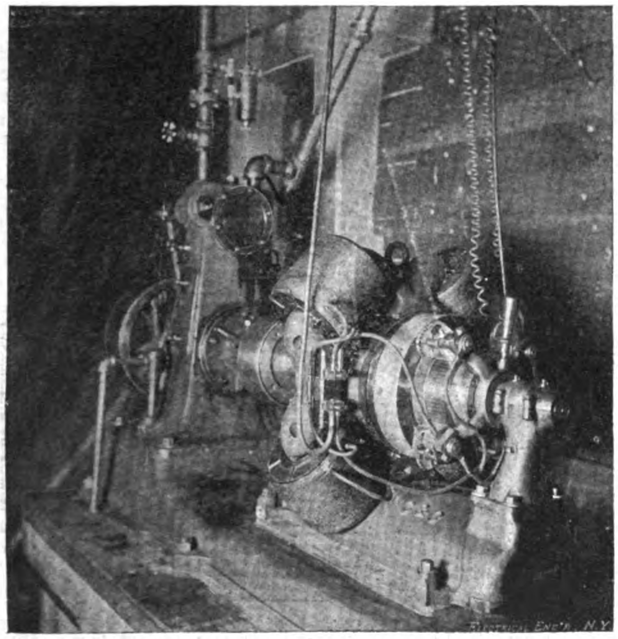
The speeds of these combinations, which are built in various sizes, are based on 80 pounds pressure one-quarter cut-off, and, with the compound-wound dynamo, permit of excellent regulation, producing a steady light, unaffected by load changes.

The temperature increase is less than 40 deg. Centigrade under full load in continuous service.

The material and workmanship are first-class, and the combination is of handsome appearance, as shown in the accompanying engraving.

The C & C Co. also build a 4-pole motor of a type similar to the generator illustrated.

The armatures are of the ring type, designed to secure good ventilation and low heating effect. The windings are ample, and the commutators especially have large surface area and brush contact. The insulation throughout is of the best, insuring long life.



C & C 4-POLE COMBINATION.

The mechanical construction is very rugged and the bearings are self-oiling, making these machines well adapted for hard usage.

The C & C Co. recommend this type of motor as being economical, smooth running, of high efficiency and of large starting torque, making it specially adapted for direct connected elevator work or printing press driving, and whenever countershafting is objectionable.

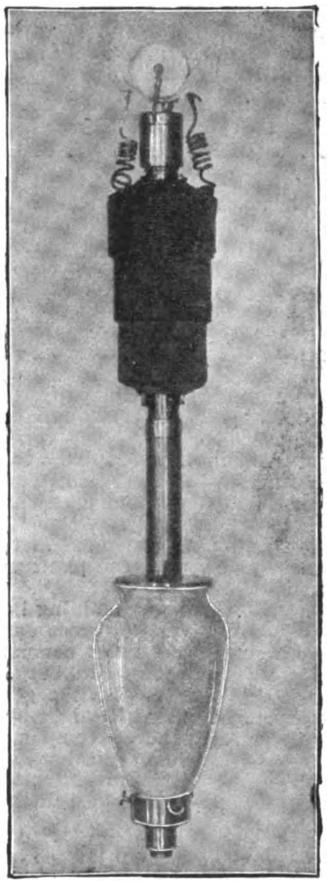
MR. F. S. PALMER, general manager of the Electric Heat Alarm Company, 145 High street, Boston, reports closing a very nice contract for an equipment in a coal pocket belonging to the City and Suburban Railway Company, Baltimore, to be installed under the supervision of the electrical engineer, Mr. P. O. Keilholtz. The outlook for this thermostatic appliance is excellent.

THE UPTON LONG-BURNING ARC LAMP.

AS is frequently the case when a departure from the customary types of an apparatus is brought out, the desire to be early in the field leads to the placing on the market of devices which are not always reduced to the simplest elements.

Believing that the simplest lamp with the fewest parts to wear or mechanism to get out of order, one that would combine steadiness and economy of light with a minimum of attention from the user in order to operate successfully, would most surely and satisfactorily meet the requirements of the case, the makers of the Upton Long Burning Lamp have kept these points most prominently in mind. Now that their lamp is perfected and on the market, they with good reason claim that the result has justified the wisdom of their course, in postponing its appearance until perfection had been attained.

The description of the Upton Long Burning Lamp below shows that it is an entirely new departure in arc lamp manufacture. There is absolutely no mechanism in its make-up, such as gears, clutches, chains or ribbons; in fact, all appliances which will wear, gum or stick and require cleaning or adjustment are entirely dispensed with in this lamp. All that is used is electricity and gravity. The current flowing through the solenoid magnetizes the armature, to which is attached the carbon, draws and holds the arc, and as the carbon is consumed the force of gravity maintains a positively steady and constant feed.



THE UPTON LONG-BURNING ARC LAMP.

The frame of the lamp is a brass pipe, threaded at both ends, over which is fitted the solenoid or magnet. This magnet is perfectly ventilated and machine wound, each layer of wire being coated with an insulating paint as the winding progresses, and the whole when completed baked to withstand a temperature of 400 degrees Fahrenheit; then it is tested at 1,000 volts pressure for leaks and short circuits, thus insuring a coil that will not burn out from any heat generated in the lamp.

The armature which is the only moving part of the lamp, is an iron pipe, which acts as carbon rod, holding the carbon at its lower end. A cast flange threaded on the outside is screwed to the bottom of frame and fits into a threaded ring attached to the inner globe, by which it is supported and completes the sealing of globe, thus forming an airtight joint at the top.

The lower carbon holder is fitted to the inner globe, by which it is supported and completes the sealing of the lamp.

In the lamp for outdoor service, the resistance and switch are fitted inside the hood. For indoor use the resistance is fitted on the cover at the top of the outer globe, provided in both cases with a changeable cut-out enabling the lamp to burn on any voltage desired from 85 to 125 volts.

The makers can furnish the lamp to consume from 3¾ to 5 amperes, as desired.

After the lamp is once in position, the labor of trimming is reduced to a minimum. When the outer globe is lowered, one turn of the ring of the inner globe holder and the same is unfastened; another turn of a thumb screw and the lower carbon is ready to be removed. The unused portion of the positive carbon is then placed in the lower carbon holder and a new 12-inch carbon placed in the upper holder, the latter forced up as far as it will go, the inner globe and lower holder replaced with a turn of the ring and screw, and the lamp is ready for current again.

The lamp is absolutely steady in operation, gives a white light without any shadow, as there is no lower frame extending into the globe to cause this objectionable feature; burns on the amperage for which the magnet is wound from the moment the current is turned in and does not vary.

The Standard Thermometer and Electric Company, of Peabody, Mass., who manufacture the Upton lamp, invite correspondence and will cheerfully give any further information that may be desired.

LARGE ORDERS FOR THE BALL ENGINE.

The vertical engines built by the Ball Engine Company, of Erie, Pa., for electric service have been received with favor by those who appreciate merit and good workmanship in an engine. Since October 1 last, these works have been running till 10 o'clock every night, and part of the time all night, on account of several large contracts received for vertical engines. Some of these orders are just being completed. Among these is a 400 horse-power vertical cross compound engine, arranged for direct connection to a 225 kilowatt Siemens-Halske generator, whcih was shipped a few days ago to the Nicopol Mariopol Mining and Metallurgical Company, Mariopol, Russia, and will furnish electric power to various machinery in the steel works mentioned.

The company will ship in a few days to the Chicago Public Library four 200 horse-power vertical cross compound and one 100 horse-power vertical tandem compound engine, each engine being direct connected to two General Electric Company machines. The form of arrangement and the details of these engines are entirely new, and the plant when erected will be a very complete one.

Besides the above, there are building in the works at present one 400 horse-power vertical cross compound engine, and one 150 horse-power vertical cross compound engine, for the Shoenberger Steel Company, of Pittsburg, Pa., each of which is direct connected to Siemens-Halske generators.

Also for the Apollo Iron and Steel Company, of Apollo, Pa., one 150 horse-power vertical cross compound engine direct connected to a General Electric alternating lighting machine, both the dynamo and exciter being driven from the shaft of the engine, and arranged on the same base with the engine.

PROMPT WORK BY THE WAGNER CO.

Mr. E. H. Abadie, manager of the sales department of the Wagner Electric Manufacturing Company, St. Louis, sends us the following note, which indicates laudable swiftness in executing a hurried request for apparatus:

An order was recently secured by us aggregating over 7,000 lights capacity in standard transformers; the requirements of the sale were immediate delivery. We received the order over the Long Distance Telephone located in our office at five o'clock on the evening of January the 13th. For transporting this order one of the largest cars was required, with an ability to carry thirty odd thousand pounds. By ten o'clock on the 14th of January the car was loaded, it left that evening at four o'clock for Chicago and was delivered the following morning at seven o'clock. The following is a copy of part of a letter from the purchaser, and you will note his appreciation of our prompt attention to his order: "You are certainly to be congratulated upon the promptness in filling and shipping the order and it occurs to us that the ability of a manufacturing company to so promptly respond to urgent requests for so large transformer capacity is a good argument for the use of their make of transformers. We do not understand that any other one manufacturer was prepared to accept the order and guarantee delivery within the time required." Our ability to make prompt shipment has resulted in a great deal of business.

THE QUEBEC ELECTRIC RAILWAY.

The contract for the complete rolling stock of the Quebec Electric Railway, including cars, motors, etc., has been awarded to Ahearn & Soper, of Ottawa. The system at Quebec will be as nearly as possible a duplicate of that at Ottawa which is recognized as a model. The motors used will be of Westinghouse make, and will be specially adapted for the grades which exist at Quebec.

DIRECT-CONNECTED PRINTING PRESSES IN MILWAUKEE, WIS.

PROBABLY one of the most completely arranged printing establishments in the West is that of the Germania Printing Company, Milwaukee, Wis. Their new home consists of a massive eight-story stone and brick structure of Italian renaissance style. It is the home of one of the largest and wealthiest publishing houses in the West. The president is Mr. George Brunder, one of Milwaukee's solid old pioneers, who has accumulated a large fortune by his industry and honesty. His name is familiarly known throughout the West among leaders of Western journalism. Electric drive has been adopted for all the machines, presses and elevators in this building. The contract for the equipment of these presses and machines with motors has been awarded to the Northern Electrical Manufacturing Company, of Madison, Wis., for direct connection of a "Northern" spherical steel invertible motor to each separately. It has been the desire of the engineer in charge of this building (A. M. Patitz, of Milwaukee), to make it the most complete electrically of any printing establishment in the West. Simplicity and substantiality in design, economy in operation and high efficiency of all machines are the salient features. The basement and two top floors are for the presses, typesetting and bookbinding machines, direct connected to "Northern" electric motors. The intermediate floors are offices, single and en suite, to meet any requirement and furnished with every modern convenience. We understand there were a large number of bids presented for the large electrical equipment of this building, and the Northern Electrical Manufacturing Company were certainly very fortunate in securing the work. This company started in a small way about two years ago, but, unlike most small concerns, they are fortunate in the possession of very strong financial backing, thus enabling them to enlarge their facilities as their business increases. They have already gone into large new shops fully equipped with a fine line of machine tools adapted to the specialties which this company has taken up and the entire shop is electrically driven.

MORTON & SMITH.

Messrs. D. G. Morton and Julian C. Smith, both of Baltimore, have formed a partnership to carry on a general engineering and contracting business, with offices in the Law Building, that city. Mr. Morton was formerly in the employ of the Southern Railway as assistant engineer of construction, and later with the B. & O. as supervisor of the Philadelphia Division. Mr. Smith has been engaged for a number of years on street railway construction work in Baltimore and Washington as assistant to Mr. A. N. Connett, and was superintendent of the Metropolitan Conduit electric road in the latter city. The new concern will make a specialty of electric railways, but will undertake electric lighting and other work.

ADVERTISERS' HINTS

THE C. McINTIRE COMPANY, 13 Franklin street, Newark, N. J., continue to supply the large demand for their patent connectors, terminals, fuse wire, links and strips.

DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., are furnishing the Diehl electric motors directly coupled to the Wing, Blackman and American Blower Co.'s exhaust fans. They are wound for any direct arc or incandescent current and are furnished with three-speed regulators.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, direct notice to their apparatus for small isolated lighting plants and also to their C & C 4-pole combinations for all direct connected power work.

NON-SPARKING, FLEXIBLE COMMUTATOR BRUSHES are manufactured by Charles Wirt, 1028 Filbert street, Philadelphia.

THE NORTHERN ELECTRIC MANUFACTURING COMPANY, Madison, Wis., have been devoting special attention to direct-connection of motors upon all kinds of machinery. Their spherical steel invertible type is particularly adapted to this service.

THE NATIONAL PIPE BENDING COMPANY, New Haven, Conn., have sold over 700,000 horse-power of the National feed water heaters during the last ten years, and they may justly be proud of such a record.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, are American agents for Felten & Guilleaume's steel music wire, for which they claim high tensile strength and absolute uniformity. They carry every kind of spring wire.

THE STANDARD THERMOMETER COMPANY, Peabody, Mass., have recently brought out the Upton long-burning arc lamp for direct current, low potential circuits. Among the advantages they claim for it are no mechanism, no parts to gum or wear, no shadow, no carbon and no guide rods to clean and polish.

FRED M. LOCKE, Victor, N. Y., is manufacturing a large variety of insulators of china and glass for all purposes. These insulators have been tested up to 70,000 volts and he has received some strong testimonials as to their efficiency.

RILEY BROS., 16 Beekman street, New York, are exploiting their new kineoptoscope for depicting every movement of actual life on a screen. Besides these they carry a full line of magic lanterns and all the accessories pertaining thereto.

THE GENERAL ELECTRIC COMPANY publish a table illustrative of the application of electric transmission in power work and show very clearly the enormous scope of their installation in this field.

THE AMERICAN TECHNICAL BOOK COMPANY make a very advantageous offer to those desiring to secure some valuable work in electricity.

NEW YORK NOTES.

COLONEL BOOKER, of the Phœnix Carbon Manufacturing Company, of St. Louis, Mo., has been in the East for the past week, renewing his many friendships, and making many new ones.

THE GOULDS MANUFACTURING COMPANY, 16 Murray street, New York City, have issued a very neat little pamphlet, tastefully illustrated, in which the good points of their triplex electric pumps are cleverly pointed out. The increased use of such appliances is large and remarkable.

HUEBEL & MANGER, 278 Graham street, Brooklyn, have sent us one of their combined pin cushions, thimble holders and paper weights. It illustrates the variety of metal work which Huebel & Manger are making outside of that which is purely electrical. The present device is ornamental in appearance and extremely useful, and with the exception of the thimble holder is an adjunct to a business man's desk, or omitting the function of a paper weight it will be found useful in the household.

THE FUEL ECONOMIZER CO., of Matteawan, N. Y., will be glad to send to those interested the pamphlet on their economizer, which has now been adapted to upwards of 150,000 boilers in Europe and America. It is profusely illustrated, the pictures including a reproduction in colors of the apparatus in actual use. It enters fully into the use and benefit of the economizer, explains the details and gives a variety of data as to the methods of operation. Different arrangements are shown, and testimonials are given from several users, while the list of large plants is very long. One interesting section is that devoted to the saving effected by the economizer, accompanied by two tables of percentage of saving, which are nothing short of astounding.

MR. D. G. SCOTT, who for some time past has been connected with the American Electrical Works, is now representing in New York City the Crefeld Electrical Works of Boston. He covers this city and vicinity from his headquarters at 136 Liberty street, and will be glad of an opportunity to quote prices on all the Crefeld wires to his friends and all others needing such supplies. He believes that these wires should win a large market by reason of their quality and moderate price.

"TELEPHONE SERVICE AT WHOLESALE" is the title of an interesting pamphlet on the private branch exchange system of the New York Telephone Company. It shows very clearly how, for a moderate sum, the subscriber by this service can several times increase the efficiency and flexibility of his telephone line. It also points out the uses and advantages for such places as large apartment houses.

MR. E. CALDWELL, well known in electrical and street railway fields as a conscientious and successful journalist, has been called to the management of the Railway Advertising Company, which controls the car advertising in a great many cities and handles that for the big Metropolitan system in New York.

BALL & WOOD CO., who have won such an enviable reputation for their engines as to stand now in the very foremost rank for engines of moderate up to high speed, have taken new and larger offices in the Beard Building, 120 Liberty street, and will enter upon occupancy on February 1.

THE ALEXANDER-CHAMBERLAIN ELECTRIC CO., of 36 West Twenty-second street, New York City, has issued a couple of very pretty colored paper weights illustrative of the Siegel-Cooper "Big Store," and of the electric fountain that ornaments the ground floor.

JOSEPH DIXON CRUCIBLE COMPANY have sent us a beautiful box of pencils, with the compliments of the season, and we now use one appropriately, to indite a line in praise of their generosity and of the excellent quality of all their goods —bar none.

NEW ENGLAND NOTES

WILLIAMS, COUCH & WHITMAN, of 196 Summer street, Boston, have dissolved their firm by mutual consent, and the business will be continued by P. L. Whitman and S. H. Couch, under the firm name of Whitman & Couch, who are in line for active work in the electrical field and ask for a continuance of the old patronage.

MR. SAMUEL H. COUCH, of the firm of Whitman & Couch, of Boston, is at present traveling in the West in the interests of his firm, and will visit most of the independent telephone exchanges before his return. Whitman & Couch are sole selling agents in the United States for the Ericsson Swedish microphone, and have installed a large quantity of their telephones in many of the independent exchanges, railroad shops, office buildings, etc.

MR. G. W. DODGE, secretary of the Consolidated Insulated Tube Company, of Boston, informs us that their factory was recently destroyed by fire, but that they are getting into shape again as rapidly as possible.

THE COUNTIES OF OCEAN AND MONMOUTH, New Jersey, have just awarded the contract for a bridge, between Point Pleasant and Manasquan, to the Berlin Iron Bridge Co., of East Berlin, Conn. This bridge will be one of the longest highway bridges in the United States and is to be 1,910 feet in length. The Secretary of War has ordered a draw span in it, which will give two clear openings, one of 45 feet and the other of 50 feet. The Berlin Company's contract includes the substructure as well as the superstructure for the bridge.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., have gotten out a very neat calendar for 1897 setting forth the merits of the famous "O. K." line and house wires. On the back of the calendar is a table of weights and measurements to facilitate the convenience of those desiring to order wire by it. They can tell at a glance just how much they need.

WESTERN NOTES

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, has been given the General Western Agency for the Alcatrez electrical compound. This will interest all consumers of electrical compounds, and those not now using the Alcatrez will do well to give it a trial as it has been proved more than satisfactory. It will not scale, crack or burn, adheres tenaciously, and is proof against the action of the elements. The compound is made from the celebrated Alcatrez asphalt, and possesses many points of superiority.

THE ELECTRICAL ENGINEERING COMPANY, 311 Second avenue, South Minneapolis, Minn., have issued as their calendar for 1897 one of the most convenient and valuable memorandum books which we have received. It contains not only space for memoranda during the entire year of 1897, but contains also a yearly calendar for both 1897 and 1898, a table of over 300 cities of the United States, with their population, and another table showing the population of the individual States. Two pages are devoted to the signals of the weather bureau, and another page is devoted to the values of foreign coins in United States money. Then there are interest laws of all the States, and some rules for computing interest in a very handy fashion; two pages are devoted to information covering the United States postal laws, and one page to weights and measures. One contains a copper wire table and another a universal wiring rule, and there are several other pages of interesting and valuable information. Taken as a whole it is just the sort of a pocket book that everybody will find very useful at some time during the year.

UPTON ARCS.—The 100 and 150 hour direct current constant potential arc lamp is rapidly securing exclusive control of this particular field of arc lighting. The Electric Appliance Company as general Western agents for the Upton arc lamp, are glad to report that they will soon be able to supply their customers with a long-burning Upton arc lamp, which has many original features, the particular one being the entire absence of feeding or regulating mechanism. The experimental lamps turned out up to date have given splendid results.

THE ADVANCE ELECTRIC COMPANY is the recent successor of the late firm of McCurdy & Smith, and is situated in their old stand, 94 and 96 North Meridian street, Indianapolis, Ind., and is an incorporated stock company. Its officers are D. D. Smith, president; Harry B. Marsh, secretary and engineer; Charles H. Talmage, treasurer. This company has just put in a select stock of goods, and is prepared to do a wholesale, retail and construction business. Mr. Smith, of the late firm, has been retained in the management of the new.

THE BROOKS-FOLLIS ELECTRIC CO., of San Francisco, will hereafter supply the Pacific coast trade with the well known dynamo brushes manufactured by Charles Wirt, of Philadelphia.

MR. FRANK B. RAE, electrical engineer and expert, of Detroit, having been engaged by the city council of Des Moines. Ia., to draft plans and prepare specifications for a municipal lighting plant, has now submitted plans for a handsome station capable of supplying 500 arcs for the streets and 200 incandescents for the city hall and fire station.

KEELEY & BAURMEISTER, Randolph, Wis., are in the market for a 300-light incandescent plant. Mr. Bert C. Keeley operates the Randolph Roller Mills.

THE CARD ELECTRIC COMPANY, of Mansfield, Ohio, have issued a very neat and tasteful brochure which they entitle "A Few Testimonials." It comprises some fifty as handsome tributes of praise as we have had the good fortune to see. The Card generators, motors, automatic motor switches and work generally, receive the highest encomiums. Their apparatus has been applied to a wide variety of uses, and is found by all to be in every respect most satisfactory.

THE MISSOURI TELEPHONE MFG. CO., of St. Louis, are just completing an expensive toll line system through the central portion of Tennessee, connecting all the towns to Johnsonville and Britts Landing. This is one of the most extensive Toll Line Systems ever built in this country.

THE BIBBER-WHITE COMPANY CALENDAR for 1897, recently distributed, must prove as ornamental as useful to its possessors. The company's name is stamped in gilt letters on a small leather panel and near the bottom is inserted the calendar proper, which may be removed. Just below their name are the words, "Everything Electrical," brief but sufficient to describe their business. Since Bibber, White & Co.'s consolidation with the New England Electrical Supply Company, under the above name, they have been excellently equipped for the prompt execution of orders for "Armorite" insulated iron armored conduit, "I-T-E" circuit breakers and switches, iron clad rheostats and theatre dimmers, Crefeld wires and cables, and a full line of general electrical merchandise. They will be glad to quote lowest prices.

THE ARMORITE INTERIOR CONDUIT CO., of Detroit, Mich., manufacturing under the Cummings patents, have just issued a reduced price list of their conduits, elbows and couplings, which ought to be in the hands of every wiring contractor, architect and builder. The conduits are manufactured in sizes ranging from 13-32 to 2½ inches inside diameter.

"S.-M."—One of the most popular cut-outs sold is the "Sawyer-Man." This is a porcelain cut-out handled by the Metropolitan Electric Company of Chicago. It fills all the requirements of the underwriters, is a neat, simple, low-priced device that is giving universal satisfaction.

PHILADELPHIA NOTES.

THE S. S. WHITE DENTAL MANUFACTURING COMPANY, of Philadelphia, have issued for 1897 a memorandum calendar, which, while evidently intended for dentists particularly, is still applicable to any business. The arrangement covers the entire period of twelve months. Each page contains space devoted to each of the six days of the week, and in the upper left-hand corner is the calendar for the individual month represented. In the space devoted to each date is a single line given up to each hour of the day, from 8 a. m. to 5 p. m., so that the individual may make his engagements for the particular hour of the day without the risk of forgetting the particular time of his engagements. The pad is a convenient one and no doubt is already in large demand.

THE SOUTHERN ELECTRIC COMPANY of Baltimore after a test of the leading incandescent lamps on the market, have signed a contract to handle the Bryan-Marsh lamps exclusively.

MR. J. G. BIDDLE, Drexel Building, Philadelphia, sold 700 Weston instruments last year, and proposes to double it this year. You can help him.

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The Electrical Engineer.

Vol. XXIII. FEBRUARY 3, 1897. No. 457.

THE LEWIS INSTITUTE, CHICAGO.

BY PROF. C. W. CARMAN.

THE opening of Lewis Institute on September 21, 1896, added another educational institution to the list of those developed and fostered by the wealth of a self-made American citizen. Allen C. Lewis, a citizen of Chicago, acquired a fortune, which in the hands of the trustees amounted to nearly $2,000,000. It is stated that his resolution to found such an institution was determined upon after the death of a son who had just completed a technical education. Mr. Lewis acquired his fortune and was a resident of what is known as the West Division of Chicago, the location designated in his will for the Institute. It is located very nearly at the geographical center of the city and is within a short walk of the Metropolitan and Lake Street Elevated roads, and also several surface lines.

It was after much thought and investigation that the scope of the work to be done by the Institute was determined. While there is a large field in this country for institutions devoted to the finishing of the most advanced technical education, and for research work, it was deemed most in accordance with the will of the founder to look to the "greatest good to the greatest number." Accordingly the curriculum was broadened to embrace a liberal education as well as technical work in the arts and sciences. The course covers a period of six years, beginning with the student when he is thoroughly prepared to take up high school work. Great latitude is given to the mature student, who wishes to correct the defects in a partial education.

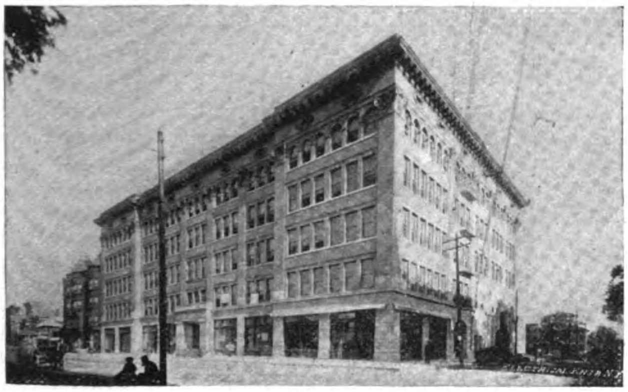


FIG. 1.—THE LEWIS INSTITUTE, CHICAGO.

A separate department for electricity has not been arranged for the reason that it is believed electricity is but a part of the general subject of physics, and that its study can be carried on as fully in that connection as in any other way. Physics is taught from the outset from a mathematical standpoint. It is believed that a student cannot take up the study of electricity with profit until he has a good fundamental knowledge of general science, algebra, geometry and trigonometry. He can then pursue the general experimental work with profit for two years, after which he may take up the subject from a technical standpoint.

The main building, Fig. 1, is 195 x 125 feet, and is six stories in height. The mechanical building is 90 x 50 feet, and two stories high.

The engines and dynamo, and boiler rooms are in the basement of the mechanical building. There are four tubular boilers, manufactured by S. I. Pope & Son. The engine room, Fig. 2, contains a 50 h. p. Skinner single acting engine which operates the ventilating system; a 60 k. w. Siemens & Halske generator, direct connected to a Ball & Wood compound engine; a 15 h. p. Western Electric motor, which operates the exhaust from the forge room, and a 3 h. p. Westinghouse motor, which operates the extra ventilating fan for the auditorium.

The first floor of the mechanical building is used for general instruction in wood-working and pattern making. A 7½ h. p. Crocker-Wheeler motor operates the lathes, an iron-cased Gibbs motor 7½ h. p. is belted to the planer, and a 4 h. p. Gibbs motor, iron-cased, is directly connected to a Barker Bros. combination circular saw. The second floor is used for metal work. The power is furnished by a 7½ h. p. Crocker-Wheeler motor.

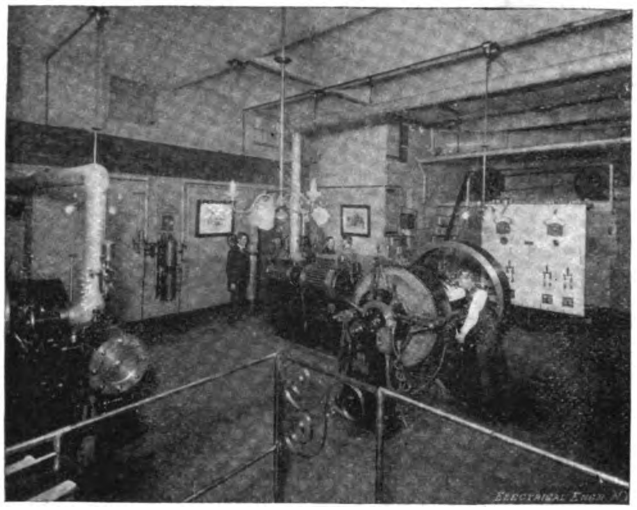


FIG. 2.—LEWIS INSTITUTE ENGINE ROOM.

The chemical department is located on the fifth floor of the main building and has three small Crocker-Wheeler motors connected to Sturtevant blowers, for the ventilation of the gas hoods. The eleven rooms at the west end of the fourth floor of the main building are occupied by the department of physics; one of these is shown in Fig. 3.

In the "General Physical Laboratory," the students' work is upon mechanics and the introduction to electrical measurements. Each table is provided with four slate-lined fuse boxes, which are connected to the switchboard by independent wires. The student prepares his apparatus on the table, after which he closes his circuits by means of flexible cord and plug switches. Five different currents may be obtained from the fuse boxes at the corners of the tables, as follows: A

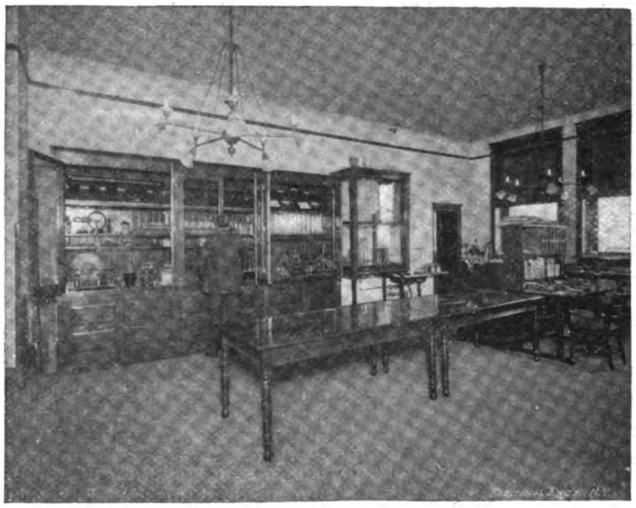
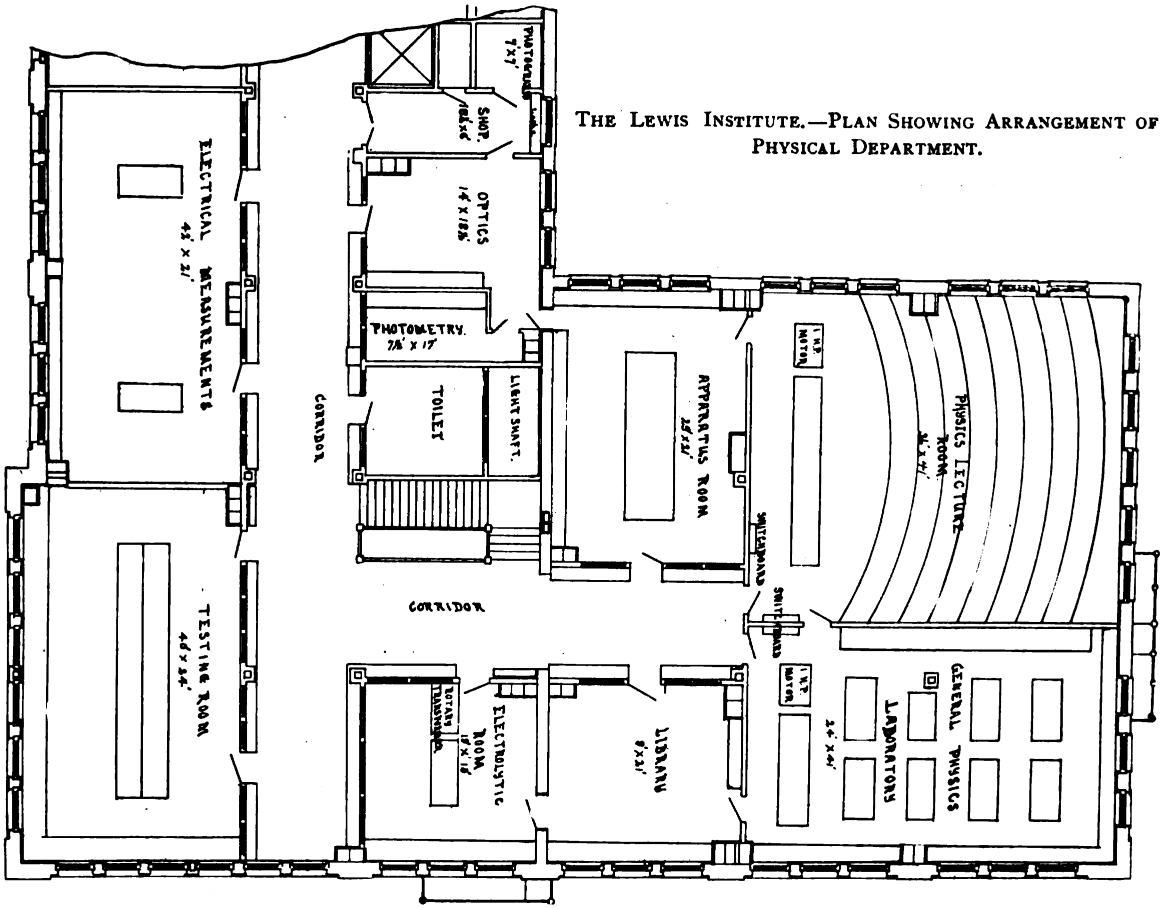


FIG. 3.—PORTION OF PHYSICAL LABORATORY.

110 volt and a 5 volt direct; a 5 volt single-phase, a 5 volt two-phase and a 100 volt three-phase. Transformers are provided by means of which a variety of other voltages are readily obtained. In addition to the usual measurements in resistance, induction, etc., the student is required to do quantitative electrolytic work.

The balance room is equipped with delicate balances for general work and six quantitative balances. If desired the student may take a practical course in electroplating. The photometric room is equipped with a Lumner-Brodhun photometer, besides the usual instruments. It is intended to give special attention to commercial work. A special room is equipped for Röntgen ray work.



The Lewis Institute.—Plan Showing Arrangement of Physical Department.

The laboratories are equipped not only with apparatus from our own country, but also from several well known foreign firms as follows: Hartmann & Braun, Dr. Edelmann, Franz, Schmidt, and Haensch, Hans Heele, Nalder Bros., Elliott Bros., Ducretet & Lejeune, Carpentier, etc.

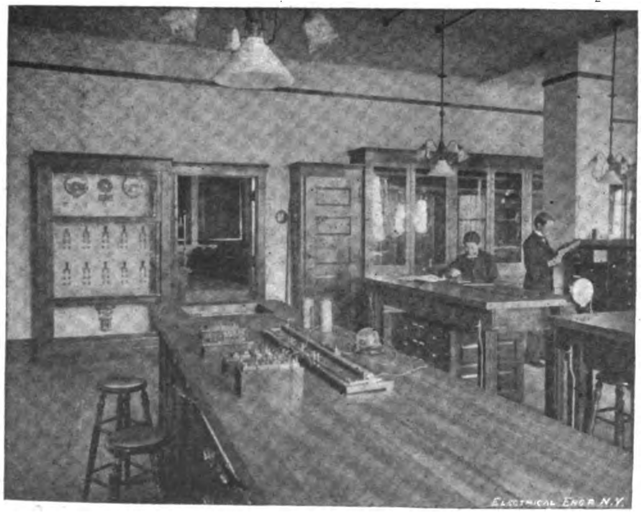


Fig. 4.—Portion of Physical Laboratory.

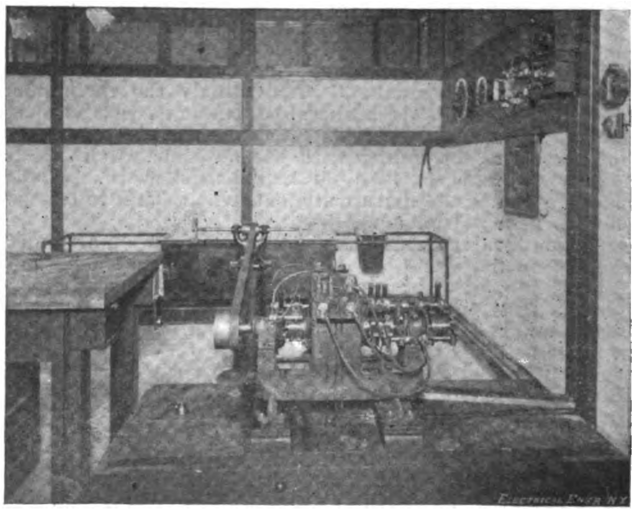


Fig. 5.—Electro Plating Bath, with Rotary Transformer.

Our engraving, Fig. 4, shows a portion of the general physics laboratory. The switchboard, seen at the left, distributes current to all the working tables. Besides the Weston volt and ammeter, it contains an automatic circuit breaker, manufactured by the Automatic Circuit Breaker Company, of Newaygo, Mich.

The wiring on the back of the switchboard, seen in the left of the previous figure, opens up as a piece of apparatus in the lecture room adjoining. Fig. 3 shows a portion of the apparatus used for lecture demonstration.

Figs. 5 and 6 show the "rotary transformer" designed for the Institute by Mr. A. Churchward, of the Excelsior Electric Company. It is really four machines in one. It is used as a motor, as a transformer of 110 volts to 5 volts direct, 110 volts to 5 volts single phase alternating, and 110 volts to 5 volts two-phase alternating current. These currents are distributed to all the testing rooms.

The four switchboards and the wiring for the 1,300 lights in the two buildings are the work of the Western Electric Company. There are fifteen different generators and motors in the buildings used in its operation, all of which may be used by students for test work.

There are about 400 students taking regular work during the day sessions, and about the same number attending class and lecture work during the evening sessions.

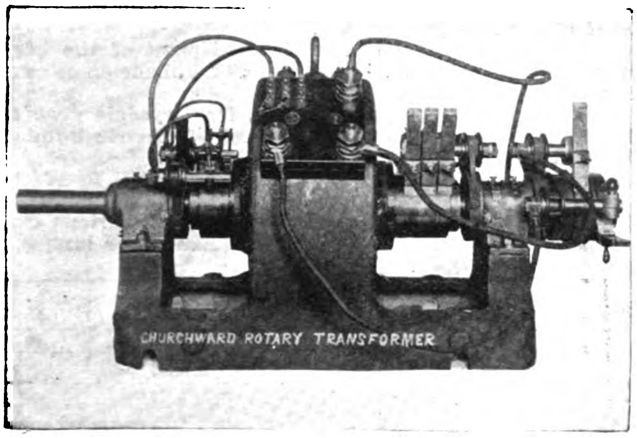


Fig. 6.—The Churchward Rotary Transformer.

Besides the regular work of the different departments, experts employed by the government are making investigations upon the impurities in the food supplies furnished to this district.

From twelve to one each day an elegantly appointed lunch room is open, where lunches, prepared under experts in domestic science and sanitation, are furnished at reasonable rates.

TORONTO, CANADA.—The plant of the Toronto Electric Light Co. has been visited by fire, alleged to be due to the short circuiting of one of the dynamos. The damage is about $75,000, covered by insurance. The city lighting was fortunately not interrupted for more than one night, several manufacturing companies shipping apparatus at once to maintain the service.

ELECTRIC LIGHTING

ELECTRICITY IN THE PENNSVLVANIA STATE HOSPITAL FOR THE INSANE, AT NORRISTOWN.

PHYSICIANS have from the very start recognized the great hygienic qualities of electric lighting, and sanitary institutions all over the world are rapidly adopting it. In retreats for the insane, especially where the exposure of naked lights has always involved danger due to the mischievous tendency of patients, the introduction of the electric light has relieved those in charge of much anxiety. We have in the past described a number of installations of this kind, but believe that a description of the plant and work performed by the electric installation at the Pennsylvania State Hospital for the Insane, at Norristown, will prove of more than ordinary interest, as it shows to what varied use an electric plant can be put in such institutions, while, at the same time, indicating the economy obtainable.

The hospital forms a collection of some twenty buildings of various sizes and at the present time accommodates 1,000 patients. The generating plant, illustrated in plan in Fig. 2, consists of three direct connected units, two of 100 k. w., with 16 x 16-inch engines, 250 revolutions, and one of 70 k. w., with a 13 x 12-inch engine, 270 revolutions. The engines are "Ideal" single cylinder non-condensing, made by the Harrisburg Foundry and Machine Works. The dynamos are multipolar, iron clad armature type, of General Electric Company's manufacture and designed for an overload of 25 per cent. above their normal rating. These machines are frequently driven at their maximum capacity, and are supplying their overload rating without abnormal heating or indication of structural weakness.

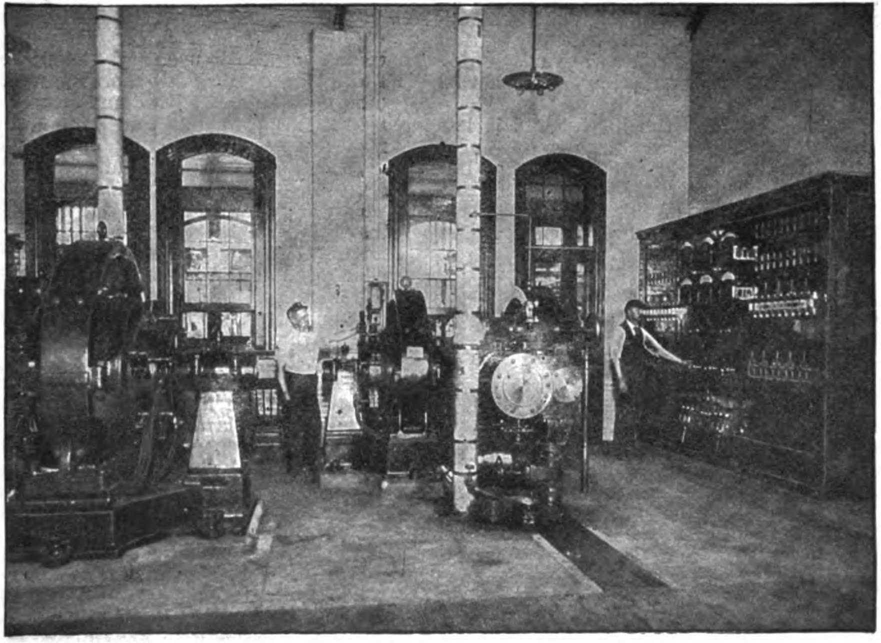


Fig. 1.—Dynamo Room, Pennsylvania State Hospital for the Insane.

The switchboard is constructed of black enamelled slate panels supported on angle irons and surrounded with a finished oak frame. The cables from the dynamos are carried under the floor in ducts and enter the board through three-pole switches, the center blade being the equalizer connection; each machine having an ammeter and voltmeter. From a switch on the board, a separate set of mains is carried through the underground ducts and tunnels to each of the different buildings, where they end at a center of distribution; from these points, pressure wires return to the board where they can be connected to a pilot voltmeter through a multiple point switch. Each circuit leaving the board is provided with a shunt and these connected to a switch and ammeter; the arrangement permitting pressure and current readings being made for any building or circuit at will. The power circuits are separate from the lighting mains, but are similarly connected to the board. All instruments are of the Weston illuminated dial pattern and specially designed for the work.

With the exception of the three steam engines operating the dynamos, the entire power of the institution is supplied by Crocker-Wheeler motors, the different departments being operated by individual motors, as follows: Printing office, 10 h. p.; bakery, 15 h. p.; carpenter and machine shops, 25 h. p.; laundry, general machinery, 40 h. p.; drying racks, 25 h. p. Although these motors have a constantly varying load and are in use at the same time as the lighting, the regulation of the engines and dynamos is so perfect that the variation of the voltmeters is never over one-quarter of one volt, and this only under unusual conditions.

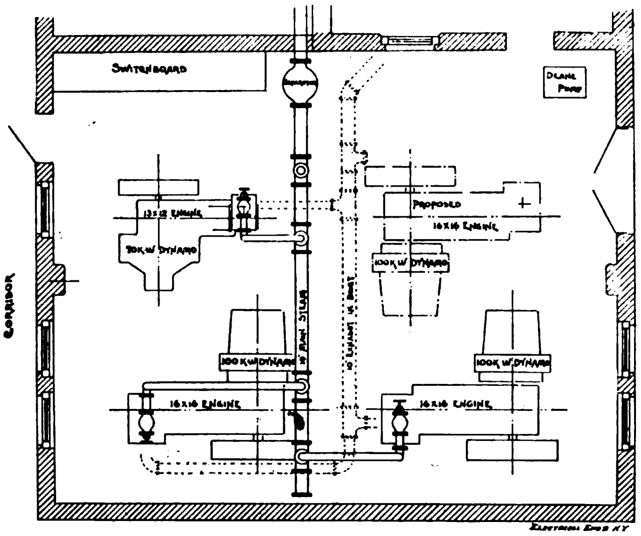


Fig. 2.—Engine and Dynamo Room, Pennsylvania State Hospital.

Owing to the great area covered by the institution, it has been impractical to utilize steam power at a number of places where it is desirable for ventilation and other purposes, but the results obtained from electric power have been so thoroughly satisfactory that plans are in preparation for an extensive application of motors throughout the property. The installation of electrical equipment has allowed improvements in the service of the departments, that under former methods were impossible, and now current is not only used for lighting and power and heating food in the wards for the sick, but its applications to the purposes of the surgical and medical staff are apparently unlimited.

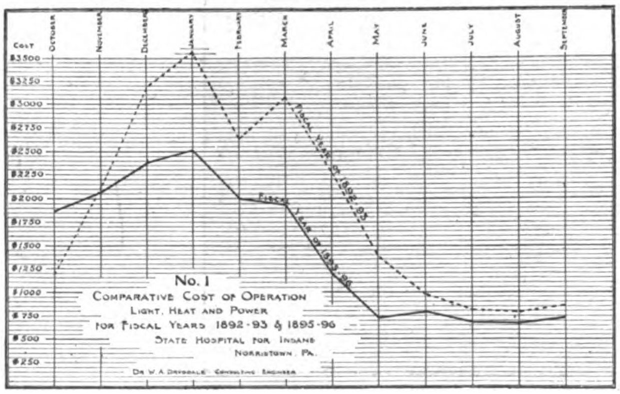


Fig. 3.

The wiring throughout the institution is carried in molding and in brass and iron-armored tubing as best suited to the particular location. With the exception of the Administration Building, the wiring is carried on the surface, and, as far as possible, out of reach of the patients, and, while no damage has ever been reported, the entire system is daily inspected. All circuits are controlled by switches, those in places accessible to the inmates being of the "Cutter" lock type and the general circuits by knife blade switches placed in locked cabinets. Each ward is provided with two centers of distribution and both the "Watch" and "General" lighting circuits are in duplicate, and so arranged that an accident to any circuit or destruction of one of the centers will not leave the ward in darkness. All the buildings are connected by large vaulted brick corridors and under these are the tunnels and ducts through which the heating, gas, water and other service pipes are carried. The mains to the various buildings follow these ducts, and are supported on glass and porcelain insulators; the construction being as carefully designed as if exposed to the weather.

The entire electrical and mechanical plant of the hospital was laid out by Dr. W. A. Drysdale, of Philadelphia, consulting engineer to the institution.

In his annual report on the plant, Dr. Drysdale gives some highly interesting data as to the cost of electric lighting as compared with that of gas, formerly used.

Formerly the lighting was furnished by 1,927 five-foot gas burners, and the steam engines developed 55 horse-power. There are now 2,354 incandescent lamps of various candle-powers (equivalent to 2,437 sixteen-candle-power lamps), and two arc lamps in use, and the power is supplied by electric motors aggregating 110 horse-power.

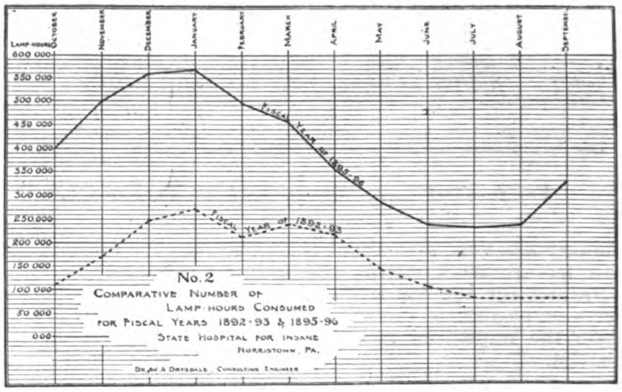


Fig. 4.

The cost of light, heat and power for the year 1892-93, including gas, coal, oils and supplies, was $22,814.63, a cost of 1.29 cents per lamp hour. The cost of light, heat and power for the year 1895-96, including lamp renewals, gas (for heating), coal, oils, extra attendance and supplies, was $17,680.28, a cost of 38 hundredths of one cent per lamp hour. A graphic illustration of these costs is given on diagram Fig. 3, the horizontal lines representing costs and the vertical the different months of the years.

While the figures show a reduction of $5,134.35 in the operating expenses, they give no indication of the relation of the costs to the work performed; and to enable a comparison to be made, the lighting and power of the two years has been reduced to a basis of lamp hours (i. e., the amount required to maintain one five-foot gas burner, or one sixteen-candle-power electric lamp for one hour. When reduced to this basis, the work performed during the year 1892-93 represents 1,768,416 lamp hours, and during the year 1895-96 a total of 4,653,040 lamp hours—an increase in the work obtained of 263 per cent., with a reduction of 22½ per cent. in operating expenses. Diagram Fig. 4 represents the work performed during the two years; the horizontal lines being lamp hours, and the vertical the months of the year.

An examination of the two diagrams will convey a much better idea of what has been accomplished than words or figures, and conclusively demonstrates that the introduction of electric light and power, aside from all other advantages, has more than justified the cost of installation, and proved one of the most, if not the most, profitable improvements undertaken by the institution.

THE ENCLOSED ARC LIGHT.—II.

BY L. B. MARKS, M. M. E.

THE next step in the development of the enclosed arc light gave us the method and devices which are in successful use at the present time. Before taking up this branch of the subject, I shall submit to you a short report of life tests and experimental investigations, made with the old equipment which I have already shown you. The length of cylinder used was 16½ centimeters over all, the diameter of body 7⅝ centimeters, and the capacity ⅝ liters. The memoranda on effect of introducing various ingredients into the carbons, and on the influence of different gases on the arc are digested from elaborate notes and observations and are given rather with the idea of recording the general results than analyzing the details of each experiment. I shall also refer to other phenomena observed in using this cylinder, especially that known as "building" of the negative electrode.

Life Tests Cylinder with Valved Cap.—In Table I. the comparative measurements are recorded showing the life of the upper and lower carbons, respectively, for different sized openings in the metallic cap or plug. It will be noted that in the first test the diameter of the opening in the plug is only a shade greater than that of the upper carbon; in next to the last test the diameter is 6.85 millimetres larger than that of the carbon, while in the last test the plug is removed from the cylinder. As is very natural, the line decreases rapidly as the opening is enlarged, but as shown in the tests, does not necessarily vary directly with the size of the opening. In each of the tests recorded, the arc was started at a point slightly higher than the center of the bulb. It will also be seen that the life of the negative decreases much more rapidly than that of the positive, as the ingress of oxygen into the enclosure is increased. Thus when the positive carbon fitted tightly in the opening in the plug, $\frac{\text{life } (+)}{\text{life } (-)} = \frac{2.222}{.102} = 21.78$

Table I.—Life Tests. Cylinder with Valved Cap.
Carbons 11.11 mm. (7-16 in.) in diameter.

Diameter of hole in valved cap (in mm.)	Mean current. (amperes.)	Mean arc tension (volts.)	Mean energy. (watts.)	Consumption (+) carbon p. h. in (mm.)	Consumption (—) carbon p. h. (in mm.)
11.905	7.96	62.9	500.68	1.988	.312
12.7	7.99	62.98	502.21	1.905	.424
14.287	7.99	62.8	501.77	2.328	.424
17.46	8.00	61.1	496.80	2.753	.534
28.575	7.94	62.8	498.69	11.556	8.077

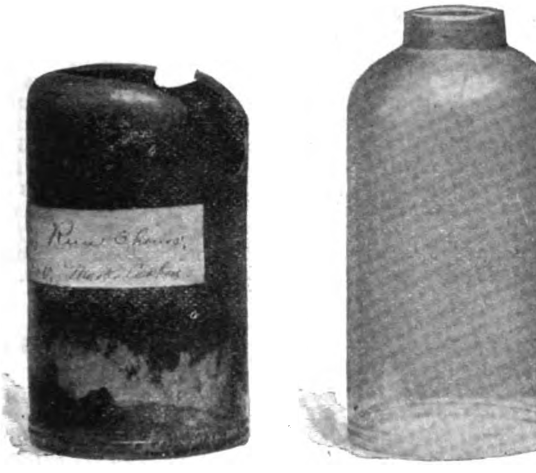


Fig. 3.—Blackening at Low Voltage of Arc.

When the diameter of the opening in the plug was 6.35 mm. larger than that of the carbon, the excess of oxygen due to enlarged opening attacked the negative vastly more than the positive, resulting in $\frac{\text{life } (+)}{\text{life } (-)} = \frac{2.753}{.534} = 5.16.$

When the plug was omitted, the disparity became still greater and $\frac{\text{life } (+)}{\text{life } (-)} = \frac{11.556}{8.077} = 1.43.$

In Table II. I give the results of life tests in which the position of the arc was shifted from the extreme upper part to the extreme bottom of the cylinder. It will be noted that in the first test the negative was 158.75 mm. long while in the last it was only 66.116 mm. long. As the arc shifts in position from the top towards the bottom of the cylinder the life of the carbons decreases. This is due to strengthening of the convection currents as the negative burns away and consequent increase in admission of oxygen.

Table II.—Life Tests. Cylinder with Valved Cap.
Carbons 11.11 mm. (7-16 in.) in diameter; mean current, 8 amperes; mean arc tension, 63 volts.

Position of arc in cylinder.	Mean length (—) carbon. (in millim.)	Consumption of (+) carbon p. h. (in millim.)	Consumption of (—) carbon p. h. (in millim.)
Near top	158.75	2.362	.266
Between center and top	140.97	2.921	.266
At center	123.19	3.683	.393
Between center and bottom	95.25	3.973	.660
Near bottom	66.12	4.825	.965

Influence of the Surrounding Atmosphere and of the Constituency of the Electrodes.—First, hydrogen; introduced through a hole in the positive carbon; tests made through range of 6 to 11 amperes and 60 to 77 volts at the arc, voltage of the mains being practically constant and equal to 120. There was only a slight variation in the length of the arc throughout this range, the maximum length being 2.36 mm. and the minimum 1.65 mm. Thus it will be seen that the presence of hydrogen tends to increase the resistance of the arc greatly, thereby shortening it to about one-sixth its normal length in carbon gas, for the same current and voltage. The arc is also unsteady, and the light cut down to a large extent. It may be noted here that when moisture has settled in the bulb or carbons of an ordinary enclosed arc, there is a tendency towards reproduction of the above conditions, the

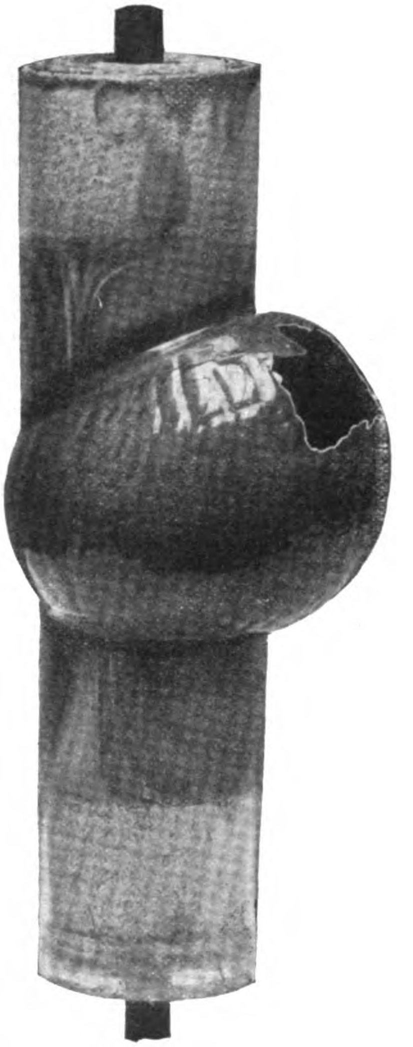


Fig. 2.—Result of Enclosing the Arc Air Tight.

arc in such case being very short and unsteady at start and remaining so until the moisture has been dissipated.

Second, iodine; tincture of iodine placed in a small glass immersed in sand in bottom of cylinder. Current ranged from 5.5 to 8 amperes in different tests; voltage of arc from 70 to 75; voltage of mains 120; minimum length of arc 2.79 mm., maximum, 3.17 mm. It will be noted that the action of iodine is somewhat similar to that of hydrogen, the tendency being to increase the resistance of the arc and thereby shorten the latter; the effect, however, is not as marked as in the last case.

Third, chlorine; generated in the usual way and admitted to the cylinder from the bottom through a tube. Current ranged from 2.3 amperes to 8 amperes; voltage of the arc from 80 to 96 volts; length of arc from 6.35 mm. to 36.32 mm. It will be noted that in this case the results are entirely different than in the other two. The presence of chlorine reduced the resistance of the arc greatly, so that at 2.4 amperes and 80 volts the length was 6.34 mm., while at 8 amperes and 96 volts the length was over 36 mm.

Following are some of the results with impregnated carbons.

First, sodium carbonate ($NaCO_3$). Carbons which had been soaked over night in a solution of sodium carbonate, gave a steady arc for 2 hours at 8.5 amperes and 55 volts, after which for the same length of arc, the voltage increased appreciably until the effect of the solution disappeared entirely. The deposit on inner wall of cylinder after two hours was thick and had a tendency to crack the glass. The ordinary foreign and American cored carbons have sodium carbonate in their cores and give similar results to the above, though less marked.

Second, ammonium chloride (NH_4Cl). When carbons were saturated with ammonium chloride the arc was over twice as long at same voltage as in last case. Ammonium chloride evaporates at a comparatively low temperature, but decreases the resistance of the arc and leaves practically no deposit in the bulb. The lower part of the cylinder became coated with condensed vapor shortly after the arc was started, but as soon as the heat became intense enough, this formation was dissipated and the glass became perfectly clear. At the end of a 4 hours' run the extreme lower end of the cylinder was slightly coated with a yellowish green band.

Third, magnesium oxide (MgO). Magnesium carbonate when used as a core of the negative carbon, is converted by heat to magnesium oxide, carbonic acid gas CO_2, gas being driven off. The CO_2 is dissociated at a comparatively low temperature and, as may be expected, the voltage necessary for a steady arc is quite low. For 15 minutes the p. d. of the arc ranged from 40 to 45 volts with a current of 8 amperes, the arc meanwhile being quite steady; the area of the crater was about 8 square millimetres. The decomposition of the magnesium carbonate was marked by a series of slight and almost inaudible explosions; finally a hard bead of MgO was left at the tip of the negative. This bead was extremely refractory; it did not succumb to the heat of the arc, but persisted as an incandescent globule from which the arc stream seemed to issue. The p. d. of the arc varied from 44 to 50 volts at 8.5 amperes, the arc being quite steady for almost an hour; there was no appreciable coating on the internal surface of the cylinder. Occasionally a slightly greenish hue was noticeable in the arc.

For comparative purposes different types of carbon points, all practically alike as to purity, but varying in granular structure, were tried. The following combinations were tested: First, lamp-black molded; second, lamp-black squirted; third, gas-black molded; fourth, gas-black squirted; fifth, petroleum coke molded; sixth, petroleum coke squirted. The results were practically the same for all structures of carbon.

The tabulated data show that for the same current and length of arc, the p. d. at the carbon points will depend upon the surrounding atmosphere as well as on the constituency of the electrodes. The fall of potential from one carbon to the other follows, in general, the well known law, the major portion of the drop (for short steady arc) being from the positive carbon to the arc stream. There was one experiment, however, which gave very surprising results and which is deemed worthy of mention in this connection as the phenomena observed seemed to constitute an exception to the rule.

A steel nail was driven into a hollow negative carbon as a substitute for the core. The sharp end of the nail projected just above the tip of the carbon. A solid positive carbon was used. When current was passed there were brilliant scincillations due to incandescent steel, followed by fumes which coated the internal wall of the chamber with a dark reddish deposit of iron oxide. A molton steel ball soon formed in the concavity at the tip of the negative. The length of the arc was between 3 and 4 millimetres, current being from 8 to 9 amperes and the p. d. at the arc varying from 20 to 30 volts. The negative was intensely hot, while the positive was comparatively cool. The area of the crater in the positive was about 1 square millimetre or about one-eighth of that in the other cases. The arc, expanded in cross section at the negative and tapering at the positive, darted from point to point across the projecting surface of the upper carbon, sometimes jumping a distance of 5 or 6 millimetres to select a path; meanwhile the negative glowed with constant brilliancy. The arc always played from the side of the molten steel ball, the latter often spinning like a top, seemingly in unison with the arc. The results of this experiment, seemed to indicate an accidental reversal of current but subsequent tests showed that no such reversal occurred.

Blackening of the Internal Surface of Enclosure.—Before taking up the analysis of the latest development of the art let us pause for a few moments and examine into the underlying principles governing the successful operation of enclosed arcs of to-day. Let us start out with the operation of an enclosed arc within an airtight compartment to which the outside atmosphere has absolutely no means of communication. The photograph I give herewith, Fig. 2, represents such a structure and illustrates the results which follow the passage of current. I shall show you the stereopticon view of the apparatus on the screen later on. You will note that the glass which was originally cylindrical, now has a large spherical protuberance at the side. You will also note that the chamber is coated on the inside with a heavy black deposit. This apparatus was originally air-tight and the carbons in contact.

Current was passed so as to form an arc and in due time the length of this arc increased from 0 to about 9 millimetres as the carbons consumed. The bulb began to blacken after the oxygen contained in it went into chemical combination with the carbon vapor of the arc stream. Such a result is natural, as the disintegration of carbon must go on as long as the arc plays; the carbon, having no substance with which to combine, is thrown off in the form of a black soot on the internal wall of the chamber. Moreover as in this case, when there are no means of exit for the expanded gases, the pressure is sometimes sufficient to distend and rupture the envelope.

Although the blackening of the internal wall of the chamber always follows the operation of a carbon in an airtight enclosure, the same discoloration may occur under other circumstances when the enclosure is not airtight or even nearly so. This second case is illustrated in a cylinder in which the annular space around the entering carbon permitted of access of oxygen to the enclosure. The blackening was due to a large current and a short arc. In the photograph, Fig. 3, I have placed a clear cylinder alongside of the other for comparative purposes. You will note that the deposit is inky in color and quite uniformly distributed over the surface of the glass. In this case the carbons were burned for three hours at a current of 18 amperes, the arc tension being 30 volts. The amount of impurity in the carbons was inappreciable.

LIGHT; ITS DISTRIBUTION AND DIFFUSION AS RELATED TO QUALITY AND EFFICIENCY.[1]—I.

BY E. LEAVENWORTH ELLIOTT.

We may, for convenience, divide the subject of artificial lighting into five different sections, viz: (1) Intensity, or brilliancy; (2) distribution; (3) diffusion; (4) quality; (5) efficiency.

The average brilliancy of illumination which will be most desirable, will, of course, vary somewhat with the use to which it is to be put. A "dim religious light," that would be very satisfactory in a church would be wholly inadequate for a library, and equally unsuitable for a ballroom. For general purposes, it is safe to say that the intensity must nowhere be less than one candle-foot, and twice this brilliancy is undoubtedly better. With our present means of producing intense light it is quite possible to exceed the limits of effective illumination and produce a glaring intensity which is a serious error both from the æsthetic and physiological standpoints.

The distribution of light involves two quite distinct problems, viz.: (1) The distribution of the several units into which the general source is to be divided, and (2) the distribution of the rays from the individual units. The first of these problems contains as a determining factor the luminosity or "candle-power" of the light units adopted. The determining factor in the second problem is the nature of the light-source itself. The result desired is in nearly all cases the same; that is, to secure a uniform brilliancy on a certain plane, or within a given space. A room uniformly lighted, even though comparatively dim, gives an effect of much better illumination than where there is great brilliancy at some points and comparative darkness at another; the darker parts, even though actually light enough, appear dark by contrast, while the lighter parts are dazzling. For this reason naked lights of any kind are to be avoided, since they must appear as dazzling points, in contrast with the general illumination.

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[1] Abstract of a paper read before the New York Electrical Society.

Light is commonly defined in the text-books as "that form of energy which is capable of affecting the optic nerve." Any stimulus of this nerve is translated by the brain into the sensation of vision. We may "see" objects, particularly stars, without the intervention of ether waves; and we may fail entirely to interpret the effect when ether waves impinge upon the retina; as, for example, in the case of "color blindness." The theory of lighting is, therefore, associated with psychology and physiology quite as much as with physics. Thus all the methods of photometry depend upon the mental comparison and judgment of the sensation of vision.

Aside from difference in intensity, light produces many different effects upon the optic nerves and their centers in the brain. These different impressions we ascribe to difference in the quality of the light. Thus, "hard light," "cold light," "mellow light," "ambient light," etc., designate various qualities. Quality in light is exactly analogous to timbre, or, quality in sound, which is likewise independent of intensity. The most obvious differnces in quality are plainly those called color. But color is by no means the element of quality. The proportion of invisible rays and the state of diffusion, are highly important factors, but on account of not being directly visible, they have been generally overlooked, and are but imperfectly understood.

It may be safely said that all rays on either side of the most plainly visible part of the spectrum are injurious to the eyes. The light of the electric light has a very large excess of violet and ultra-violet rays, which injures the quality very greatly. Gas flames, on the other hand, have an excess of infra-red or radiant heat rays, which likewise injure the quality. I have heard the same charge made against the Welsbach light, but have not yet been able to verify it. The absorption of these extra-spectral and injurious rays by suitable transparent screens is undoubtedly feasible, but seems never to have been even suggested.

The importance of diffusion has also been greatly neglected. We must keep in mind the distinction between diffusion and distribution. Distribution refers to the instrinsic brilliancy of illumination at every point in the given space; diffusion refers to the number of rays that cross each point. The amount of diffusion is shown by the character of the shadow. Daylight on a cloudy day may be considered perfectly diffused; it produces no shadows whatever. The light from the electric arc is least diffused, since it emanates from a very small surface; the shadows cast by it have almost perfectly sharp outlines. It is largely due to its high state of diffusion that daylight, though vastly more intense than any artificial illumination, is the easiest of all lights on the eyes. The eyes should be subjected as little as possible to the direct rays from any light-source. It is a common and serious mistake, in case of weak eyes or overstrained eyes, to reduce the intensity of the light, instead of increasing the diffusion. The eye is made to receive light, and, like any other organ, is strengthened by use. To attempt to strengthen weak eyes by reducing the light, is like attempting to strengthen your arm by putting it in a sling. Farmers, who are continually out in the brilliant sunlight, are almost entirely free from weak eyes. An abundance of light of the right quality is what the eye needs.

The efficiency of a light-source is the ratio of the energy given out as light, to the total energy consumed. All our present means of producing light are wasteful in the extreme, the efficiency probably never exceeding 5 per cent,, and half that being nearer the average. The production of light is one of the dreams of the physicist and will probably some day be realized. But while we are compelled to use the present wasteful methods of generating light, it is the more important that care be taken to secure the greatest possible illumination from any given source.

The dynamo has been brought to marvelous perfection. But while electrical engineers will argue and labor for the difference in 2 per cent. in the efficiency of the dynamo, they will not give so much as a thought to the waste of half the light after it is produced. The promotors of incandescent gas lighting are equally inconsistent. They do no end of talking about the saving of gas by their systems, but say nothing about the absorption of a third to a half the light by the various shades and globes which they supply with their burners. In short, there has been almost a total neglect and a resulting absolute ignorance on the part of those whose business it is to know of the general principles of the utilization of artificial light. It is the chief purpose of this paper to briefly set forth these principles, and review the various attempts that have been made to apply them to practical use.

MUNICIPAL OWNERSHIP.—DEFECTS AND DANGERS.[1]

BY W. W. LOW.

THE author contended that if people would study and discuss the municipal ownership question as thoroughly as they did the financial question in our last campaign, the result would be the entertaining of a more rational view of the subject.

From an extended experience in the electric lighting enterprises he was satisfied that if this branch had been owned and operated under municipal control from the time the first light was installed to the present day, it would have been on an average far more expensive to the inhabitant than it has now been. There is hardly a franchise granted at the present day without limiting the charges for service rendered, and as long as such charges are reasonable, as long as the earnings are no more than other unlicensed enterprises, which, he contended, they are not, then municipal ownership will not be advantageous, but detrimental to the public welfare.

In case there should exist plants which owing to loose franchises should abuse their powers, it might be well to have a law such as already exists in some States, by which a reasonable charge could be determined and regulated.

The most serious objection to municipal ownership, Mr. Schuette maintained, lies in the increased opportunities and temptations offered for boodling, and the multiplied power to form and maintain rings. Given the addition to the regular city officials and employés, of all those of water works, gas works, electric light plants, telephones, telegraph, railroads, and then add, as some advocate, the saloon interest, which are also licensed institutions, the combined forces, having abundant spare time while under public pay, can and would electioneer every day in the year.

The natural result would be that this active self-interested element would exert such a political influence in our caucuses and elections, that our citizens other than the office class, would be practically disfranchised.

Mr. Schuette exhorted the association to stand in a solid phalanx ready to defend one and all against any and all unjust, unfair legislation which may be attempted against the electric light interest.

HEATING AND COOKING BY ELECTRICITY.[1]

BY GEORGE CUTTER.

AFTER giving some very interesting figures on the expenditure of current in the different applications of electrical heat for cooking and other purposes, Mr. Cutter made some excellent suggestions in regard to the encouragement and extension of the supply of current for domestic and other uses. He insisted that:

(1) Every central station manager should familiarize himself with the well-developed heating and cooking apparatus now on the market, so as to be ready to talk it to his customers.

(2) He should arrange to show the apparatus in operation so as to create a public interest in it.

(3) He should study the question of rates so as to be able to offer special inducements to a more varied use of current.

(4) He should educate his patrons to use the current economically, for therein lies the secret of expanding the use of heating apparatus.

(5) And last, but not least, he should insist on the use of devices which are efficient and whose durability is practically vouched for by the standing of the manufacturers.

J. C. KNIGHT, of Elizabethport, N. J., has been engaged as superintendent of the People's Electric Light Company, Oswego, N. Y., to succeed F. E. Pritchard.

MR. ROBT. A. L. GRAY, electrical engineer, Toronto, Can., writes us: "I have had very good results with the Data Sheets, and especially with the incandescent wiring tables."

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[1] Abstract of a paper read before the Northwest. Elec. Assoc.

ROENTGEN RAYS

X-RAYS—APPARATUS AND METHODS.—II.

BY ELMER G. WILLYOUNG AND H. LYMAN SAYEN.

TESLA coil or induction coil—which?—Having carefully examined the results, apparatus and methods of others, all over the country, devotees some of the high frequency coil, some of the induction coil, and having made many and careful experiments with both forms of apparatus ourselves, we favor the induction coil, on account of: 1. Simplicity. 2. Ease of manipulation. 3. Cleanliness. 4. Sharpness of definition obtainable. 5. Noiselessness. 6. Less strain on tube.

Although we have diligently examined, we have yet to see results obtained by any form of apparatus superior to those made right here in Philadelphia, by Dr. Goodspeed, of the University of Pennsylvania. Dr. Stern, of the Polyclinic Hospital, ourselves, and many others who might be mentioned, and this either as regards detail, penetration, or quickness of exposure. Indeed, we may say that we have never seen results obtained with the Tesla coil that are equal in any of the above respects to the results just referred to.

The Tubes.—Many forms of tubes have been suggested. With practically no exception all tubes now in use employ as cathode a concave aluminum disc whose center of curvature is at the center of a small platinum plate (⅝ to ¾ square inch in area), the plane of the plate being inclined to the normal from center of the concave cathode. This platinum plate is sometimes made the anode, sometimes the anode is a separate plate or wire elsewhere in the tube. This form of tube is known as the "focus" tube, the cathode rays being focussed upon the platinum plate which then becomes the active source of X-rays. In the double focus tube we have two concave cathodes at opposite ends of the tube, the platinum wire reflector being in the form of a wedge with a side presented to each of the concave cathodes.

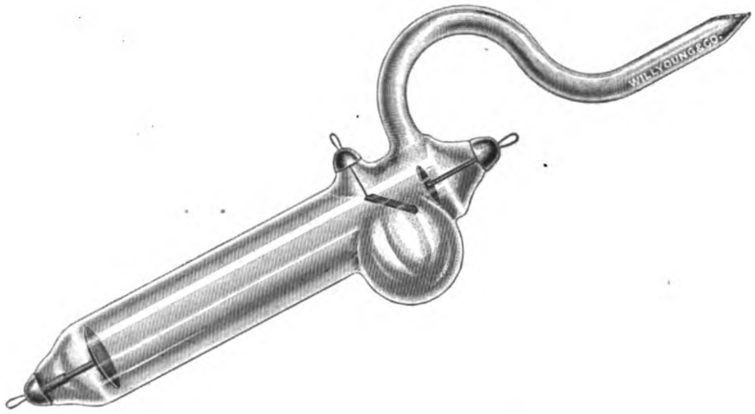

WILLYOUNG & CO.

FIG. 5.

In the use of the tube everything depends upon the vacuum, X-rays seeming to be of a heterogeneous character just as are light rays, the quality of the X-ray varying with the degree of vacuum. The higher the vacuum the more penetrating power the tube has. Hence it is well to select tubes and use different tubes for different purposes. A tube of extremely high exhaustion is best for working through the body; but with forearm, hands, feet, etc., the tube has too great penetration, the bones appearing almost equally transparent with the flesh.

The chief difficulty with most tubes is the change of vacuum which takes place in use. This is thought to be due to the occlusion of the residual gas upon the inner surface of the glass resulting in an increased vacuum. It may be partially restored by heating the tube by use of a spirit lamp or Bunsen flame. This must be very carefully done, however, to avoid cracking the tube. When the platinum reflector is used simply as an anti-cathode and the anode is aluminum a simple reversal of the discharge will prove fairly successful. Some makers have adopted the scheme practiced now for many years of blowing a small side pocket upon the tube, into which is placed phosphoric anhydride or some other chemical substance or composition absorbing moisture. When heated, this substance gives off vapor to make up for the loss; it is difficult, however, to drive off just the right amount of vapor in this way and the vacuum is liable to be made too low, in which case flesh and bone are about equally opaque. So rapid is this change of vacuum that in most cases involving over a few minutes' exposure or running of the tube, one of the above methods becomes necessary. In any case, eventual, almost complete exhaustion, seems to be the rule, and the tube must then be returned to the makers and re-exhausted. "Blacking" is another cause of decreased efficiency in the tube. It is due to deposition of platinum upon the inner surface of the tube.

The "Bowdoin" tube, shown in Fig. 5, was devised after a considerable amount of experimental work by Profs. Robinson and Hutchins, of Bowdoin College. In general design it does not differ essentially from many other forms of focus tube upon the market. The two respects in which the tube does differ from other tubes is, first, in the arrangement of electrodes, the reflector plate not being connected to the coil at all, but merely acting as an obstacle to the bombarding rays, while the anode is a disc at the end of the tube away from the cathode. This arrangement is found to perfectly and entirely prevent blackening, no matter how long the tube may be used.

The most important feature of this tube is, however, the presence upon its interior surface of a fluorescent material which has been fused into the surface of the glass. As the tube is used, this material either by the bombardment, or heating, or both, gives off just enough air or vapor to make up for the occlusion due to the natural working of the tube. The vacuum therefore tends to remain always constant. Although it seems almost absurd that one could put in just enough of this material to make up for the gas otherwise lost, yet it is a fact that these tubes remain practically unchanged in vacuum at all times, the equivalent spark length retaining its value at all times within, at the outside, a variation of 10 per cent.

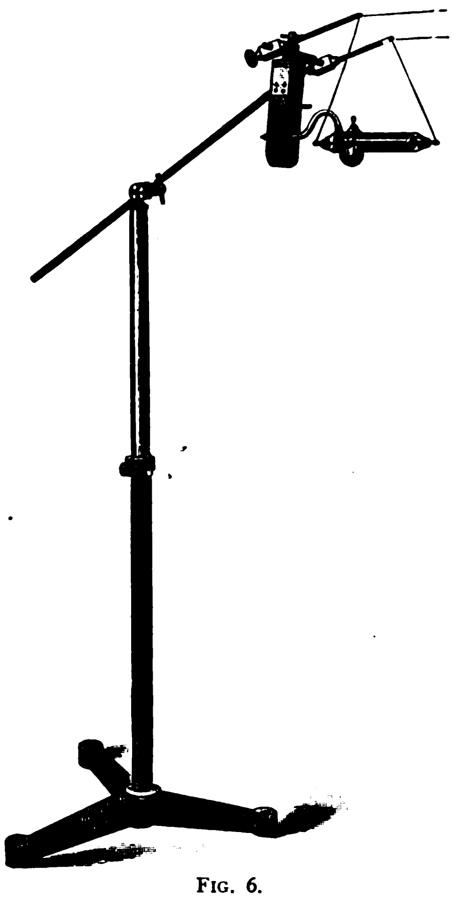


FIG. 6.

In use the tube requires no "nursing" whatever. It should always have a parallel spark gap which should be quite small, say, an inch or inch and a half, and either the primary current or the vibrator tension adjusted so as to produce only very small secondary discharge. The energy of this secondary discharge may then be immediately increased until the reflector plate shows a dull red spot of about half the size of the nail of the little finger. The tube is now in its most efficient condition, and, with a well constructed and smooth working break, may be run for an hour or two without the slightest attention. The "getting ready," as above described, takes considerably less time than the time it has taken us to describe it. Indeed, in our own work, we do not trouble to make this preliminary adjustment at all, as we make it once for all when we first begin to work with a tube and do not afterward disturb it, merely closing down the switch when starting work.

Life of Tubes.—The life of tubes in general is limited. (A) by the time required for the vacuum to become too great; hence requiring re-exhaustion. (B) by ability to stand the electrical strains.

(A) applies to all tubes so far as we know, save the Bowdoin tubes. Probably six or eight hours continuous working, or the equivalent, suffices to incapacitate the average tube. We think that even with the Bowdoin tube there is a strong tendency to eventual very high vacuum, but the time required would be very great relatively, say, ten to fifteen times that operative in the case of other types of tubes.

(B) All well made tubes (from the glass-blower's standpoint) are about equally liable to this limitation. It is probable that these strains are cumulative in their effects upon the tube, the latter gradually weakening until eventually break-down takes place with secondary discharges, much less than would have been originally required for breakdown.

The Stand.—The stand, shown in Fig. 6, has been devised by us for applied X-ray work. With it the tube may be placed in any position within a cylinder 6 feet high and 6 feet in diameter, thus making it possible to get under or over a patient, no matter what the latter's position. Rods of vulcanized fiber clamp to the stand in any position and carry the lead wires of the tube thus keeping them away from one another and from the metal of the stand. They carry little spring clips at their extremities by which the wires are caught without tieing or bending. The whole stand is of bicycle tubing and very rigid.

The Subject.—The patient should, of course, be placed in as easy a position as possible. For body pictures, hip and knee joints, etc., a recumbent position may be assumed. The plate should lie beneath and upon a stiff board backing, to avoid risk of breakage. Work upon the shoulder, neck, head, etc., may be done with the patient straddling a straight-backed chair, facing the back, and leaning the body against the back for support. The plate may be bound fast to the body by bandages.

Laws for Exposure.—Since the X-rays proceed in straight lines from (approximately) a point source, the intensity of their action varies inversely as the square of the distance from the source. Hence the time of exposure should vary directly as the thickness of the intervening substance. To apply these principles in practice take a trial picture of the hand at 5-inch distance, this being amply sufficient for good definition with such small bones. Say one minute is required for a good result. Then to take a hip joint, we estimate the thickness of the latter to be, say, ten times that of the hand. We must, therefore, expose ten minutes on account of thickness alone. But, owing to the greater distance of bones from plate, the tube must be removed much further to get definition. At least fifteen inches from the dry plate should be given; this is three times the distance used for the hand from which the times require to be as the squares of these figures or as 1 is to 9. The total exposure must, therefore, be 90 minutes. This method gives something to go by. After a little experience perhaps the most convenient thing to do is to arrange a little table, based upon previous results, and showing times and distances required for well defined results for distinctive parts of the body.

Short Exposures.—We have obtained and do regularly obtain without difficulty well defined pictures showing complete detail of the osseous structure involved in times and with distances from dry plate to reflector, as follows:

Hand and wrist	5 to 10	seconds,	at 5 inches.
Forearm	10 to 15	"	at 5 "
Arm above elbow	½ to 1	minute,	at 7 "
Shoulder	10 to 15	"	at 10 "
Thorax	15 to 30	"	at 10 "
Hip joint	30 to 45	"	at 12 to 15 in.
Stones in kidneys	30 to 45	"	at 12 to 15 in.
Glass, iron, lead, etc., in any part of trunk (on an average)	30	"	at 12 to 15 in.

We have very carefully investigated every claim to quicker exposures than these, often by a personal visit, sometimes by correspondence with personal friends whose reliability was undoubted. We have been unable to learn of any results equally good having been obtained in shorter times by any one at any place with any form of apparatus, and we do not believe any such have been obtained. We except one or two cases of undoubted authenticity when wonderfully short exposures were secured; but the operator has, in these cases, not been able to secure such results a second time.

Manipulation—Development of the Plate.—Suitable and well constructed apparatus is not the only essential to good results. A great deal depends upon the operator and comparatively trivial differences in procedure make all the difference between success and failure. We describe here the method which we follow and which allows us to count with certainty upon securing at least nine successful plates for every ten exposures.

(a) General Adjustment.—First see that the coil is working smoothly and so as to give a uniform discharge in the primary. The secondary spark points should be separated by the distance given by the makers as proper for the tube. The coil must then be adjusted either by changing the e. m. f. at the primary or by variation of the vibrator adjusting springs so as just not to spark over this air gap. The tube should then be joined in parallel with this secondary spark gap. The coil may then be started up, using the fluoroscope to show whether direction of discharge is right. If not, the primary current should be reversed. If X-rays are not now profuse, the secondary discharge points should be further separated and the vibrator springs tightened so as to produce correspondingly greater discharge. Continue this until either X-rays are secured as desired, or the tube becomes too hot, or possibly blueish or pink in color. Blue denotes too low a vacuum to expect X-rays, but often a gentle running of the tube for ten or fifteen minutes while in this condition will raise the vacuum to a suitable value. Pink denotes a very low vacuum and usually means, in a tube which has ever been right, a puncture or leak; such a tube can only be made good by re-exhaustion and repair. With most tubes a vivid green fluorescence is the sign of the X-ray vacuum. With the Bowdoin tubes, as also with many others, the most efficient condition is with the platinum reflector plate at cherry red heat over an area of half or two-thirds that of the little finger nail.

Sometimes the vacuum will be too high for the production of X-rays with any length of secondary discharge. It may be reduced by gentle warming of the tube by a spirit lamp flame. Some reverse of the current in the tube, but this is apt to blacken.

Sticking of the vibrator must be guarded against; it is often fatal to the tube. This is because of the much larger current through the primary when such sticking occurs. Upon release, therefore, a secondary discharge much above normal is produced and this the parallel spark gap is unable to carry off. The tube therefore receives much more energy than it should and may break down even though the parallel spark gap be as advised by the manufacturers.

(b) The Plate and Its Development.—We have used at one time and another a number of different makes of plates with very fair success. For some time past we have confined ourselves to the Carbutt X-ray plates and though we are not prepared to say that they are the best plates to use, the results are so uniformly good as to make it seem inadvisable to us to try other plates not radically different in principle.

For developer we use the Carbutt "J. C. Tabloids"—three J and three C to five ounces of water; add about two drachms of restrainer (the usual 10 per cent. solution). Dr. Stern, of the Philadelphia Polyclinic, advises heating this developer until quite warm to the touch just before using. This we have found so good that we have adopted it as part of our procedure.

From 15 to 20 minutes will be required for development. The image will come up very slowly and not very sharply. Not much detail will be visible by holding up to the light. Continue development until the film outlines have similarly appeared and faded away to a general blackness upon the glass side. Then rinse and hypo.

The fixing generally requires from a half hour to two or three hours. This long time is probably partly due to the unusual thickness of the Carbutt X-ray films, but probably even more to some chemical condition set up by the unusually large quantities of restrainer used. Mr. Carbutt advises three J and three C tabloids to six ounces of water to 20 to 30 drops restrainer. Our experience is that a plate so developed always requires intensification; a tedious nuisance which can never give so good results as a normally exposed and developed plate.

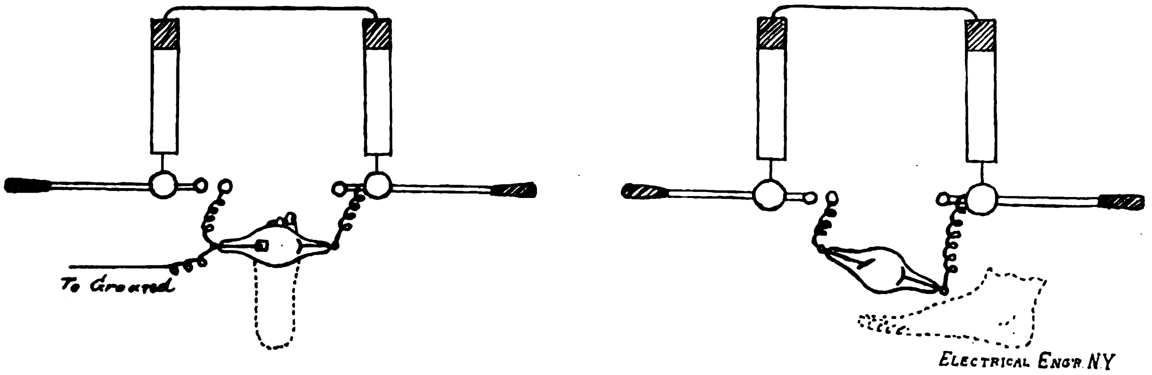
ELECTRIC TRAIN BULLETIN COMPANY.—Articles of incorporation have been filed at Camden, N. J., by the Electric Train Bulletin Company. The objects of the corporation are to manufacture, buy, sell and lease train bulletins or indicators and general devices. The capital stock of the company is $500,000, and the amount paid in is $1,000. The resident corporator is J. W. Harner, of Beverly, N. J.

X-RAYS OR STATIC DISCHARGE?

BY G. A. FREI.

IN the issue of The Electrical Engineer of January 6, Prof. Elihu Thomson expresses some doubts as to the correctness of my experiments published in the Engineer of December 23, 1896, and evidently thinks that the apparatus used were mere toys. Without giving a description of the apparatus which would be in the light of an advertisement, I will simply state that they were powerful enough to show the palpitations of the heart clearly and distinctly and cannot therefore be considered as toys.

The enclosed dagram, Fig. 1, shows the manner in which the experiments were made. It will be seen that the anode is grounded, an arrangement which enables one to use tubes having a comparatively high vacuum. Although the experiments were made during the first two weeks in November, the skin showed not the slightest discoloration or any other signs of the experiments when I wrote the article about the middle of December.



FIGS. 1 AND 2.—THE FREI EXPERIMENTS.

On December 21, I decided to try another experiment. The diagram, Fig. 2, shows the position of the tube and the connections. The result has been rather a surprise and of such a nature that I am obliged to modify my former views regarding the results obtained with the static machine. Neither Prof. Thomson's injury to his finger nor the effects of my last experiment, however, can change my views regarding the cause of the effect. The injury is evidently caused by an electric discharge from the wires or the ends of the tube, and if the necessary precautions are taken to carry this discharge to the ground the patient subjected to the X-rays will be perfectly safe.

Whether the same arrangement would answer the purpose when coils are used I am not prepared to say.

THE X-RAY PHENOMENA AND THEIR USEFUL APPLICATION.[1]

BY C. D. HASKINS.

AFTER describing the principal phenomena of the X-rays the author showed the different directions in which the X-ray has up to the present time proved to be of the most practical use. Already no inconsiderable number of lives have been saved by the speedy locating of bullets and the like, but it is not alone in surgery, that the X-ray phenomena find a useful field. In medicine, also, successful application of them has been made, especially in locating tuberculosis colonies in the lung tissues. The lung tissues when in their normal condition are probably more transparent to the X-rays than is other flesh, whilst fortunately, for the sake of consumptives, tuberculosis spots are relatively opaque. One can, therefore, readily detect with the fluoroscope and still more readily by photographic means, little dark spots in the lung tissues which indicate the presence of these bacteria.

In the arts the X-ray phenomena will pobably speedily be put to many useful applications. In the inspection of gems, alone, the X-ray is very useful. Diamonds, for example, are practically transparent to the X-ray, while all known forms of paste are quite opaque. It is, therefore, but the work of an instant to detect by means of a fluoroscope the falsity of even the best imitations; and this same holds true with a large number of the other precious stones.

Possibly, also, successful rough analyses of coals may be accomplished by means of the fluoroscope. The density of the shadow of a coal sample, viewed through the fluoroscope, is dependent upon the percentage of ash, and by matching the shadow of the sample under investigation with that of a sample of coal of similar size and thickness, and with a known percentage of ash, speedy and probably quite accurate results may be obtained.

In the inspection of all classes of small merchandise the X-ray apparatus will probably some day come into general use. Objects of all kinds, when composed partly of metal, or other relatively impervious substance, and partly of some relatively permeable material, can be examined with the greatest certainty. There is no difficulty, for example, in determining just how deeply a screw-driver is set into its handle, or just how long the fastening screws or nails are in a box. So, too, parcels, or mail packages, can be examined quite successfully without being opened. Mr. Haskins suggested that possibly this hint would not be misplaced if gently communicated to the United States Custom House.

Mr. Haskins illustrated his remarks by numerous lantern slides.

POWER TRANSMISSION

THREE-PHASE POWER PLANT IN THE BOLT WORKS OF PLUMB, BURDICT & BERNARD, NORTH TONAWANDA, N. Y.

ALTHOUGH the transmission of power outside the limits of Niagara Falls is not yet a month old, a large nut and bolt works at North Tonawanda, has been waiting, fully equipped for the appearance of the current, for the past year. These works, the largest nut and bolt factory in the country are those of Messrs. Plumb, Burdict & Bernard.

At the time the electrical equipment was under consideration, the question of utilizing Niagara power naturally arose, and it speaks volumes for the foresight both of the owners of the works and the equipping company, the General Electric Company, that the three-phase system was selected, instead of the two-phase. The three-phase system having been chosen by the Niagara Falls Power Company for the transmission of power from Niagara Falls to Tonawanda and Buffalo, the bolt and nut works can be operated directly from the transmission line by simply connecting the necessary static transformers.

The factory of Messrs. Plumb, Burdict & Bernard is situated at North Tonawanda, directly on the lines of the New York Central and Erie Railroads, and about half a mile from the route taken by the overhead wires of the Niagara-Buffalo transmission. It is divided into three single story brick shops, running north and south, the forge being nearest the railroad, the cold shop, engine room and machine shop, lying in the center and the threading and finishing shops on the side nearest the transmission line.

Until Niagara power can be obtained, the works are being operated from their own generating station, which will be abandoned as soon as the Niagara Power Company is ready to tap the three-phase lines into the factory. The generating station, Fig. 1, is set between the cold and machine shops in the central building. Steam from the engine is supplied by three Riter Brothers return tubular boilers, each of 100 horse-power capacity. The engine is an improved Green of 400 horse-power, belted to a General Electric Company three-phase, six-pole 150 kilowatt 25-cycle 500 r. p. m. generator. The exciter is a 3 kilowatt 125 volt bipolar machine. The switchboard is of the panel type, built up of two panels, one for the generator, the other for the feeders.

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[1] Abstract of a paper read before the Northwest Elec. Assoc.

The forge shop, where the nuts and bolts are cut off from the raw rods and bars, is about 360 feet long, having the forges and machines set down each side of a central aisle, along which a track is laid. Above the machines on each side runs a line of shafting, and in arranging the line of shafting Messrs. Plumb, Burdict & Bernard have adopted a very simple method. Suspended from the roof girders down each side are four lines of channel iron in two sets, each set bolted back to back. Each line is separated from the other about 20 inches. Through the space between each pair of channels, pass long bolts which support the hangers for the shafting, and allow of a ready rearrangement at any time. This method is adopted throughout the shop.

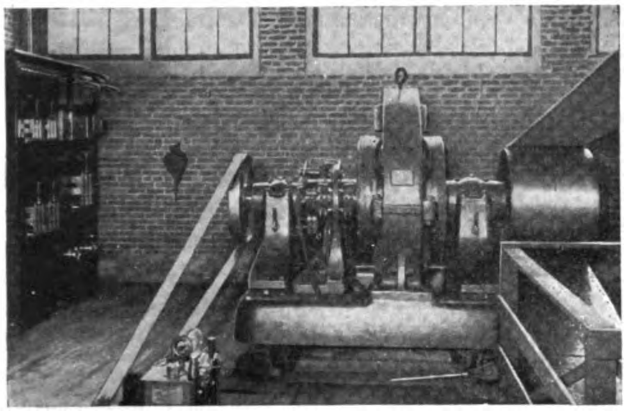


FIG. 1.—THREE-PHASE CENTRAL STATION, NORTH TONAWANDA NUT AND BOLT WORKS.

The forge shop contains five 20 horse-power General Electric induction motors, four driving the shaft and one operating a blower. The shafting is divided into four sections, and each one is belted to one of the induction motors. The driving motors themselves are set upon a platform above the shafting in the center of the shop, and are boxed in. The blower motor directly connected to the blower occupies a platform at the south end of the shop. The machinery driven by the motors in the forge shop are different sizes of bolt headers and nut punchers and shearing machines for shearing the bolt lengths from the rod.

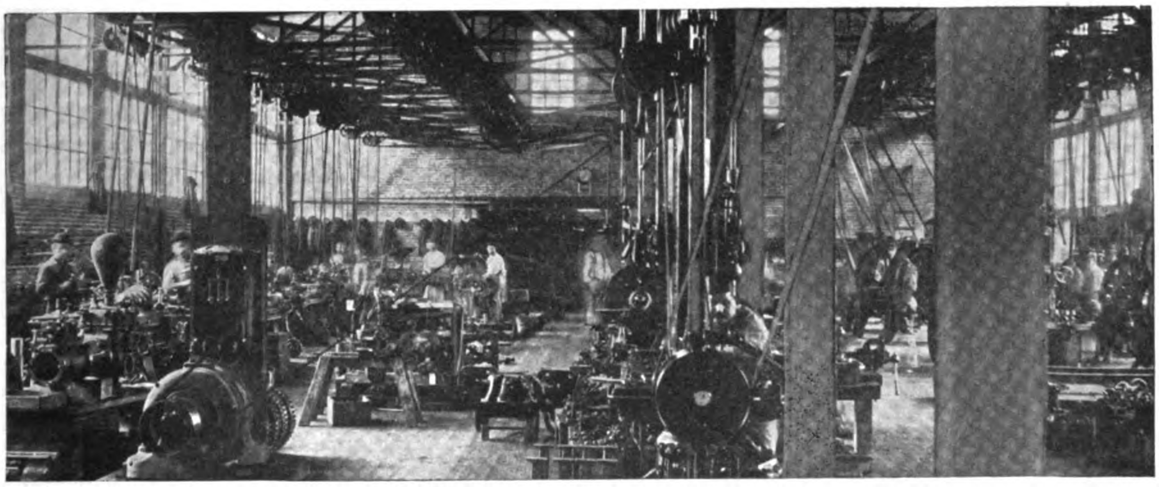


FIG. 2.—20 H. P. INDUCTION MOTOR DRIVING TOOL MAKING AND OTHER MACHINERY, NORTH TONAWANDA NUT AND BOLT WORKS.

In the cold shop the pointing department is operated by one 20 horse-power motor, set on the floor and belted to jack shafts and countershafts as necessary. In the machine shop, lying on the south side of the engine room, is another 20 horse-power motor, also set upon the floor. It is used to drive a variety of tool-making machinery such as planers, milling machines, drills, slotters, shapers, etc., Fig. 2.

The threading and finishing shop, 400 feet long, is next in length to the cold shop which is 430 ft. in length. In it the bolts and nuts traveling from the other shops are threaded and tapped and put together ready for the market. This shop is driven by six 6 horse-power motors set on small platforms, and three 20 horse-power motors. The smaller motors and one 20 horse-power motor is used to drive the automatic and semi-automatic machines. For the former they are belted to jack shafts from which belts are dropped to pulleys on a shaft running underneath the machinery. For the semi-automatic machinery, the pulley is on the level of the machines and is belted to the jack shaft above.

The other 20 horse-power motors are set on the floor and are belted to shafting on the opposite sides of the shop as shown in the illustration. These serve to drive the heavy threading and tapping work not automatic, and some idea of the variety of machinery in these shops, and the work the motors are called upon to do, may be gathered from the fact that the sizes of bolts made run from 3-16 inch up to 1½ inches.

The advantages of electric drive are markedly noticeable in this plant. There are no separate engines for the individual shops and no belt holes in the walls as would have been the case had the steam driving plant been confined to an outside building. The wires come through three small porcelain bushed holes in the wall of each shop. The central steam and generating station is confined to one room at present, and will probably shortly be entirely abolished. The motors in the forge shop occupy no space on the floor of the shop and those in the other shops occupy either small space upon the floor or are erected on small platforms. They require no attention beyond the filling of oil wells, which is performed but once in six months. They are started by the throwing of a switch, and maintain a steady and constant speed under all conditions of load. This is noticeable in the quality of the output.

LITERATURE

NOTE BOOK OF TABLES, DIAGRAMS, AND USEFUL INFORMATION. Ziegler & Co., Boston. 51 pages, 5 by 7 inches. Paper cover. Price, 30 cents. This is a handy little booklet containing much useful information, such as tables of resistances, dimensions, etc., of copper wires, wiring tables, etc., It also includes a number of diagrams for wiring motors, bell circuits, burglar alarm circuits, and telephone circuits both for two sets and for intercommunicating systems of various kinds. It ought to prove very useful in the hands of amateurs as well as professionals.

GLASGOW is about to establish an elaborate system of electrically-regulated municipal clocks. Between 200 and 300 clocks with 18-inch dials are to be placed in prominent positions throughout the city.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - 1564 Monadnock Block, Chicago, Ill.
Philadelphia Office - - - - - 916 Betz Building.

Terms of Subscription
United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

Vol. XXIII. NEW YORK, FEBRUARY 3, 1897. No. 457.

OCEAN DEPTHS.

THE discussion on the Pacific cable and the movements on both sides of the Atlantic indicate the nearness of the approach that is being made to the execution of the enterprise. It has semed to many people that there has been an inordinate amount of preliminary talk, stretching through a weary number of years; but the cabling of the other, lesser oceans was not accomplished without the lapse of a prolonged period of necessary work and agitation. Important as these cables are and profitable as most of them turn out to be in the long run, when well managed, it takes no little time to overcome the indifference of governments or capitalists, or to harmonize the various interests. In the case of the Pacific cable there was until recently some doubt as to its earning capacity. The rapid development of political changes in the Far East, with concurrent commercial advances, have shown at once that a cable there ought to be and that it would pay. At this moment, that point is pretty well settled, unless, as happens occasionally, the eagerness for the prize should lead the contestants to overdo the thing; thus laying two cables where one will at first amply suffice. Next, however, to the question of earning a profit, and perhaps even more immediately interesting is the problem of laying the cable successfully.

It is well understood that the Pacific Ocean offers many serious difficulties; their nature and variety have often been alluded to in these pages. Chief among them, of course, are the extreme lengths between landing places and the enormous depths. None but those who traverse the Pacific realize its magnitude, but a study of any map shows how scattered are the destinations any one of which should serve as the terminal in the antipodean orient. With regard to depth, it is interesting to bear in mind the fact that while a depth of about 5¼ miles has been found in the Atlantic, that recorded in the Pacific is about 6 miles; and that one of the deepest Atlantic cables lies in some 3 miles of water. The importance of this comes in when dealing with a cable route like that of the Pacific which is a good round 7,000 nautical miles, while an Atlantic cable is one-third that length. Moreover, the Pacific bed appears susceptible to a noteworthy degree to submarine volcanic disturbances, tending to destroy or modify a cable bed suitable for other reasons. It is said that the deep water in the Pacific is much colder than that in the Atlantic, but this would obviously lend itself to better conductivity and cleaner signaling, while on the other hand, the enormous depth to which it may be necessary to descend, with consequent increase of pressure, may have its influence on the type of cable adapted to withstand the strain.

MR. TESLA'S VIEWS ON THE FUTURE OF ELECTRICITY.

THE inauguration of the Buffalo-Niagara electric transmission, brought together, as our report showed, a representative gathering of influential men and elicited a number of memorable addresses. Of the speeches devoted to the technical side, that of Mr. Tesla's deserves more than passing notice, as containing the expression of his latest views and convictions on subjects which he has made his special study for some time past. Speaking of the types of prime movers in use to-day, Mr. Tesla gives no encouragement for the future of the reciprocating high speed engine in its present form, nor for the steam turbine. His ideal engine is one which expands the working fluid with utmost rapidity and loses little heat in the walls; an engine stripped of all usual regulating mechanism, packings, oilers and other appendages and forming part of an electric generator. Mr. Tesla, though not mentioning it by name, here evidently referred to his oscillator, brought out in 1893. As to the outlook for a carbon consuming battery. Mr. Tesla does not consider it over-promising, viewed from the standpoint of a source of power. The probability of replacing the engine-dynamos by batteries is, in Mr. Tesla's opinion, a remote one, the more so as the high pressure steam engine and the gas engine give promise of a considerably more economical conversion. Mr. Tesla also sees drawbacks lurking in the fact that carbon to be consumed in batteries has to be prepared for that purpose and cannot be used as found, as it is under the boiler. The manipulation, cleaning, renewal, regulation, etc., of the batteries, and their size, together with the character of the liquids employed in them, would make it difficult, if not unprofitable, to handle such a plant in a densely populated city district. While thus expressing little faith in the carbon battery, Mr. Tesla has hopes for the ultimate supply of isolated plants or dwellings in the development of what he calls a light "storage battery," involving the use of chemicals manufactured by cheap water power, such as some carbide or oxy-hydrogen cell. We incline to the opinion that what Mr. Tesla has in mind partakes more of the nature of a primary gas battery.

But it is Mr. Tesla's conclusions on the results of his own particular work which will perhaps command the greatest attention among electrical engineers and the public at large. It will be recalled that in his very first lecture at Columbia University in 1891 he threw out the suggestion that it might be possible to operate engines at any point on the earth "by the energy of the medium." Six years of continued study have brought him beyond the stage of mere conviction, and he now feels sure that the realization of his ideas is not far off. But at the same time Mr. Tesla confesses the disappointing conclusion reached by him that under the theoretically best conditions such a method of obtaining power cannot equal in economy, simplicity and many other features the present method of converting the energy of falling water into electric current, and transmitting it over long distances at high potential. With this conviction of the greater utility of water power, Mr. Tesla has bent his energies to the means of transmitting it, and now informs us that he has devised means which permit of power transmission at potentials much higher than are now considered practical. He hints further that the progress he has made gives him fresh hope that he will be able to transmit power from station to station without the employment of connecting wires, but he adds that, whatever method of transmission be ultimately adopted, nearness to the source of power will remain an important advantage. We cannot help expressing our gratification at this promised realization of one of Mr. Tesla's fondest dreams, but we hardly expect that the manufacturers of wire will receive the announcement in a like spirit of joy. Mr. Tesla has thrown out enough in his remarks to put the public again on the qui vive. The electrical community will await with impatience the practical demonstration of his new methods, accept the "report of progress" and "extend the time of the committee."

ELECTRICAL FARMING.

STATISTICS show that the value of the agricultural and live stock products of the United States for exceeds in value the worth of its manufactured articles, but strange to say, in probably no industry do we find electricity less applied than on the farms. And yet just in this direction lies what, we are convinced, will be one of the broadest applications for electric energy for all purposes. Farming operations are now carried on very generally by machinery, in the tilling of the field, in the preparation of the farm products for market, and again in its consumption on the farm itself. What could be more desirable, therefore, than the carrying on of all this work by electric power, which has the great advantage that it can be readily and cheaply brought to the exact spot where it is wanted? Just what can be done in this respect is well brought out in a recent United States Consular Report which describes the electrical installation on a farm in Mecklenburg, Germany. The power is originally obtained from a small brook, the water of which drives a turbine of about 16 horse-power, connected to a continuous current dynamo. The plant is also provided with a storage battery, so that it is enabled to store the energy of the waterfall during the time when the farm machinery is not in operation. Conductors lead to all points of the farm, driving motors for thrashing, sawing logs, straw cutting, pumping and small machine tools, the farthest motor being 1,800 feet from the dynamo. The plant is run at about 140 volts.

This installation during the year furnished 34,000 horse-power hours of energy, including 120,000 lamp hours of lighting. The cost of the plant was $12,376, of which the electrical part figured at $7,140. The working expenses, including interest and depreciation, amounted last year to $1,428. The former working expenses were $1,713.60. This shows a difference of $285.60 in favor of electricity. But in addition to this there is gained the advantage that four horses can be dispensed with and the remaining horses are always ready for use—a matter of considerable importance at harvest time and other busy periods in the fields. Besides, the fact that power is always available enables the farmer to employ his hands at once in thrashing, in case they are prevented by bad weather or by some other reason, from working in the fields. Of course the difference in working cost above indicated appears small in itself, but when it is considered that the whole plant is capable of developing only 16 horse-power at the turbine, of which considerable was lost in transmission, owing to the low tension adopted, the showing is a good one. Besides the æsthetic value of the installation, which affords electric light for all the buildings, including all the animal houses, must also be considered, though it may be hard to estimate. We are not unmindful of the fact also that in the case under consideration the power was derived at the low cost, delivered, of about 4 1-5 cents per horse-power hour, due to the cheapness of the water power, and that available water powers are not a universal adjunct of farm lands. But the interurban electric railway and the enterprising central station in farming districts are gradually reaching out for the farm. Only recently we described a farm motor installation in Pennsylvania operated by single phase alternating current at a distance of nearly five miles from the central station, with the most gratifying results. Just at present much attention is being given to the adapting of electric motors to machine tools, an innovation at first pooh-poohed by machine tool builders, but which they are now all gradually being forced to adopt. We might suggest that the manufacturers of agricultural machinery could, more than any one else, hasten the day of the supremacy of electricity on the farm, by adapting the electric motor to the apparatus they build. Instead of the portable steam engine plant dragged about to every point where work has to be done, with the frequent boiler explosions due to low water power, electricity will be available at all points from wires connected to a small central power plant. This is no fancy picture, and those who may devote their attention early to this work will be well rewarded for their enterprise. We have here only had in mind the application of electric power to farming work, but there is also much of interest and value attaching to the application of electricity direct to the soil, and of the electric light in the cultivation of plants; but these things may well be left until the more immediate work can be got into shape and put well under way.

HIGH VOLTAGE DISTRIBUTION.

AN article by Mr. H. Scholey in the February issue of "Cassier's Magazine" does what is but tardy justice to Mr. S. Z. de Ferranti, and we are glad to see the work and merit of that wonderfully able inventor and engineer presented with such clearness and sympathetic treatment. The article is, indeed, very well written and very interesting. The main facts in Mr. Ferranti's career are not unfamiliar to electrical engineers in this country, but few of us here appreciate how much he has done. It is enough to remember his early insistence on his ability to transmit alternating current at 10,000 volts from Deptford, and to note that 140,000 lamps in London now depend on the Deptford plant and circuits that he set up for that "impossible potential." That he is still a pioneer is seen in his latest alternator supplied to the Deptford station, a machine of 2,000 horse-power, which Mr. Scholey says is probably the largest in Europe, and which gives a current of 120 amperes at 10,000 volts, having also been run up to 12,500 volts. It runs at a peripheral speed of 11,000 feet per minute. With such an example before them, why should not the builders of the next big dynamos for Niagara put the high voltage right into the machines, and dispense with the step-up transformers whether for two-phase or three-phase work?

IF there is a rare thing in this world it is zig-zag lightning, and the artists therefore when they paint the phenomenon always make the zig-zag flash across their pictures as zig-zag as possible. It is said that to the English artist Turner, who made so wonderful a study of all atmospheric effects, was the first to paint lightning in the curvilinear, wavy form that photographs now reveal it to have. The magazines have had one or two articles recently, in which lightning pictures are shown, made from photographs, and in every one the flash looks quite curly. In no instance is it like a steep flight of stairs to heaven. This should help reconcile the artists who count more on the way the thing looks than the way the thing actually is; and many of whom are still unreconciled to the poses and attitudes of Mr. Frederic Remington's realistic horses.

THE Gas Exhibition at the Madison Square Garden is extensive and interesting, but we fear it can hardly be justifying the hopes of its promoters. In fact, it might perhaps be taken as the "swan song" of gas, for the public betrays little concern or curiosity and even the technical public has not betrayed a very lively interest. We are sorry for this, as the management has been enterprising, and there are many objects worthy of study and attention. But the fact remains that gas in this instance, contrary to its nature, has not been recognized as expansive in its possibilities by the great show-going and curiosity-loving population of New York.

ELECTRIC TRANSPORTATION

TROLLEY TRIUMPHANT IN CONNECTICUT.

A SPECIAL dispatch from New Haven, Conn., says: Notwithstanding the measure introduced in the State Senate to repeal what is known as the "parallel clause" of the general street railroad law, the leaders of the trolley interests in the State Legislature say that they are seeking no general legislation in their own interest, and, to use their own words, are "asking for nothing" and are contented with the situation as it stands. It remains true, however, that the existing "parallel clause," which imposes on the Superior Court Judges a decision as to whether a projected trolley parallel is a public necessity and convenience, will be opposed by many of the projectors and promoters of new trolleys. It is not generally known that the "parallel clause" applies to a projected new trolley road intended to parallel an existing trolley line as well as to a new trolley road intended to parallel a steam road. This partly accounts for the fact that a good many of the operating trolley companies favor the existing clause, the repeal of which is, therefore, doubtful, notwithstanding the trolley interests in combination undoubtedly control at this time both houses of the State Legislature.

What use they will make of their strength is now a question which arouses more interest throughout the State than any other matter before the Legislature. The common opinion seems to be that the trolley interests will at least so far work together as to help any of the trolley schemes which are resisted by no other interest except the New Haven Railroad Company. The hostility of the trolley corporations to that company, which has so long and bitterly fought them, and which crushed so many trolley enterprises in the Legislature of 1893, is well defined, and that very many parallels of the steam lines, will be authorized seems certain. One feature of the new situation is the rise in price of the bonds of trolley roads in this city, especially of the older roads. But it is believed that not half of the new trolley roads which will be chartered by the Legislature as a result of the steam railroad defeat will ever be built.

New Haven Railroad officials, in explaining their defeat, attribute it chiefly to the craze for trolley roads in many of the towns around them, which are seeking quicker transit. That craze, however, is not more marked than it was two years ago or four years ago, and the chief reason alleged for the steam railroad defeat are the anger of the lobby agents whose bills were cut down by the New Haven Company after the last session, and the better organization before election of the trolley corporations, which in many towns applied the "trolley test" to legislative candidates.

Surveys have begun for a new trolley road between Bristol and Meriden via Southington, a distance of about ten miles It will be a short "cut off" between the New England and New Haven steam lines.

EXTENSION OF ELECTRIC RAILROADING IN IRELAND.

United States Consul Ashby writes from Dublin as follows: The Dublin United Tramways have published notices of their intention to proceed in Parliament, session of 1897, with bills to permit extensive construction of new lines and to substitute electric traction for horse-power upon the existing lines. The company have also given notice of their intention to proceed before the privy council, Easter sittings, 1897, for authority to extend, vary, and enlarge existing tramway lines with such changes at passing places or crossings as may be necessary. All of these notices are the legal preliminaries toward the adoption of electricity as the means of traction upon existing lines and such new extensions as they may make. The new extensions contemplate a large number of lines connecting the various suburban districts with each other and with the city proper. The Dublin, Wicklow, and Wexford Railway Company have also given notice of their intention to proceed in the parliamentary session of 1897 with bills to allow extensions of their system of railways and with power to substitute electricity as the motive power upon their system to such extent as they may choose. This company now operates about 140 miles of railway. It is said that it is the intention of the company to substitute at an early date electric traction for both passenger and goods trains on their line from Westland Row (Dublin) to Bray, a distance of about 14 miles, most of the way lying through populous suburban towns. It is alleged that the competition of the Southern District Electrical Tramway, which parallels this line for 8 miles, has made this change necessary, as this line, which was opened in May, has already seriously interfered with the earnings of the railway and is constantly growing in favor with the suburban population. The municipal council of Bray is also favorably considering the construction of an electric tramway. Bray is a fashionable seaside resort, with a constant population of about 10,000, and has at present no tramway system. I also understand that the Tramways Company of Belfast intend to apply to Parliament for power to substitute electric traction on the tramways of that city. Should the action of Parliament be favorable to these various projects, there should be a good Irish demand for electrical goods.

AN ELECTRIC FREIGHT LINE.

Surveys are being made for the line of a proposed twenty-eight-mile electric railroad, which is to connect Norway with North Waterford, Stoneham, Harrison, and Bridgeton, Me. The road is to be used mainly for freight, and standard steam railway cars equipped with electric motors are to be used. For the passenger service, cars with express, smoking, and baggage compartments are proposed.

MECHANICAL

MEETING OF HEATING AND VENTILATING ENGINEERS.

THE annual meeting of the American Society of Heating and Ventilating Engineers was held last week at the house of the American Society of Mechanical Engineers. A number of interesting papers were read having more or less bearing on work which the electrical engineer is frequently called on to take into consideration. Among them were the following: "Methods of Proportioning Direct Radiation," by Prof. R. C. Carpenter; "Determining the Volume of Air Passing through a Register per Minute," by J. H. Kinealy; "Arrangement of Mains in Hot Water Heating Apparatus," by W. M. MacKay; "Circulation of Steam for Heating Purposes at or Below the Pressure of the Atmosphere," by R. P. Bolton.

Prof. R. C. Carpenter also read a paper on the "Relative Efficiency of Ventilation by Chimney and by a Fan." After stating the laws of the operation in each case the author gives a table showing the number of times that a fan or blower is more efficient than a chimney in discharging air from the top, with the outside temperature at 60 degs. F.

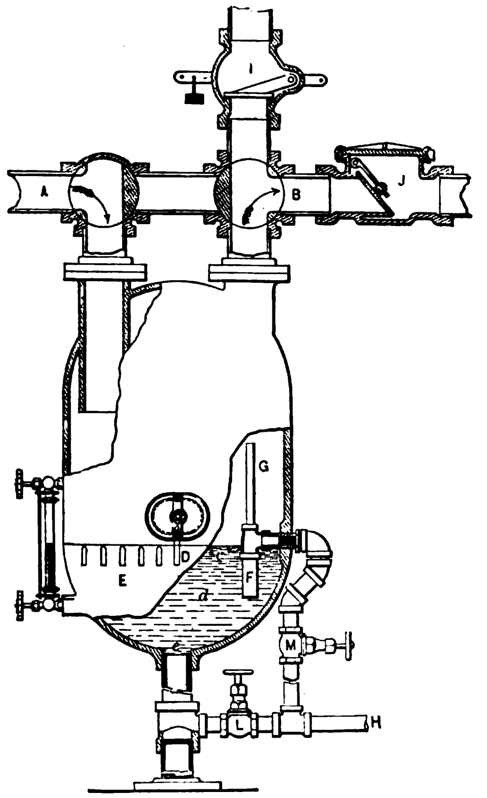
The table shows that in delivering air from a chimney 100 feet in height, even when the exhaust steam is wasted, the poorest fan will do nearly three times as much ventilating and the best 12 times as much as a chimney for the condition when both are using the same amount of heat. When the exhaust steam is utilized the average fan will move more than 100 times as much air as a chimney with the consumption of the same coal.

A fan is seldom used to draw air from a passage or flue, but is often used to deliver air into a passage or flue, and as this air is seldom heated the work of a fan under usual conditions is more fairly compared with the second case in chimney ventilation, viz., that of delivering cold air into a chimney.

A table embodying the latter conditions has been calculated by Prof. Carpenter, assuming that the exhaust steam is not utilized. This table includes a range of chimney heights from 10 to 300 feet and of chimney temperature from 80 to 450 degs. The table shows that with a 100-foot chimney and with the chimney gases at 400 deg., a fan or blower is 17.3 times as efficient as a chimney under such conditions.

Mr. W. J. Baldwin presented a very interesting paper on "Separation of Oil and Grease from Exhaust Steam," in the course of which he described a grease extractor devised by himself, which had given excellent results in practice. The author employs oil dams within the bulb, shown at E in the illustration, the upper edges of which dams are slightly above the water level of the apparatus, and their depth about three inches, with a high dam at D to prevent the return of the oil over the surface of the grating formed by the low dams E.

It was found in practice that with this arrangement the surface of the water at E was depressed and that the general movement was towards the high dam D under the lower edge of which both oil and water passed, the oil accumulating at C and the water returning in an under current again at the lower level just under the edge of D to fill up the space between the grating formed by the dams E E. This water is thus kept continually clean and ready to receive each deposit of grease, and it has been found by actual practice that the lighter oils are condensed by the contact with the water, so that the processes within the separator are akin to what one may call "washing the steam."



THE BALDWIN GREASE SEPARATOR.

The illustration shows the entire arrangement of the grease separator. Steam enters at A through a three-way cock, is cleansed of its oil and passes out again through B, either through the check valve J to the heating apparatus, or through the back pressure valve I to the roof. The accumulated water within the body of the apparatus is carried away through the overflow F, which is made non-syphonable by the open pipe G, allowing nothing but the excess of clean water to pass to the blow-off tank sewer.

Occasionally the valve L is opened and the dirt, water, and oil blown out. The gradual overflow of clean water from F prevents the clogging of pipes or sewers which would be the case by the constant dripping of oil.

THE OPPOSITION TO MR. H. C. PAYNE.

President Keelyn, of the Western Telephone Construction Company, has organized a remarkably strong opposition to the appointment of Mr. Henry C. Payne as Postmaster General. The protest recently referred to in these pages has been forwarded to Mr. McKinley, with the signatures of about 175 persons, most or nearly all of whom appear to be actively identified with opposition telephone interests. The chief ground of objection urged against Mr. Payne is that he is a "Bell benchman."

A PROGRESSIVE SHOP GIRL.

Anne Weiser, who in her capacity as shop girl was interviewed recently, as to what she would do if she had the new million dollar house of Mr. J. D. Rockefeller, among other sensible things, said: "I would have electric lights and furnaces and there would be real comfortable rooms lighted and heated for the servants."

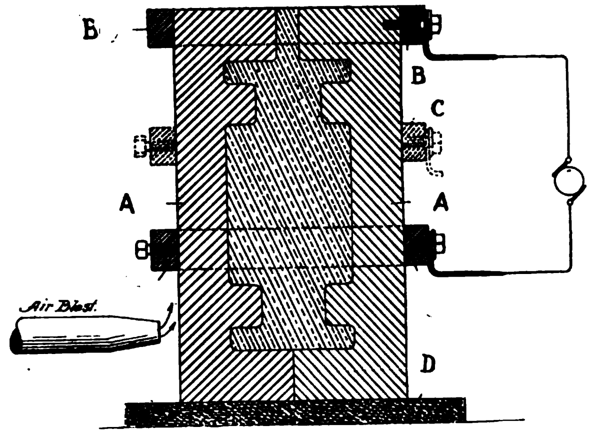
MISCELLANEOUS

ELECTRICITY IN ALUMINUM CASTING.

It has been found that with such metals as aluminum, where the shrinkage is considerable and special precautions have to be taken to overcome it, the most satisfactory results are obtained by heating the mold to the temperature of the molten metal when cast, that is, the molds should be heated to about 1,200 degrees Fahrenheit, which is about the temperature of molten aluminum. Then the ingot mold and metal contained therein are cooled together by special process, as by a blast of cold air or water, until the metal in the sinking-head or "riser" of the casting is the only portion still retaining its heat.

This system is the one which has been found to be the most satisfactory in the manufacture of aluminum bicycles; in fact, it is the only method which has been found to be satisfactory for making difficult castings as the frame work of bicycles.

A process having the same object in view, but allowing of more certain results being attained has just been patented by Capt. Alfred E. Hunt, of the Pittsburg Reduction Company. In this method, instead of the heat being applied externally, the heating is done by passing an electric current through the metal mold, and taking off the current at the desired times and as wanted, thereby more conveniently and accurately obtaining the desired temperature of the mold in the cooling of the aluminum and similar metal castings.



HUNT'S METHOD FOR CASTING ALUMINUM.

The accompanying engraving shows the manner in which the method is applied in practice. The mold is supplied with two contact rings, the upper one, B, being fixed and the lower one, A, movable. Current is first sent through the contact rings until the mold is heated up to the temperature of molten aluminum. The metal is then poured and the lower contact ring A moved upward towards B, as shown in outline at C, so as to shorten the circuit through the mold and molten metal and to cause the upper part to be heated by the current while the heating influence is removed from the lower part. The lower part will then cool, and its cooling is accelerated by water or an air-blast. The contacts are then approached still more, so as to expose more of the lower part of the mold to the more rapid cooling, and so the operation is continued until the casting becomes solid and sufficiently cold to prevent unequal shrinking. As the chilling of the metal progresses slowly from the bottom to the top, the casting shrinks in like direction and sound castings are produced. The whole operation is economical and very efficient, especially when it is conducted in places where electrical energy is cheap.

JACKSONVILLE, FLA.—The work of laying the extension of the Jacksonville Street Railroad is being rapidly pushed ahead. The road bed is being graded, and all work is being done as the work progresses. About 1,500 feet of track will be laid.

CONVENTIONAL DIAGRAMS OF ELECTRICAL APPARATUS.[1]

BY D. W. C. TANNER.

IT has become apparent, more especially in the last few years, that the use of simple and comprehensive diagrams is necessary in order quickly and conveniently to represent the different forms of electrical apparatus and their innumerable arrangements.

Perhaps the most noteworthy of the efforts which have been made toward uniformity of symbols has been that of Prof. Francis B. Crocker, whose chart appeared in The Electrical Engineer of May 13, 1891, and was afterward reprinted in Houston's "Electrical Dictionary." This chart was compiled for the use of students at Columbia University. While many of the diagrams are in common use to-day, there are some which have become almost obsolete in so short a time as six years, and many totally new ones are required which have become necessary since the chart was published.

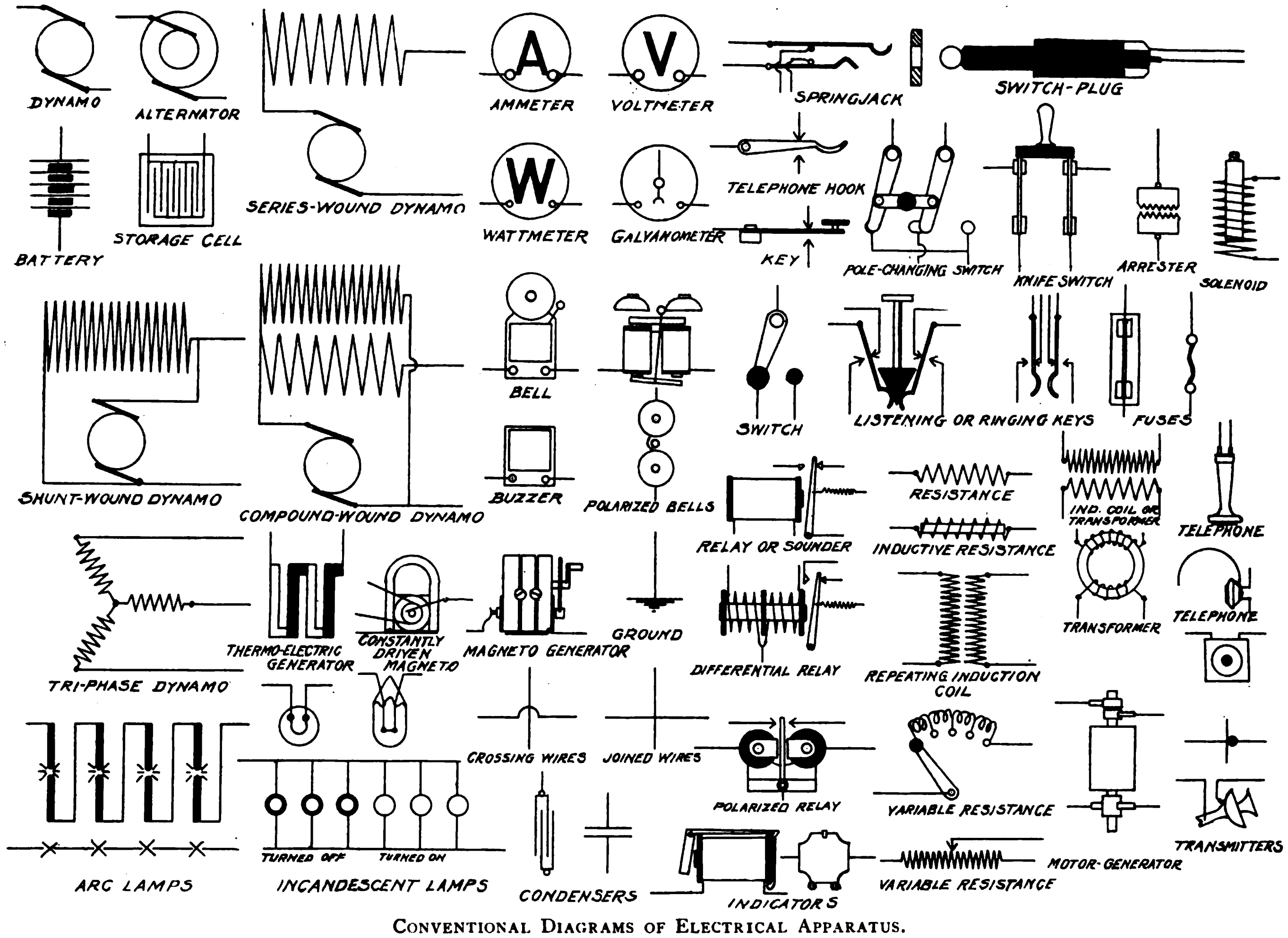
In 1873 C. H. Davis and F. B. Rae published a "Handbook of Electric Diagrams," which deserves but a passing notice, for the work was designed merely to show the circuits and mode of operation of a number of telegraph instruments, and not their simple representation.

The Patent Office has done something toward simplification and uniformity, but by criticism rather than by definite instruction. If the diagram submitted does not please the examiner, it is promptly rejected, but often without giving the applicant a very clear idea of just what is wanted. The most that is done is to refer to the work of some attorney whose diagrams are considered good.

Prior to 1892, the method of illustrating a telephone exchange system varied pretty largely with the tastes of the individual. Very often a switchboard was shown in vertical section, complete, with the keys, spring jacks, plugs, etc., in their proper places, fully drawn in detail. About this time Mr. F. R. McBerty, of the Western Electric Company, began the work of simplification, and the present method of illustration, which is remarkably clear and easily understood, is very largely the result of his work.

The symbols shown in the accompanying chart have been selected as being those which, upon careful comparison with others, seemed to be the best adapted for the purpose. Of course, it is very difficult to make such a chart complete, but it is hoped that the majority of the symbols for which demand is most frequent, will be found without difficulty.

Where more than one symbol is shown for the same device, the simpler form is intended to be used where it is desired to show a number of the devices, and that which bears a somewhat closer resemblance to the original will be best adapted where only one or two are required. The intention was not to show the circuits and mode of operation of complex systems or mechanisms, but only to indicate the symbols for the elemental or unit pieces or apparatus, which may be combined at pleasure.



CONVENTIONAL DIAGRAMS OF ELECTRICAL APPARATUS.

ALUMINUM FOR ELECTRICAL CONDUCTORS.

BY C. C. BURR.

IN substituting aluminum for copper for conveying current from the power house of the Niagara Falls Hydraulic Power and Manufacturing Company, to their pot room building, the Pittsburg Reduction Company made this innovation because aluminum had many qualities in common with copper and others in addition that made it particularly desirable. The relative location of the power house and pot room rendered the installation of the line exceedingly difficult, as the power house is situated at the bottom of the Niagara gorge, nearly 250 feet below the building where the current is used. This line being vertical and of sufficient cross section to carry at least 10,000 amperes, and owing to its considerable length of rather large cross section relative to the amount of current transmitted, rendered it exceedingly difficult to install.

To construct a line of this length and carrying capacity requires nearly 24 tons of copper, while if made of aluminum its weight would be only 11½ tons, with the same current capacity as the copper line. Furthermore, aluminum, owing to its lightness, is no more expensive than copper, is equal in strength, and superior, in that it is not so easily corroded. Another advantage gained through the lightness of aluminum was the saving in the construction of the wire tower. This tower is a steel-frame structure fastened to the side of the penstock and follows the general course of it from the power house to the top of the gorge. This wire tower would have necessarily been heavier had copper been used.

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[1] Abstract of a paper read before the Chicago Electrical Association.

Considering all the merits of the two metals, the Pittsburg Reduction Company adopted aluminum in place of copper, as it had advantages over copper to more than offset its lower conductivity. The relative conductivity of copper and aluminum is as 100 is to 63; but as copper is 3.3 times heavier than aluminum weight for weight aluminum has a conductivity relative to copper as 208 is to 200. The temperature co-efficient of the two metals is nearly the same.

The details of the line are as follows: Each conductor is made up of 250 ⅜-inch rods, 350 feet long. This seems at first to be a somewhat complicated construction, but it possessed many advantages over the ordinary form of conductor for this particular location. The rods in this conductor being in one piece at once dispenses with all intermediate joints and splices. These rods are supported in the wire tower at intervals of 25 feet. The supports are of wood and the conductors are so fastened that each rod is supported independently of the others. This method of support affords an easy means of equalizing the weight, and providing for expansion and contraction by changes of temperature. This is accomplished by making an S-shaped bend in each rod just above each support.

It may be of interest to note that in addition to these conductors that carry the current up the side of the gorge, the current used in reducing aluminum is distributed to the pots or furnaces through aluminum conductors. These conductors have the same area as the main cables, but are made up of flat bars instead of round rods. In this connection it may be stated that these bars are subjected to particularly severe use as they are exposed to considerable heat and to acid fumes. Notwithstanding this, these conductors do not corrode sufficiently to cause any trouble, or show any tendency to warp out of shape.

Aluminum has been in use for electrical conductors in both the upper and lower works of the Pittsburg Reduction Company for some time, and has shown itself in no way inferior to copper and it is perfectly safe to say, I think, that it has passed the experimental stage and has shown itself as an electrical conductor, as in other uses, the equal of copper.

THE FIN DE SIECLE SAFE BURGLAR.

BY SLEUTH.

A NEW and very perfect illustration of the fact with which all electrical experimenters are familiar—the difference between laboratory experiment and practical use of electrical manipulation—has just recently come to the surface; which, originating in the columns of a daily newspaper—you know how profoundly scientific and eminently practical a daily reporter is—has been copied, profusely lengthened, made as terrible and ghostly as possible, by some of the electrical journals, and has sent shudders of fear through the brains and bodies of bankers and other unfortunates who have money under time locks and other safeguards, who dislike to part with their valuables without proper consideration.

Alas! for their future wellbeing. There is no safety in the coming years for their hoarded wealth, if this newpaper prophesy is to be credited. Now, we are told, it has become possible for the expert electrical burglar to use a current of 350 to 500 amperes, at a pressure of 40 to 50 volts, and go through an iron safe wall of three to six inches in thickness, in from three to ten minutes. This has been done—in the laboratory. Previous to perfect success in this line, however, it will be necessary the burglar should procure his supply of current, at the proper voltage; or, arrange so that, by having his amperes in one vessel and his volts in another, they can be mixed according to his needs. Kept apart in that way the fiery element could do no harm.

He cannot be quite sure of proportions in ordinary commercial currents, and, consequently, he might possibly err fatally in picking up the wrong conductor.

But, in addition to all that, before he can reach the safe, he must cross a perfect network of wires, so placed out of sight as to defy inspection, positive and negative in the same flexible cord, to cut which means a short circuit; burglar alarms on every gate, door, window, and in certain floor boards; connected to chairs, desks, stools, etc., the disarranging of any one of which rings the alarm. Having passed all these barriers successfully, if he ever could, when he attacks the safe, long before he can melt his way through the outer layer of metal he has brought two wires together, rung an alarm, without knowing it—and he doesn't get into the safe after all.

The original article on this sensational subject suggested that the supply of current could be readily taken from the street main. So it could, most certainly. In proof of this the fact has been repeatedly shown that men can, and have, taken the current from supply mains, even more than is required for melting through safes, though in numerous instances the parties maintained most perfect silence about it ever after.

I hardly think electrical safe burglary can be looked upon as an exact science up to date.

LETTERS TO THE EDITOR

DR. PERRINE AND THE CHICAGO SCHOOL.

MR. R. A. BAGNALL, of the Chicago School of Electricity, in his letter to you protesting against my disclaimer of connection with their school, states that this has not been announced except in so far as using my name as an editor of the Lesson Leaves they are publishing would imply such connection. He also states that no one interested financially in the National School of Electricity is in any way connected with the Chicago School of Electricity, but as I knew that it was publicly charged that the Chicago school was a direct outgrowth of the National school, I wrote to you in order that it might be clearly understood that I had no connection with this outgrowth.

I charged bad faith on the part of the managers of the National School of Electricity because although they originally agreed to publish the Lesson Leaves only as lecture syllabi for the information of their own students, these lesson leaves were published in book form and subsequently the copyright was sold, my name being used as one of the editors without my consent and without my having had any effective connection with their preparation as an editor. As I previously wrote you I reviewed these lessons as they were issued and after they were completed, protesting against certain matter which I found in them, but I was unable to see that my suggestions had any effect upon the true editors and at the time the National school failed I had already written a letter to the president protesting against the publication of these Leaves, but did not mail the letter on account of hearing that they had failed before it was possible for me to do so.

I do not now intend to criticise the Lesson Leaves either favorably or unfavorably, and simply state that I was in no true sense an editor of them, although I endeavored to act in that capacity as required.

Pardon me for encroaching on your space in this matter, but I have been charged with having written my previous letter without proper information, and I desire to have it known that my position is unchanged by any information received since its publication.

FREDERIC A. C. PERRINE.

January 22, 1897.

THE SIEMENS-HALSKE UNDERRUNNING TROLLEY.

WE have noticed from time to time both in the reading columns and advertising columns of your paper that statements were made by certain competitors that they absolutely owned and controlled the patents covering all underrunning trolleys.

This statement does not refer to the Siemens trolley or contact bar, the well-known device in use all over the world, which has been described repeatedly; it makes a sliding contact with the trolley wire, making overhead construction very simple and doing away with the necessity of switches and frogs, besides making it impossible for the device to be "off the trolley."

There were also statements in the papers that certain American companies had patents on electric railway conduits and had installed what they pleased to term "The Buda Pesth Conduit System."

It is a well-known fact that the first successful electric conduit system—the Buda Pesth conduit system—was installed by Messrs. Siemens & Halske, Berlin, and all United States patents covering the main features of this system are owned and controlled by the Siemens & Halske Electric Company of America.

The Siemens & Halske Electric Company are prepared to furnish complete trolley stands and trolley contacts and to install complete trolley stands and trolley contacts and to install complete electric conduit railway systems under the patents they own and control or they are willing to license prospective customers under these patents.

We think that these facts—and facts they are—will be undoubtedly of interest to many of your readers and we ask you kindly to mention them in the reading columns of your valuable paper.

F. B. BADT, Sec'y.
Siemens-Halske Electric Co.

Chicago, Ill., Jan. 28, 1897.

A NEW (?) METHOD OF SPEED CONTROL FOR ELECTRIC MOTORS.

In the December 16, 1896, issue of The Electrical Engineer there appears an article by Prof. W. A. Anthony, under the above title, propounding a scheme for the speed regulation of motors. This idea is brought out as new. As a matter of fact, it is very old. There is a patent to Wightman and to one other person in the United States; there is a patent to Rechniewsky in France, patents to Essberger in Germany, and, I believe, also an English patent, although I cannot give its name. Essberger's patent is No. 84,182, issued June 10, 1894. The patent to Rechniewsky is some years before this. I cannot give the exact date at the moment.

Machines embodying the idea in question have been built to a considerable extent by the Union Elektricitäts-Gesellschaft, of Berlin. Quite a number of machine tools were fitted with motors of this type and exhibited at the recent Berlin Industrial Exposition. A line of these motors is listed in the last general catalogue of the Union Elektricitäts-Gesellschaft, dated April, 1896.

It is strange that such an old idea should be brought out at this late date as apparently new, especially as so many patents have been taken out on the subject.

Professor Anthony's method of accounting for sparking in motors might be considered new. The sparking in a motor is not due to the disappearance of magnetic lines, but to their distortion into the region of commutation.

JOHN B. BLOOD.

Berlin, January 11, 1897.

(Mr. Blood has forwarded to us the catalogue referred to in his communication.—Eds. E. E.)

PERSONAL

CONOVER-GOE COMPANY.

THE gentlemen interested in this new company, just established at Chicago, bring to it years of experience in the electrical business. This, combined with ample capital to carry out their plans of work, would seem to promise a successful future. Although a "new company" in one sense of the term the members of it are by no means "new" to the central stations and consumers of the United States. As will be seen, the business to be carried on is in reality an amalgamation of the interests, in the Western States, of several different concerns under the management of Messrs. Conover and Goe. These lines of manufacturing have been successful for a number of years, but it is the purpose of the Conover-Goe Company to extend the field of operations and to increase the demand for the output of the various factories interested.

Mr. George W. Conover is well and favorably known to the electrical fraternity. He was for many years the buyer for the old Electrical Supply Company, and his associations with that company brought him into personal contact with the leading manufacturers of electrical and hardware specialties. The acquaintances thus formed have since been added to by several years of activity in selling electrical supplies. It is a rare thing to find the qualities of a good buyer and a good seller combined in one person, but Mr. Conover's business career seems to warrant the assumption that he has the two talents strongly developed.

GEORGE W. CONOVER.

D. E. GOE.

Mr. D. E. Goe has been identified with electrical development, as he expresses it, ever since he was 'knee high to a duck," having made an application for patent on sundry improvements, etc., when only thirteen years old. As he stands about six feet in his "stockings" we estimate his experience covers a period of about thirty years. His actual work began with the unpoetical occupation of scooping out telephone postholes under the direction of the late Wiley W. Smith. However, he soon determined to climb up, and various promotions brought him to the position of State Superintendent for the Southern Telephone and Telegraph Company. About this time electric lighting was claiming a large share of energetic talent, and Mr. Goe became engaged in the installation of isolated plants. The fund of practical experience gained in this occupation has been of invaluable service. In 1890 he made the acquaintance of Mr. F. S. Terry and was asked to assume the duties of advertising manager for the Electrical Supply Company. To this work he applied himself with a zeal that smacked of dormant newspaper acumen, and station men were taught through the advertising columns of the trade press that the Electrical Supply Company was by all odds the biggest thing on deck at that time, and they also discovered that there was a real funny, as well as a serious side to the station man's daily toil. For the last two years he has been manager for the Central Electric Company and has also directed the advertising work for them.

The Conover-Goe Company have contracted for the entire output of electrical and hardware specialties manufactured by the C. H. Dicke Tool Company. Other lines controlled in Western States are made by the Paragon Arc Lamp Company, Boston, Mass.; the line of Hartford switches made by the Gibbs Electric and Manufacturing Company, of Hartford, Conn.; porcelain specialties, rubber goods and insulated wire made by C. S. Knowles, Boston, Mass. We have no doubt that the affairs of the Conover-Goe Company will at once assume gratifying and profitable proportions and we are quite certain that the many friends of the gentlemen interested will wish them all possible success.

MR. C. B. STERLING has become president of the Standard Electric Lamp and Novelty Company, of 248 West Twenty-third street, New York City, taking the place of Mr. Chas. A. Fowler, who has resigned in order to devote his attention to other pressing interests. Mr. Sterling is a very young man, of energy, tact and experience, who is already well known and greatly liked in the industry. He informs us that his company has its hands full of business, and is supplying a good many new customers. The company will be glad to answer inquiries as to small lamps and novelties in the illuminating decorative line.

MR. MORRIS F. TYLER.—An unsuccessful attempt was made about a week ago to abduct the four-year-old son of Morris F. Tyler, president of the Southern New England Telephone Company, in New Haven. The little fellow was seized while playing on the lawn in front of the house and taken to Whalley avenue, where his screams attracted the attention of a bystander and the thief dropped the boy and ran. The boy, Leonard, was taken to his home and Mr. Tyler notified the police.

MR. H. C. DAVIS.—A gold watch was taken from the pocket of Henry C. Davis at the Grand Central station on Jan. 26. More than could be realized on it was offered in an advertisement for its return to the owner's son, C. H. Davis, No. 99 Cedar street. The watch was presented to Mr. Davis when he was president of the Electric Club. He is now president of the State Line and Sullivan Railroad, in Pennsylvania, and his home is in Philadelphia.

PROF. A. G. WEBSTER, of Clark University, is delivering a course of ten lectures at the Lowell Institute, Boston, on the nature of electricity and its relation to the various phenomena of the ether.

SUPT. J. ELLIOT SMITH, of the Fire Department, has been commended by Commissioner La Grange for the economical management of his department of telegraphs.

THE STOCK MARKET

ACTIVITY AND STRENGTH.

CONDITIONS improved again last week, the close of which found the market cheerful and even buoyant. The main reason was perhaps the activity and strength in all leading bonds, prices of which have materially advanced, while many are simply unobtainable.

Attention is being directed to the copper stocks, whose advance reflects a more active demand for the metal, due in no small measure to the revival of electrical uses. A year ago copper was at 10 cents, and in spite of very dull business in this country it advanced to 11½ cents at the close. That was an advance of 1½ cents. The year opened with copper at 11½ cents, and with any sort of good business, instead of the advance being 1½ cents it will be 3 cents for the year.

Electrical securities were firm and in brisker inquiry all the week. General Electric sold from 34⅛ up to 35⅞, and its more sanguine supporters predict an early 40. Twenty-one thousand seven hundred shares changed hands, or nearly five times as many as of Western Union, which remained quiet around 84. In Boston, American Bell declined ¼ to 212¾ on sales of only 367 shares. Other electrical stocks are quiet. The general commercial improvement is shown in the fact that the number of business failures fell off no less than 103 for the week, as compared with the preceding week, or about 25 per cent., a remarkable gain for the better also over 1896, by 67.

REPORTS OF COMPANIES

DISSOLUTION OF THE RIES ELECTRIC SPECAITY CO.

The affairs of the Ries Electric Specialty Company, of Baltimore, were finally wound up at a meeting of the directors last week at the office of Bernard Weisenfeld, who, with Mr. Sylvan Hayes Lauchheimer, were appointed receivers of the company in July, 1894.

The meeting was called to order by Mr. Elias E. Ries, the president of the company, and was attended by a majority of the directors and stockholders. The receivers submitted a statement showing that the account filed by them in Circuit Court No. 2 provided for the payment of all the merchandise creditors of the company in full, with interest to date. A resolution was then passed formally dissolving the corporation according to law.

The Ries Electric Specialty Company was incorporated in June, 1891, with a capital stock of $25,000, which was subsequently increased, in June, 1892, to $150,000.

EDISON ILL. CO. BROOKLYN, N. Y.

The Edison Company, of Brooklyn, at their annual meeting re-elected the old Board of Directors and officers. The report submitted contains a great deal of interesting matter, and among other items of interest it announces that during the year 16,098 feet of underground mains and 6,981 feet of underground feeders had been added. The overhead system of the Citizens' Company has 417 miles. The meter department has a total of 2,810 meters. At the foot of Sixty-sixth street, the company has arranged to place a large station, with the intention of equipping it so as to run with the utmost economy and efficiency, as well as for the transferring of current for any use economically to any part of the city. The condensed balance sheet shows: Debits—License account,$945,000; plant account, both companies, $4,120,628; insurance fund, $58,980; accounts receivable, $105,110; material and supplies, $54,943; cash on hand, $29,564; total, $5,314,227. Credits—Capital stock, $3,750,000; first mortgage bonds, $1,000,000; accounts payable, $72,085; bills payable, $155,000; dividend due January 15, $56,250; accrued interest, $12,500; insurance fund, $58,980; depreciation account, $150,000; profit and loss balance, $59,411; total, $5,314,227.

DEATHS FROM GAS IN BOSTON.

The many deaths in Boston by asphyxiation have directed sharp attention to the nature of the gas furnished, and it is likely that a legislative inquiry will result. Figures furnished by Dr. Draper for the district in which he is the medical examiner show twenty-four accidental deaths by asphyxiation in 1896. This is considerably over a third of the total number of such deaths in the district for eighteen years, while the first month of 1897 furnishes many more evidences of the peril. The increase in mortality is claimed to be coincident with the use of water gas. This latter is much more insidious than the old kind. There was a chance of resuscitation in cases of partial asphyxiation by coal gas, but the water gas poisons the system in a very brief time. Dr. E. S. Wood, of the Harvard Medical School, says that water gas contains as a rule about 40 to 50 per cent. of hydrogen, 30 to 40 per cent. of carbonic oxide, and about 10 per cent. of petroleum or naphtha gas. As it is comparatively devoid of odor, its escape from pipes and diffusion through the air of an inhabited room in dangerous amount cannot be readily detected. Carbonic oxide, Dr. Wood says, is one of the most active of poisons, producing, when inhaled, speedy death, and, according to Leblanc, one volume of it diffused through 100 volumes of air totally unfits it to sustain life. It is suggested by Dr. Wood that the addition to water gas of more petroleum gas would very greatly diminish the danger by imparting to the mixture a very powerful odor.

MR. CHARLES DICKERSON, until recently chief engineer of the Pabst Lighting and Heating plant, Milwaukee, has been chosen chief engineer of the Fond du Lac, Wis., Electric Company.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

BY MAX OSTERBERG.

Central Stations:

GRAPHICAL COMPARISON BETWEEN ALTERNATING VS. DIRECT CURRENT STATIONS. By Fritz Goldenzweig. Two stations built in Vienna in 1892 are carefully compared and results show considerable saving in the alternating current station over the direct.—Elektrot. Zeitschr., Dec. 31, '96.

Dynamos and Motors:

REPAIRS OF ELECTRICAL MACHINERY. By A. R. Harris. Author explains how simple repairs on armature or on connecting pieces may be made.—Am. Mach., Jan. 14, '97.

IMPROVEMENT IN CONTINUOUS CURRENT TRANSFORMERS. A diagram of a continuous current trasformer system of distribution for a district in which the power is so remote from the center of consumption as to make it undesirable to have direct supplementary low pressure feeders. Also an illustration of variable ratio transformers generating on one side 485 amperes between 205 and 240 volts the primary pressure being 1,000 volts.—Lond. Elec., Jan. 8, '97.

A TWO-PHASE ROTARY TRANSFORMER. The Alioth Electrical Company, of Munchenstein, has built a machine into which a two-phase current at 2,400 volts is fed, and then transformed down to 70 volts, into continuous current, to feed the three-wire lighting network.—Lond. Elec., Jan. 8, '97.

Electro-Chemistry:

RESISTANCE OF ELECTROLYTES TO ALTERNATING DISCHARGES. By Prof. Cardani. In the "Nuovo Cimento" for October, author states that electrolytes do not conduct such discharges through the surface layers, but evenly throughout their mass, that they obey Ohm's law, whatever the frequency of oscillation. Herein they differ from metallic conductors. Their impedance is equal to their resistance to continuous currents.—Note from Electricity, Jan. 20, '97.

THE PREPARATION OF MANGANESE IN THE ELECTRIC FURNACE. By Henri Moissan. With very large currents (500 amperes and 50 volts) the reduction of oxide of manganese can be accomplished in a few minutes.—Electricity, Jan. 20, '97.

Electro Therapeutics:

THE DEVELOPMENT OF THE HIGHER VOCAL REGISTER BY ELECTRICITY. By W. H. King, M. D. Paper read before the Nat. Soc. of Electro-Therapeutists. After an introduction dealing with the principles of physics, author compares the larynx to a musical box, the vocal register to a string under tension and shows how by electrically caused reactions the vocal chord can be made more flexible, thus being enabled to produce quicker vibrations, and hence develop higher vocal register.—Electricity, Jan. 20, 97, and subsequent issue.

Lighting:

DETERMINATION OF THE COST OF ELECTRIC LIGHTING BY GAS ENGINE. By J. L. Christy, M. E. and S. A. Hasbrouck, M. E. A test with 10 h. p. gas engine showed the cost of electric light from a dynamo connected by counter shaft to be for small loads .78 cent per lamp hour, while for larger loads this went down to .29 and .277 cent. The price of gas was figured at the rate of $1.25 per 1,000 cubic feet.—Stevens Indic., Jan., '97.

LIGHTING BY MUNICIPALITIES. By Frank B. Rae. Author quotes a number of specific cases in which cities saved considerable amounts after they had their own plants. While certain items such as taxes, water rent, etc., are lost as soon as the city takes the lighting upon itself, Mr. Rae believes that items such as depreciation should not be considered in the annual expenses.—Elec. Journ., Jan. 15, '97.

SOME NOTES ON THE USE OF HIGH VOLTAGE LAMPS. By G. L. Addenbrooke. Author admits that the progress in the manufacture of this type of lamps has been greater than formerly assumed by him; 220 volt lamps are being introduced in many places in England. But it is believed that 250 volt lamps will be the upper limit for some time to come. Lond. Elec. Eng'r., Jan. 1, '97.

RESULTS OF INCANDESCENT LAMP TESTS. By H. Riggert, Hanover. A large number of tables, showing efficiency, variations of voltage, etc.—Elektr. Zeitschr., Dec. 31, '96.

THE PROBLEM OF LAMP SUPPLY. By Dr. O. Gusinde. The city of Hanover's electricity works supply their customers with lamps free of charge under certain conditions; these are given in detail. The article also contains a copy of the forms in which specifications for bids are made.—Elektrot. Zeitschr., Dec. 24, '96.

ST. LOUIS LIGHTING CONTRACT. Detailed specifications issued by the Board of Public Improvements. The requirements are at present 7,000 arc lamps and 4,000 incandescents.—Elec. Journ., Jan. 15, '97.

ON THE EFFECT OF PRESSURE IN THE SURROUNDING GAS ON THE TEMPERATURE OF THE CRATER OF AN ELECTRIC ARC. By W. E. Wilson, F. R. S., and G. F. Fitzgerald, F. R. S. The greatest difficulty in the way of exact results seems to lie in the determination of the temperature of the crater. Editorially an interesting practical point in connection with this paper is brought out: If the temperature of the crater is lower than the vaporizing point, there is a possibility of the luminous efficiency of the arc being increased by some device which will raise its temperature nearer to the vaporizing point.—Lond. Elec., Jan. 8, '97.

Measurement:

THE METRIC SYSTEM IN ELECTRICAL INDUSTRIES. By F. S. Hickok. Paper read before the Chicago Elec. Assoc. Nov. 6, '96. Commencing with the methods and systems of the ancients, author gradually leads up to the development of methods of measurements up to the present time.—Electricity, Jan. 20, '97, and subsequent issues.

Miscellaneous:

TORONTO SCHOOL OF PRACTICAL SCIENCE. Illustrations and some particulars of the engineering equipment.—Can. Elec. News, Jan., '97.

ELECTRIC WELDING. By Sydney F. Walker. Paper read before the Bristol Channel Center of the Institute of Marine Engineers. After explaining that the term welding should really be applied to iron and steel only, author explains what the real process of rigidly combining two pieces of the same or of different materials is, and then takes up Thomson's, Terener's and Benardos' processes. Lond. Elec. Engr., Jan. 8, '97.

Power Transmission:

LOCAL DISTRIBUTION OF ELECTRIC POWER IN WORKSHOPS, Etc. By Ernest Kilburn Scott. The first of a series of articles commences with an enumeration of the advantages of electrical transmission of power to isolated points comparatively close together, such as the tools in a shop or factory. Author gives a table showing the relation between the power, total dead weight and number of bearings for different sized shaftings in several representative establishments.—Lond. Elec. Eng'r., Jan. 1, '97.

Railways:

THE SYSTEM OF THE WASHINGTON, ALEXANDRIA & MT. VERNON RAILWAY. This railway system consists of a combination underground conduit and high speed trolley. Descriptive details and illustrations of the important features are contained in Str. R'way Journ., Jan., '97.

STREET RAILWAY SYSTEM OF PARIS. Br. M. Lavalard. The first of a series of articles giving a general outline of the development of the railway system.—Str. R'way Journ., Jan., '97.

ELECTRIC RAILWAY POWER STATIONS IN AMERICA AND THE ECONOMIC RESULTS OF THEIR OPERATION. By L. D. Tandy. Author has prepared tables, the first one showing the type of station as to its first cost, boilers, pressure used, style of engines, method of general connections, cost of coal per net ton, pounds of coal per kilowatt hour, pounds of water per ton of coal, also per kilowatt hour; finally cost per kilowatt hour. The sum total for the latter varies from .0061 in the finest to .0112 in the poorest type of station. Another table gives percentage comparison between the high type stations.—Str. R'way Journ., Jan., '97.

ELECTRIC RAILWAYS WITH STATIONARY ACCUMULATORS. By Ludw. Schröder. Various methods used in actual practice are explained; of special interest is the plant in Meckenbeuren-Tettuang, where the storage battery is simply connected in multiple with the dynamos, which latter, however, though compound-wound, always run as shunt machines. In order to charge the batteries they are subdivided into several parallel sections, to cut down the voltage. Another interesting system is at Remscheid; there a booster is in series with a storage battery, the field of the booster being regulated by the main current, thus drawing the battery into use, or charging it or keeping it neutral.—Elektrot. Zeitschr., Dec. 31, '97.

MUNICIPAL CONTROL OF TRAMWAYS. By T. P. Wilmshurst. Author favors municipal ownership, principally for the reason that such roads are run with the intention of best serving the public, and that it is not even necessary for such a road to earn any money so long as it is self-sustaining.

In connection with municipal lighting plants, it offers the opportunity of straightening the load line.—Lightning, Jan. 7, '97.

Telephony, Telegraphy, etc:

NEW TELEPHONE EXCHANGE AT WINNIPEG. Some difficulty has in the past been experienced with boards, where it is necessary to transfer connections from one section to another, in having the line properly disconnected when the conversation was finished. A special feature has been introduced into this board to obviate the trouble.—Can. Elec. News.

Wires, Wiring, etc:

BARE COPPER MAINS. J. H. Tonge has had a stoneware conduit manufactured, which is cheap, easily and quickly laid. It is made in sections, two feet long, the ends being imbedded in concrete on stoneware bearers. In the course of manufacture a recess is cut out of every third section, within which an insulator, secured with pitch, is dropped. Copper strips are then laid in the slots of the insulators and the whole covered up with flagstones. The design permits of a feeder and three-wire distributor at a pressure of 440 volts between the outers.—Lightning, Jan. 7, '97.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JANUARY 12, 1897.

Alarms and Signals:—

SYSTEM FOR ELECTRIC SIGNALING. W. McC. Ramsey, Allegheny, Pa., 575,733. Filed Aug. 9, 1894.

Block signal system for a single track trolley road.

ELECTRICAL SIGNAL SYSTEM. P. Freeman, New York and R. B. Slater, Montrose, N. Y., 575,805. Filed May 25, 1896.

Means whereby a train may be prevented from entering upon a given block until the block is clear throughout its length.

SWITCH AND SIGNAL APPARATUS. J. G. Schreuder, Edgewood Park, Pa., 575,908. Filed Sept. 21, 1895.

Electropneumatic system.

Conductors, Conduits and Insulators:—

INSULATOR. F. Hoover, Paducah, Ky., 575,952. Filed May, 19, 1896.

Adapted to fit in the under side of the cross arms.

Dynamos and Motors:—

BRUSH-CARRIER FOR DYNAMO ELECTRIC MACHINES. S. S. Wheeler, New York, 575,918. Filed May 26, 1896.

Comprises rings insulated from each other and mounted on the frame of the machine at the inner end of the commutator, brush-carriers on the rings extending over the commutator, and brushes mounted on the carrier.

Electro-Metallurgy and Electric Smelting:—

ELECTRIC SMELTING. T. L. Willson, New York, 575,788. Filed February 20, 1895.

Consists in feeding the material to be reduced in a suitably pulverized condition, together with the reducing agent in similar condition, into an electric arc formed by alternating current.

ELECTRIC FURNACE. J. A. Deuther, Boston, Mass., 575,828. Filed August 21, 1896.

Comprises a suspended electrode, a mechanism for vibrating the electrode, and a feed mechanism for feeding the material to be treated within the path of the electric arc during the interval beween a back and forth movement of the electrode.

ELECTRIC FURNACE. J. Joyce and J. A. Deuther, Boston, Mass., 575,829. Filed October 12, 1896.

Similar to above.

Lamps and Appurtenances:—

WIRE GUARD FOR LAMPS. P. R. Wagor, Springfield, Mass., 575,794. Filed March 6, 1896.

Adjustable wire guard for incandescent lamps.

Measurement:

APPARATUS FOR DETERMINING ELECTRICAL RESISTANCES CONTAINING ELECTROMOTIVE FORCES. O. Frölich, Charlottenburg, Germany, 575,767. Filed May 11, 1895.

Employs a Wheatstone bridge system including the resistance in one of its lateral branches, means for causing variations in the current flowing through one of the diagonal branches of the bridge system, and means for measuring the ratio of the variations of the current in two diagonal branches.

ELECTRIC METER. W. C. Fish, Lynn, Mass., 575,777. Filed October 16, 1896.

Combines an armature, a field coil therefor, recording mechanism actuated by the armature, and means for weakening the field periodically.

Miscellaneous:—

ELECTROMECHANICAL MOVEMENT. E. D. Chaplin, Cambridge, and H. G. Halloran, Boston, Mass., 575,699. Filed March 21, 1896.

Reciprocating measurement adapted especially to rock-drills.

ROENTGEN RAY TUBE. E. Thomson, Swampscott, Mass., 575,772. Filed August 21, 1896.

Comprises a chamber having a Crookes vacuum and provided with a pair of concave electrodes both of which face upon a bombarded metal piece situated in substantially the focus of their concavities.

ELECTRIC APPLIANCE FOR HORSES. L. A. Gray, Arlington, Md., 576,053. Filed October 29, 1896.

ELECTRIC CONTROLLING APPARATUS FOR PNEUMATIC DESPATCH TUBES. E. A. Fordyce, Chicago, Ill., 575,883. Filed June 23, 1893.

Details of construction.

Railways and Appliances:—

RAIL SUPPORT. W. B. Potter, Schenectady, N. Y., 575,782. Filed August 25, 1896.

Rail insulator to "third-rail" system.

CLOSED CONDUIT ELECTRIC RAILWAY. E. W. Rice, Jr., Schenectady, N. Y., 575,785. Filed October 31, 1896.

Embodies an independent ground connection adjacent to the pick-up-magnet contact and adapted to protect the coils on the pick-up-magnets from leakage currents.

RAILROAD TRUCK. Alonzo C. Mather. Chicago, Ill., 575,723. Filed January 23, 1893.

An electric motor truck having the motor mounted on top of the truck and projecting into the car body above it.

GEARING FOR ELECTRIC CARS. Alonzo C. Mather, Chicago, Ill., 575,724. Filed December 1, 1893.

Similar to above.

TROLLEY TRACK FROG. W. J. Sumner, Holyoke, Mass., 575,770. Filed March 25, 1896.

Switches, Cut-Outs, Etc.:—

FUSE-HOLDER. W. W. Dean, St. Louis, Mo., 575,040. Filed September 19, 1896.

Consists of circuit terminals between which the fuse is adapted to be connected and a heavy grounding spring engaging one end of a lever forming one of the circuit terminals, the spring being adapted to effect the separation of terminals when the fuse is broken.

Telegraphs:—

PRINTING TELEGRAPH. O. L. Kleber, Pittsburg, Pa., 575,830. Filed July 18, 1895.

Details of construction.

Telephones:—

TELEPHONE TRANSMITTER. R. S. Barnum, Chicago, Ill., 575,869. Filed June 1, 1896.

Comprises a diaphragm and carbon block forming electrodes, the block being provided with a recess in its face adjacent to the diaphragm, a hinged tongue, and loose particles of conducting material arranged within the recess so as to partially cover the tongue.

MICROPHONE. P. Hardegen, Berlin, Germany, 575,887. Filed May 28, 1896.

Comprises a vibrating diaphragm, an electrode and a connection between the electrode and the diaphragm consisting of a flexible ring of material forming with the electrode and diaphragm a chamber for the granular material and serving to support the electrode on the plate to permit its vibration.

TELEPHONIC TRANSMITTER. M. Kotyra, London, Eng., 575,896. Filed November 17, 1896.

Comprises a vibratory helical case, carbon blocks at each end of the case, and granular microphonic material between the blocks.

LEGAL NOTES

CITY INJUNCTION AGAINST A PRIVATE PLANT IN PHILADELPHIA.

A Common Pleas court in Philadelphia has issued a special injunction in the suit of the city against C. J. Carney, restraining the latter from erecting, stringing or maintaining any poles or wires or other appliances for the purpose of supplying electric lights in the vicinity of Second and Marion streets.

The facts in the case are that, by ordinance of Councils, approved January 3, 1894, it is provided that "no telegraph, telephone or electric wires shall be erected over or across any of the streets, alleys or roads of the city of Philadelphia, without permission being first obtained from Councils by the passage of an ordinance to that effect, and no wires shall be strung until a permit is first obtained from the Department of Police and Fire Alarm Telegraph."

It is alleged that, in violation of this ordinance, the defendant is now, and has been for some time, conducting an electric light and power plant in the rear of the premises southwest corner of Second and Marion streets, and is engaged in supplying electric lights and power to a number of stores in the vicinity, and is maintaining electric wires over public streets and highways of the city without authority from Councils, or without having obtained permission from the Bureau of Police and Fire Alarm Telegraph.

SHAW vs. WORTHINGTON—AN ELECTRIC CRANE LITIGATION.

The case between Manning, Maxwell & Moore, representing the Shaw Electric Crane Co., and the Morgan Engineering Co., in the United States Circuit Court of New Jersey, known as the Shaw vs. Worthington case, has been decided in favor of the Morgan Engineering Co. Manning, Maxwell & Moore were represented by Francis Forbes and Frederick H. Betts, of New York City, and the Morgan Engineering Co. by John R. Bennett, of New York City.

This case has been a long drawn out patent litigation, covering years of time, and the Morgan Engineering Co. are being highly congratulated on their victory. The points in suit related to the use of motors for the various purposes of crane travel, hoisting and transverse motion.

THEFT OF CURRENT.

R. B. Mullen and Arvid Rydstrom, of the board of public works, Tacoma, Wash., have filed with the city clerk a recommendation to the city council that that body petition the State Legislature to pass an act to protect electric light currents. The communication says: "The unlawful taking of electric light currents has reached such a point that something must be done to have the matter put upon a better basis of protection."

TRADE NOTES & NOVELTIES

INTERIOR CONDIUT AND INSULATION CO.

The annual meeting of this company was held on Jan. 25, when the results of the business done in 1896 were shown to have been very satisfactory. Nothing of special public interest was brought before the stockholders. The following directors were elected: E. H. Johnson, H. Steers, A. C. Bakewell, C. D. Tows, Carl Schurz, J. Markle, J. C. Reiff, F. S. Hastings and F. H. Benedict.

FELTS.

ALFRED DOLGE & SON, 110 East Thirteenth street, New York, with factories at Dolgeville, N. Y., are supplying the electrical trade with wool felt used as a non-conductor between high potential transformer coils, also for storage batteries; felt wheels for polishing purposes, felt washers, etc. These felts are in quality surpassed by none on the market. Among the many that use them may be mentioned the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.; Johnson Electric Service Co., Milwaukee, Wis.; General Electric Co., Schenectady, N. Y. "Dolge" felts are known all over the world, and Dolgeville is to-day a notable illustration of what is possible of accomplishment in America by any man with energy enough and courage to enable him to overcome the difficulties that inevitably arise in the pathway of progress. In 1875 Mr. Alfred Dolge, the founder of the firm of Alfred Dolge & Son, located a small felt factory at the place since named after him. At that time the place had but a few inhabitants, but it has since grown to a town of about 2,800 people, occupied largely in the manufacture of felts. Not alone are Messrs. Alfred Dolge & Son known for their superior goods, but they are also widely known for the co-operative system existing between them and their employés. They have "a just distribution of earnings system," established by Mr. Alfred Dolge, which includes a pension fund, by which after various terms of service the employés receive pensions ranging from 40 to 100 per cent. of their wages. A "labor insurance system" also exists, by which they are insured, at the firm's expense, for from $1,000 to $3,000 each, and an endowment plan by which the employés are credited each year with the difference between their "actual earnings" and the amount paid them in wages. Mr. Dolge laid out the streets, built houses, sewers, established an electric light plant, helped build a free school, and virtually founded and equipped the entire town of Dolgeville, N. Y.

ELECTRIC APPLIANCE CALENDAR.

The Electric Appliance Company have just completed the distribution of their calendar and moonlight schedule for 1897. It is a very large and elaborate affair, and the feature of a complete and accurate moonlight schedule makes it useful as well as ornamental. The Electric Appliance Company have tried to distribute these very generally to the Western trade, but if any have been overlooked, they will receive one of these valuable calendars on application to the Electric Appliance Company, 242 Madison street, Chicago.

PLATINUM.

Buyers in need of platinum can obtain it from Mr. C. F. Croselmire, 251-255 New Jersey R. R. avenue, Newark, N. J., in sheet or wire of any size or degree of hardness. Mr. Croselmire makes a specialty of preparing this metal in sizes required by the electrical trade, especially manufacturers of incandescent lamps. He also pays strict attention to remelting and exchange of scrap, etc.

ADVERTISERS' HINTS

THE BERLIN IRON BRIDGE CO., East Berlin, Conn., illustrate their regular pattern of double thickness corrugated iron shutter with the corrugations running at right angles to each other. These are built into a heavy angle iron frame, thoroughly supported by bonds, flanges, hinges, etc., and form a fireproof shutter under the most severe conditions.

THE STANDARD ELECTRIC LAMP AND NOVELTY CO., 248 West Twenty-third street, New York, will be glad to quote prices on minature incandescent lamps, Geissler and Crookes' tubes, and lamps for decorative purposes.

ALFRED DOLGE & SON, 110 East Thirteenth street, New York, advertise non-conducting wool felts for insulating felt wheels for polishing purposes.

PEERLESS RUBBER MFG. CO., 16 Warren street, New York, recommend the "Honest John" rainbow packings for water and hydraulics. They say there is nothing like it in the world.

J. HARPER BONNELL CO. express themselves entirely satisfied with the operation of an American-Ball engine furnished them by the American Engine Co., Bound Brook, N. J.

THE PURITAN ELECTRIC CO., New York and Boston, are able to make immediate shipments of their alternating current 100-hour arc lamp, but it is impossible to say how long they will be, if the present demand continues.

THE EXCELSIOR ELECTRIC CO. call attention to the "Churchward" multipolar apparatus manufactured by them, including direct connected generators for power and light; motors for direct connection to tools, elevators, etc.; belt-driven apparatus, starting boxes, controllers, equalizers, boosters, rotary transformers and motor dynamos. They are wound for any voltage with shunt, series or differential windings.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, Pa., claim the honor of installing in the largest and most modern isolated plant in the world, in the new Astor hotel, a battery of chloride accumulators of 4,000 ampere hours capacity.

STANDARD THERMOMETER AND ELECTRIC CO., Peabody, Mass., note the following advantages of the Upton alternating arc lamp: Burns on any frequency from 7,000 to 16,000 without change of adjustment; will not stick, overfeed or short circuit; made for either 10 or 14 amperes, as required.

THE STANDARD AIR-BRAKE CO., 100 Broadway, New York, have a word to say about their apparatus, and its adoption on high-speed trolley lines.

THE AMERICAN ELECTRIC HEATING CORP., offer "just the layout needed," as one of their customers writes, referring to their dealers' assortment of electric heating appliances sent with a show case for $25.67.

BRUNT & THOMPSON, East Liverpool, O., have brought out a regulating socket with many economical features.

K. McLENNAN & CO., Chicago, Ill., present additional testimonials to the merits of Gale's commutator compound.

THE WALKER CO., Cleveland, O., call attention to the construction of the armatures in their machines.

THE BIBBER-WHITE Co. are well stocked with full lines of hanger boards, adjustable binding posts, positive snap knife-blade contacts, switch cutouts and a complete assortment of general electric supplies.

MR. C. E. STUMP has taken hold of "City Government" as president, and is making it go with lots of swing and energy. The paper has a large field of usefulness, and Mr. Stump, as an old trade journalist, knows how to cover the ground. It would be hard to say what a municipality does not buy or do nowadays. The offices of the paper are in the American Tract Society Building, New York City.

MR. J. N. BAGGITT is installing a plant at Bartow, Fla., and will be there after February 10. He wishes to receive catalogues and prices of electrical machinery and supplies as soon as possible.

WESTERN NOTES

FUSE WIRE.—The Chicago Fuse Wire and Mfg. Co., 153 Lake street, Chicago, have just issued a very neat and new descriptive circular and price list of their well known tested fuse wire and links. It is fully illustrated and does this important subject justice. Mr. W. R. Goodman, the manager, has had eight years' experience in handling these goods, and knows fully the requirements of the trade. The company are now equipping their laboratory with the latest and best instruments, and are going to considerable expense in order that the tests may be thorough and that perfect goods may be placed on the market as "the standard for accuracy."

THE B. & O. ROAD has established a bureau of development, in charge of W. W. Peabody, Jr., and with H. A. Trondley as special agent with headquarters at Cincinnati. The object is to build up towns along the road where land and labor are not expensive, and where new factories can be advantageously located. The road runs through some excellent regions of this character.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, have made their excellent calendar for 1897 the medium of some effective advertising of the large number of electrical supplies for which they are the general Western agents. These include the Packard lamps, Packard transformers, "O. K" weather-proof wire, Paranite rubber covered wire, Armorite interior conduit, Upton arc lamps, "Electra" imported carbons, Whitney electrical instruments, Taunton bare copper wire, Boudreaux dynamo brushes, Dayton ceiling fans, Meston fan motors, etc. The lighting schedule is given with each day of the month during the year.

CENTRAL ELECTRIC COMPANY.—The big shipment of Wagner transformers described so graphically by Mr. Abadie last week was for the Central Electric Company, who supplied it to the National Board of Trade of Cycle Manufacturers at the Coliseum, Chicago, where it was duly installed by Mr. D. A. Kimbark. The shipment, installation and starting up were record-breakers for swiftness and satisfaction to the customer.

THE ARMORITE INTERIOR CONDUIT COMPANY, of Detroit, Mich., have secured the contract for the new Girard estate building, now in course of construction in Philadelphia. This building when completed will be one of the largest and most handsome buildings in that city, and about 200,000 feet of Armorite conduit will be required. Mr. James Fulton Cummings, the indefatigable manager of the Armorite Company, is to be congratulated upon this magnificent contract.

ST. LOUIS, MO. Mr. Chas. Green, president of the People's Railway Company, has offered to lease the cable conduit for wire subway purposes.

ST. LOUIS.—The St. Louis Electrical Supply Company are experiencing a strong demand for their celebrated St. Louis battery. Up to the first of the year they have booked orders for 20,000 batteries for '97 delivery. This certainly looks well for the prosperity of the coming year and incidentally would seem a strong indication of the superiority of the battery.

DENVER TELEPHONE.—The Colorado Automatic Telephone Company using the Strowger system is to set up in business in Denver. Doctors R. F. Le Mond and S. W. Jacobs are interested. They are also putting in a plant at Colorado Springs.

THE LANGUAGE PHONE COMPANY has been incorporated at Seattle, Wash., by W. H. Llewellyn, of New York, and W. C. Oakley, of Chicago, to be interested chiefly in phonographs. The capital stock is $500,000, divided into 5,000 shares of $100 each. The trustees of the company are: Oliver L. Spaulding, Chicago; Lee D. Matthews, Chicago; Edward A. Rogers, Chicago; Ellis Morrison, Seattle; Harry K. Allen, Chicago; Warren A. Drake, Chicago; Richard S. Rosenthal, Chicago; Franklin W. Jarvis, Chicago; and W. H. Llewellyn, New York. The principal place of business is Seattle.

MENOMINEE, MICH.—The Menominee Electrical & Mechanical Company have issued an illustrated circular on their combination bicycle lock and stand, which holds the wheel tire by a loop and a pair of jaws; each stand has its own special lock. The stand is very handy, and moderate in price, a good thing for stores and for individual riders.

THE ADVANCE ELECTRIC COMPANY, of Indianapolis, has been formed to deal in electrical supplies with a capital stock of $5,000. The directors are H. B. Marsh, D. B. Smith and C. H. Talmage.

THE PYLE ELECTRIC HEADLIGHT COMPANY to make headlights for locomotives has been formed at Indianapolis, with a capital stock of $25,000 by L. Hollweg, G. C. Pyle and F. H. Ewers.

NEW YORK NOTES

MR. W. S. HADAWAY, JR., of 107 Liberty street, New York, is to be credited with the designing and installing of the very ingenious electric heating apparatus placed by H. B. Coho & Co. in the Consolidated Dental Co.'s new factory, a description of which appeared recently in our pages.

FORD, BACON & DAVIS will hereafter be the name of the former firm of Ford & Bacon, the new member being Mr. G. H. Davis, M. E. They are moving into new quarters and after February 1 will be found in the St. Paul building, 220 Broadway, opposite the postoffice.

WHITMAN & COUCH.—In our advertising pages of last week, January 27, an error was made in the advertisement of Whitman & Couch. We inserted a description of the magneto ringing set of this company, but by an inadvertence the cut accompanying the description was of their wall set. The cut of the wall set is well shown, and the descriptive matter accompanying it, concerning their magneto ringing set, is properly set forth, but the two should not be taken in connection with each other.

WESTERN ELECTRIC COMPANY. C. L. W. Eidlitz, the architect, has planned an immense combination office and factory building for the Western Electric Company. When the structure is completed it will have a frontage of 145 feet on West street and 285 feet on Bethune street. It will be built of red brick and terra cotta and be ten stories high. At present, owing to an unexpired lease of the corner property, only the rear section is to be erected.

SILICA GRAPHITE PAINT.—The Joseph Dixon Crucible Company, Jersey City, N. J., have issued a couple of pamphlets in regard to this valuable article, which has proved so useful not only in preserving roofs of all kinds, but as applied to electrical poles and other structural work. One pamphlet is devoted to testimonials; the other contains a variety of other matter also, and something about the company.

THE CLONBROCK STEAM BOILER COMPANY, of Brooklyn, N. Y., have, they consider, proved the superiority of their Morrin Climax boiler over all the others, in securing the entire boiler contract for the Tennessee Centennial Exposition to be held the first of May next.

MR. GEO. T. DAVISON has resigned as superintendent of the electrical department of the Hackensack Gas and Electric Company, and will open an office of his own for supplying electrical outfits for private houses, offices and business plants.

MR. NEWTON L. SCHLOSS has removed his office to 39 Cortlandt street, New York, and would be pleased to hear in regard to any work requiring the services of a mechanical or electrical expert.

THE NEW COMMERCIAL CABLE BUILDING, to rear its lofty domes on Broad street, beautifies the New Year's card issued by the Commercial Cable Company.

THE DIRECT UNITED STATES CABLE COMPANY, LTD., have issued as usual a very neat and useful pad calendar mounted on a stiff cardboard, decoratively illuminated, and we are indebted to the New York manager, Mr. John Brown, for copies of it.

TRIPLETS.—H. B. Coho & Co., 203 Broadway, never do things by halves, and this year they issued to their friends no fewer than three sizes of 1897 calendars; so that you can take your choice. All three are neat, pretty and useful.

THE DE VEAU TELEPHONE TRANSMITTERS are a great success, and are efficient, it is said, chiefly because of the "coal grain" carbon used in them. This grain, however, is more in the nature of very fine shot-like balls. Hence there is an utter absence of packing, and a wonderfully fine transmission of sound.

THE STANDARD AIR BRAKE COMPANY, E. J. Wessels, general manager, 100 Broadway, has issued a very neat little record of its triumphs—for victories they certainly are—in introducing the air brake on street cars. But we must confess that this country does not yet show up in the proper proportion, in view of its greater use of mechanical traction. In this case, the heathen needing missionary work are at home.

NEW ENGLAND NOTES

IRON CLAD RHEOSTATS.—The Bibber-White Company, of Boston, among its other excellent specialties is handling the rheostats and theatre dimmers of the Iron Clad Rheostat Company, of Westfield, N. J. These products are in high reputation and brisk demand, and are to be encountered in a great many of the newer installations.

THE AMERICAN ELECTRIC HEATING CORPORATION of Boston have got out a complete revised price list in condensed form, completely describing their improved products. Many improvements have been made in the past year and new items added, while prices have been reduced. Dealers should get the new lists and new discounts.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., are putting up a new machine and blacksmith shop for the Robert Palmer & Son Shipbuilding Company, of Noank, Conn. The same company are furnishing a rolling mill for the Rome Brass and Copper Company, of Rome, N. Y., an iron roof for the new armory at Rutherford, N. J., and a new power house for the Plattsburg, N. Y., Light, Heat and Power Company.

THE UNITED ELECTRIC COMPANY, of Springfield, Mass., are about completing their new station at Indian Orchard and have placed an order with the Jewell Belting Company, of Hartford, Conn., for four 40-inch Jewell dynamo belts, each 70 feet long. This company in its different plants has thoroughly tested most of the more prominent makes of belting and have placed this order with the Jewell Company on account of the excellent records made by belts of their manufacture which have been in use a number of years.

PHILADELPHIA NOTES

MORTON & SMITH, engineers and contractors, Law Building, Baltimore, consisting of D. G. Morton and J. C. Smith, are doing considerable electrical work of a local character. Of late they have had several sub-contracts for the gun battery to be erected at Hawkins Point, Md.

READING, PA.—A charter has been granted to the Mansion Electric Co., of Reading, with $20,000, full paid in. The parties interested are: F. E. Bailey, of Philadelphia, president and general manager; Henry B. McCormick, secretary and treasurer; Vance C. McCormick, J. M. Cameron and L. U. Bailey, of Harrisburg. The plant has been started, and has a capacity of 2,000 lights, and was built by F. E. Bailey & Co., of Philadelphia.

BIRDSBORO, PA.—Application has been made for a charter by the Birdsboro Electric Co., by F. E. Bailey, of Philadelphia; George Brooke, George Brooke, Jr., Robert Brooke, Edward Brooke, of Birdsboro. Work has been started on the plant, it will be in operation by the 1st of June, and will have a capacity of 1,000 lights. F. E. Bailey & Co., Philadelphia, have the contract for the complete plant.

F. E. BAILEY & CO., Betz Building, Philadelphia, Pa., representatives of the Armington & Sims Engine Co., have the contract for building a complete electric light plant at Birdsboro, Pa., to have a capacity of 1,000 lights, to include a 100 h. p. engine. They have just completed a 2,000 light plant for the mansion Electric Co., of Reading Pa., that includes one 125 h. p. and two 40 h. p. engines, and have installed a 125 h. p. engine for the borough of Quakertown, Pa.; one 600 h. p. engine for the Nanticoke Light Co., of Nanticoke, Pa. The above engines are of the Armington & Sims new self-oiling type, with their new governor.

THE HESTONVILLE ROAD has made a fine showing in its recent annual report. The company now has 151 cars and carried nearly eleven million passengers in 1896. The total gross receipts were just short of $550,000.

THE SOLAR ELECTRIC COMPANY, of Brookville, Pa., has been formed with a capital stock of $10,000.

THE NEWTON MACHINE TOOL WORKS of Philadelphia report a very favorable outlook for future business. Among others, they report an order from The Central R. R. Company of South America for heavy milling machine equipment, including the heaviest class of rod milling machines, heavy plain milling machines, nut milling machines, vertical rotary planers, etc.

DOVER, N. J.—The Frick Company of Waynesboro, Pa., have recently furnished for the Dover Electric Light Company one complete 16x32x32 cross compound condensing Corliss engine, with steam and exhaust valves actuated by independent eccentrics; flywheel 20 feet diameter, 43-inch face; weight of wheel 40,000 pounds; made in segments. The shaft is 13 inches in diameter; the main bearings are 11 inches in diameter and 22 inches long; crank pins 6 inches long and 3⅝ inches diameter. The connecting rods are 3½ inches in the neck and 4⅞ in the center. The piston rods are 4⅝ inches and 2¾ in diameter, respectively, fitted with metallic packing. There is also a high pressure side with cylinder 16 inches by 42, with extended shaft; also wheel and main outboard pillow block arranged to receive the low pressure side in the future, so as to make the second cross compound engine, the same as that above named.

J. H. McEWEN MFG. CO., Ridgway, Pa.—The whole property of this company, including patents, good will, factory, machines in progress of construction, etc., will be sold at auction in Ridgway on February 22. No bid less than $100,000 will be considered.

SOUTHERN NOTES.

THE TRADESMAN ANNUAL.—The 18th annual number of the Tradesman, published at Chattanooga, Tenn., contains over 260 pages, and presents one of the most complete, exhaustive and valuable review of the South, its resources, development and possibilities, that to our knowledge has ever been published. The special articles are from the leading thinkers, statisticians and business men in our country; the information given is the result of careful investigation and practical knowledge. The business directories and statistics are most valuable features of this valuable number and it will be preserved as a reference book on all subjects pertaining to the South and its resources.

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The Electrical Engineer.

Vol. XXIII. FEBRUARY 10, 1897. No. 458.

POWER TRANSMISSION

LOCAL DISTRIBUTION OF THE CATARACT POWER AT NIAGARA FALLS.

A GREAT deal of information has been given of late as to the long distance transmission of current from the Niagara Falls power plant to Buffalo, and the subject is necessarily one that excites general interest. But it is not to be forgotten that there is already a very large local distribution of energy around the power plant. Just what this is we are now able to indicate, for the first time, in a graphic way that will make the data an excellent supplement to the article by Mr. W. B. Rankine, which appeared in the New Year Anniversary Number of The Electrical Engineer. We show herewith the interior of the cable bridge across the canal, from the power house, Fig. 1, also the interior of the local subway, Fig. 2; and a map showing the location of the respective factories, which derive their power from the central plant, Fig. 3.

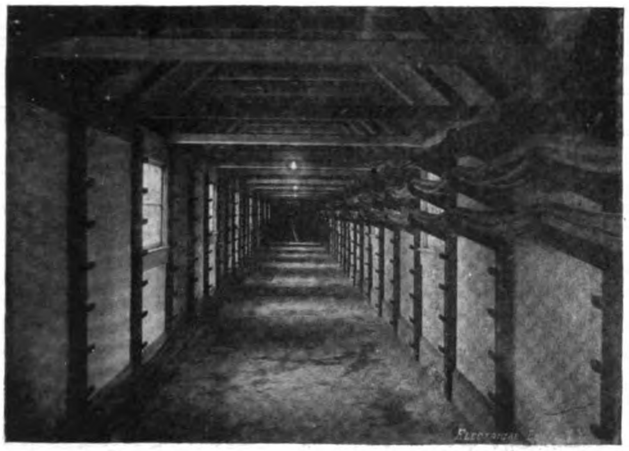


FIG. 1.—CABLES CROSSING CANAL BRIDGE, NIAGARA POWER PLANT.

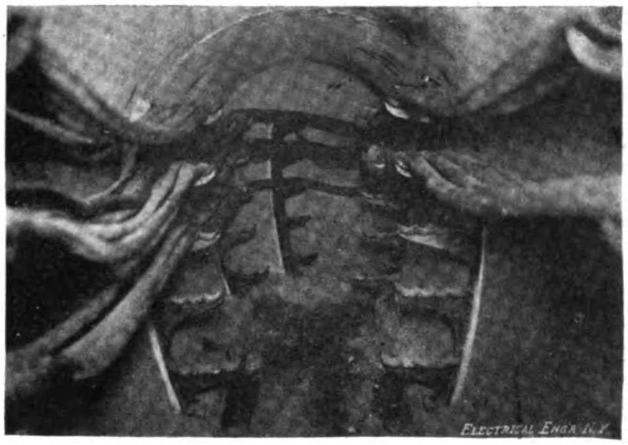


FIG. 2.—CABLES IN NIAGARA SUBWAY FOR LOCAL DISTRIBUTION.

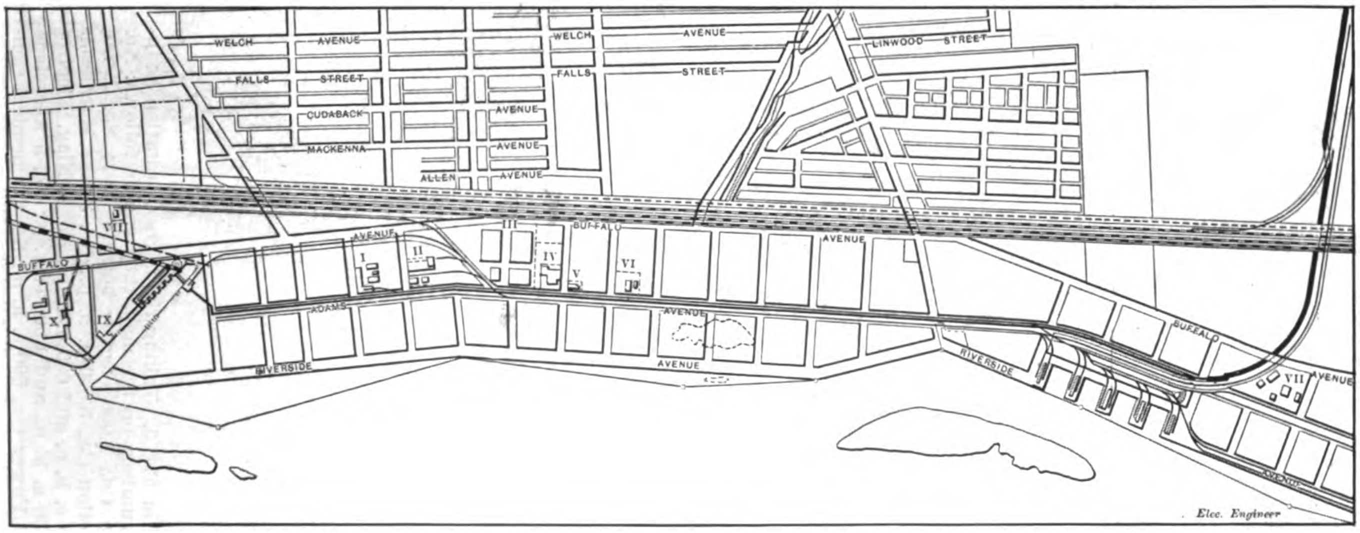
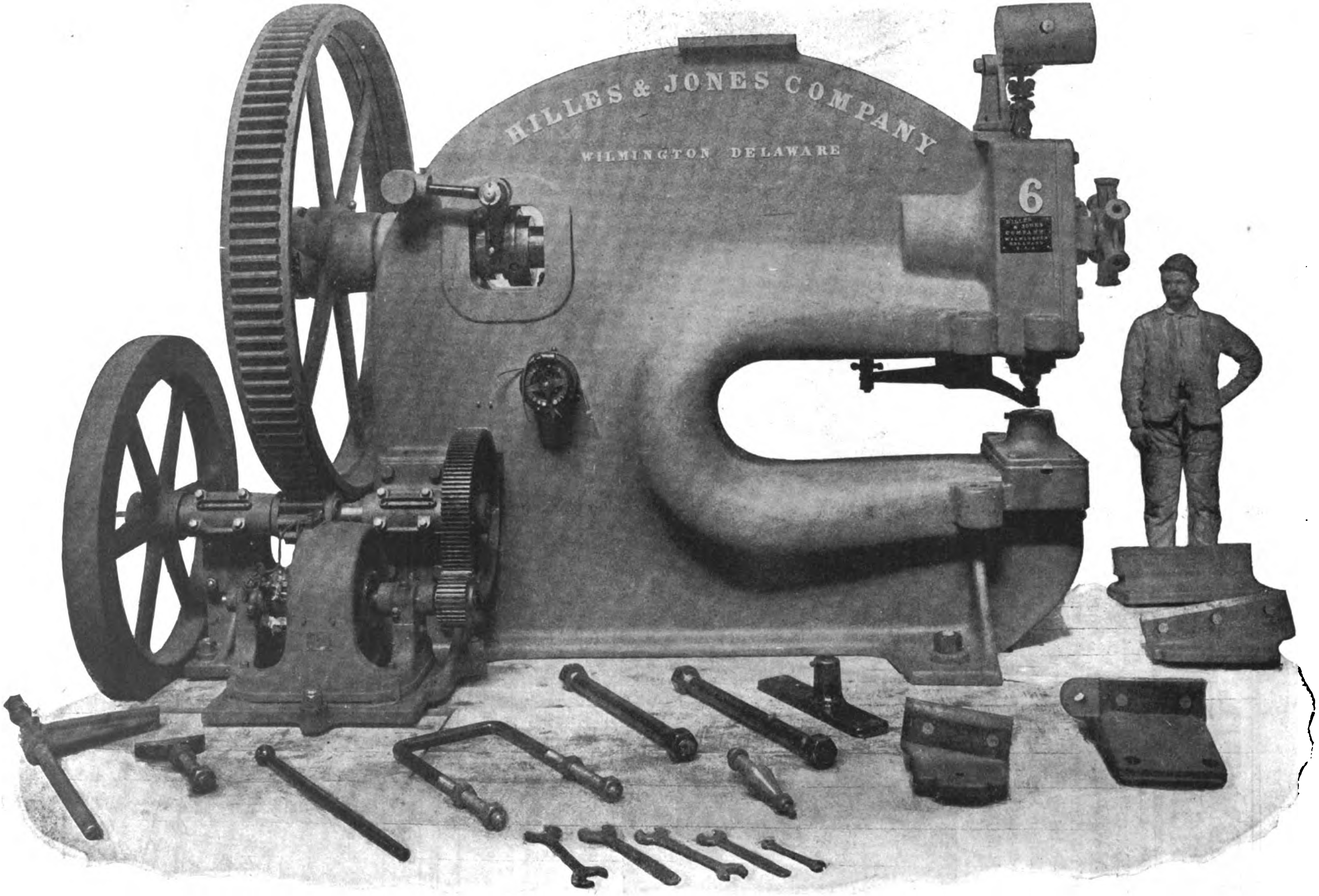


FIG. 3.—MAP SHOWING LOCATION OF FACTORIES USING NIAGARA POWER CO.'S POWER AT NIAGARA FALLS, N. Y.

Turning to Fig. 1, the cables crossing the bridge may be enumerated as follows:

To Pittsburg Reduction Co. and Niagara Electro-Chemical Co., four 950,000 cm., lead-covered, made by the General Electric Co.; to the Carborundum Co., two 1,000,000 cm., lead-covered, made by the General Electric Co.; to the Acetylene Light, Heat and Power Co., two 1,000,000 cm., lead-covered, made by the General Electric Co.; to the Buffalo and Niagara Falls Electric Light and Power Co., four 300,000 cm., lead-covered, made by the Washburn & Moen Mfg. Co.; to the Buffalo and Niagara Falls Electric Railway Co., one 1,000,000 and two 500,000 cm., lead-covered, made by the General Electric Co.; to the Niagara Falls and Suspension Bridge Railway Co., five No. 0000, lead-covered, made by the John A. Roebling's Sons Co.; to the local street railways for track return, two 500,000 and one 1,000,000 cm., bare cable, made by the John A. Roebling's Sons Co. All of the above are led into the subway. Besides these, there are four 1,000,000 cm., of General Electric make leading to the step-up transformers on the Buffalo transmission line, and three 350,000 cm., made by the General Electric Co., bare cable, on the overhead line running to Buffalo from the transformer building.

Fig. 2 gives a faithful picture of the local subway with the cables in place, open to ready inspection and access. Of this subway there is a good half mile to the first large group of



ELECTRICALLY DRIVEN PUNCH AND SHEAR, BUILT BY THE HILLES & JONES CO., WILMINGTON, DEL.

factories shown in Fig. 3. Taking the users in rotation as indicated by the numbers on the map, they run as follows: No. 1, Carborundum Co., 1,000 electric horse power; No. 2, the Pittsburg Reduction Co., 3,000 e. h. p.; No. 3, the Mathieson Alkali Co., 2,000 e. h. p. and 600 e. h. p.; No. 4, Niag. Electro-Chemical Co., 350 e. h. p., and 1,000 e. h. p.; No. 5 Acetylene Light, Heat and Power Co., 500 e. h. p.; No. 6, Chemical Construction Co., 500 e. h. p:; No. 7, Albright, Wilson Co., 300 e. h. p.; No. 8, Buffalo and Niagara Falls Electric Light and Power Co., 500 e. h. p.; No. 9, Niagara Falls Water Works, 50 e. h. p.; Niagara Falls and Suspension Bridge Co., 250 e. h. p.; Buffalo and Niagara Falls Electric Railway Co., 300 e. h. p.; No. 10, Niagara Falls Paper Co., 3,300 hyd. h. p. This makes a total of 13,650 horse-power for local consumption, of which quantity that used beyond the subway is, or will be, distributed on pole lines. It will be noted that No. 7 factory has gone a considerable distance from the power house, and one of the interesting features of the development in the future will be the way in which the industries scatter wider and wider afield and the growth of population around the new centers of industry.

ELECTRICALLY DRIVEN COMBINED PUNCH AND SHEAR.

THE illustration on the opposite page represents an interesting application of electric motor driving as adapted to tools of the heaviest kind and subject to the severest duty. It shows a combined punch and shear manufactured by the Hilles & Jones Company, of Wilmington, Del. This massive and substantial tool is capable of punching 6-inch holes in ¾-inch steel.

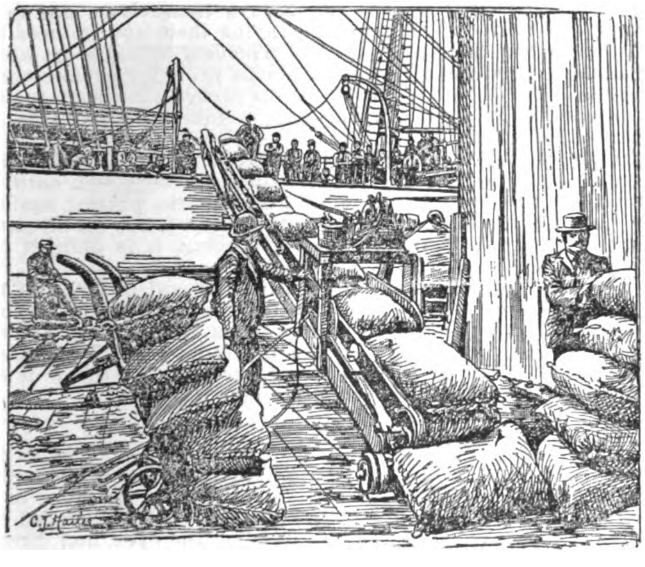
The machine frame is of box form throughout and weighs nearly 40,000 lbs. in a single casting. It is well adapted for shearing plates and bars as well as punching, the knife blocks being secured to the nose and the sliding head by through bolts and tongues so that they can be readily removed without injuring the main frame. The sliding head is counterbalanced through a spiral spring and has a tapered brass shoe for taking up the wear. The spur wheel is large, with turned shrouds, the clutch which engages with this being controlled by an improved adjustable automatic stop which allows the sliding head to be brought to rest at any desired point of the stroke. The motor is mounted on an extension base connected to the main frame and drives on to the fly-wheel shaft through a pair of cut gears. This method of construction takes up but very little floor space, considering the capacity of the tool, and makes it entirely self-contained. It avoids also any pipes or belting which might interfere with overhead traveling cranes and has proved itself an economical and most satisfactory method of driving.

At the time the work is being done on machines of this class, there is a momentary slowing up which, of course, sends more current through the motor. Hence, as a rule, for this class of work, the compound wound motor is found most serviceable. For punches and shears, especially, the speed is constant; for bending and straightening rolls some variation would not be material.

LOADING SHIPS BY ELECTRIC POWER AT TACOMA, WASH.

NOT long ago 2,500 tons of flour—an ordinary cargo—was loaded on one of the Northern Pacific's oriental steamers in twenty-four hours. This is scarcely an unusual occurrence at Tacoma, where 2,000 tons of cargo are loaded or unloaded in twenty-four hours very frequently.

An important factor in this record-breaking work is a new electric conveyor for loading and unloading vessels, invented by Messrs. McCabe & Hamilton, the stevedoring firm which handles all the business of the Oriental steamers and wheat ships visiting that port. Realizing the need of such a conveyor, Mr. McCabe and Mr. Hamilton both devoted considerable thought to the problem during the summer of 1895. They finally gave up all notion of using complicated apparatus and decided to try a very simple device which their judgment recommended. With this conveyor Tacoma's splendid record for the fast dispatch of vessels has been established. It was used for the first time in loading flour on the Northern Pacific steamship Strathnevis in October, 1895. The accompanying illustration shows the conveyor at work.


LOADING SHIP BY ELECTRIC CONVEYOR.

With this apparatus flour and grain can be loaded at any stage of the tide, and without reference to the weather, for should it rain a canvas is quickly spread from the door of the warehouse to the ship's hatch. With the system of loading in vogue elsewhere about eighteen men are required to do the work done by this conveyor, with which the bags are delivered into the ship's hold at the rate of 2,500 to 2,700 pounds a minute, or seventy-five tons per hour. When speed is desired two conveyors are used, as was done when the record of 2,500 tons in 24 hours was made.

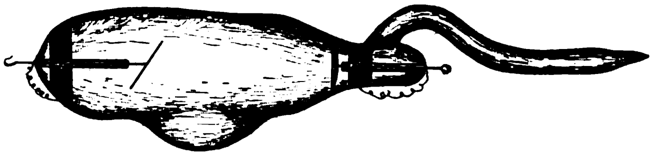
The electric conveyor is about forty feet long. Two wheels in the center allow it to be moved at will. A two-horse power motor supplies the power, the current being taken from the Tacoma Railway and Motor Company's wires. The revolving belt on which the sacks are placed is of rubber and passes over twelve rollers. The belt is propelled by a driving wheel attached to the side of the apparatus. The rollers are placed close enough together and the belt revolves at such speed as to carry all the weight in flour or grain that can be placed upon it. The conveyor works as well when placed at an angle of 45 degrees as when on a level.

ROENTGEN RAYS

HOW TO KEEP X-RAY TUBES IN CONDITION WHILE WORKING.

BY MAX OSTERBERG.

THE Röntgen rays have certainly arrived at a stage at which the subject may be considered a separate branch of the science of electricity. It is a subject which the engineer, the physicist, and the physician or surgeon should take up conjointly in order to bring it to that stage of perfection which is desirable, and in fact necessary. Every one who has the opportunity to experiment should consider this a duty to his fellowmen, and even without pecuniary gain in view, the time spent over this class of work will repay the worker by giving him the satisfaction of having at least done his share in helping hundreds, aye, thousands of the most deserving and most unhappy of his fellowmen, the crippled and injured. The physician has a field of his own; his work should be devoted principally to investigate by means of the fluoroscope, and in those weird shadows read the condition of his patient. The physicist must devote his time to improving means of obtaining good effects brought about in any manner, whatsoever, no matter how complicated or how simple, while the engineer should take the role of the economist, and try to lower the expense of constructing and running the apparatus, as well as devise ways and means to handle the apparatus with ease, and in spite of necessary complications have it arranged so that a layman with ordinary intelligence can handle it. All this is not new, but it cannot be impressed too frequently, nor too strongly. To those who feel as enthusiastic as I do I need not apologize for this moral urging; to those who are so unfortunate not to appreciate this keen desire to lend a helping hand, I do not want to appologize.


OSTERBERG'S METHOD OF CONTROLLING ROENTGEN TUBES.

During the last few months I have more than ever felt the desirability to preserve one tube as long as possible for more than one reason, and the money question was by no means the most important one. After working a tube for some little time, one becomes thoroughly familiar with it, and only commences to do satisfactory work with the same. The position of maximum effects, the color of the fluorescing glass, the amount of heating during a certain time, remain practically constant, and therefore nothing but practice is required to manage that part of the manipulating. You open your switch to allow the tube to cool from time to time, just as instinctively as you fold your napkin after a meal; you hold your fluoroscope in the right position without special thought, and thus can concentrate your entire attention on the investigations which you happen to be undertaking.

After a while, however, the vacuum in the tube goes up, and you have to devise means for again reducing it to that stage at which it works most satisfactorily. Reversing the current in the tube is but an apology for a cure, since it blackens the bulb, thus absorbing too many efficient rays. Heating the tube with a Bunsen burner, or an alcohol flame is a much better method, but it lasts but a comparatively short time. Of late I have been successful in finding a method to prolong the life of a tube which is bound to prove a valuable aid in many cases.

I found, while working with sheets of tinfoil connected to the secondary of the coil, with the intention of investigating capacity and condenser effects in the secondary, that by attaching two small rings of tinfoil around the tube just at the place to which the anode and cathode extend, and then connecting one ring to the anode, the other to the cathode terminal that the tube will again fluoresce for many hours, in fact, I have not been able to work a tube a sufficient length of time to raise the vacuum so as to make it useless under this method.

The voltage required to produce good effects decreases considerably; while I used 12 volts to run the tube successfully, I needed but 4 to get as fine a Röntgen ray after I had a high vacuum, with tinfoil rings around the tube. Care should be taken to attach the rings properly and neatly, for otherwise too much distortion of the cathode rays which are reflected from the anode will take place and give a blurred Röntgen ray image. If working with a sufficiently high voltage in the primary this can be easily investigated, for while it is possible to get the platinum anode red hot when the tinfoil rings are put on neat and clean, this will not be possible when they are just put on carelessly. A rubber cap lined with tinfoil, made to fit the terminals of the tube will prove a valuable aid. This cap can be put on as soon as the tube commences to weaken. I suggest this rubber cap so as not to expose the edges of the tinfoil to the atmosphere, as this causes a considerable amount of leakage, which means just so much loss of energy.

OXYFLUORIDE OF URANIUM AND AMMONIUM, A NEW X-RAY FLUORESCENT.

BY FREDERICK S. KOLLE, M. D.

CONSIDERABLE interest has been aroused by the announcement of the above new chemical compound, introduced by Dr. Van Melckebeke, at the Société Medico-Chirurgicale of Antwerp. From personal experiments with the new fluorescent, I can certainly vouch for the compound. In Germany and England, radiographers still adhere to the use of the potassium platino-cyanide in preference to the calcium tungstate of Edison, but the above oxyfluoride will probably replace both within a short time, until some new or more powerful compound is discovered.

The product obtained differs from the Wurz double fluoride of uranyl and ammonium, having the following formula: $Ur_2O_2Fl_2NH_4Fl$, in that the precipitation of its microscopic octahedral crystals, are formed by a greater amount of ammonium fluoride, the relation being about one part of the latter to two parts of the uranium nitrate, with a formula of $Ur_2O_2Fl_24NH_4Fl$; the chemical reaction being expressed as follows:

$$2(UrONO_3 + 3H_2O) + 6NH_4Fl = Ur_2O_2Fl_2, 4NH_4Fl + 2NH_4NO_3 + 6H_2O.$$

The preparation of this oxyfluoride to obtain best results, is made as follows: Take (1) ounce of uranium nitrate c. p. (Merck's reagent), and allow it to dissolve in (4) four ounces of water, which is brought to a boiling point in a porcelain evaporating dish, over a sand bath, using the Bunsen flame. The uranium will solve readily, leaving a straw-colored liquid, to which add gradually one-half ounce of ammonium fluoride c. p. (Merck's reagent), and allow the two to boil a few moments. Fumes of ammonium nitrate will be given off.

The solution should not contain any sediment and is then set away to cool and crystallize; this takes place in about one hour or more, when the liquid will have lost its yellow color and appears like water. At the bottom of the dish a yellowish sediment, not unlike flowers of sulphur, will be seen, which, when examined by the microscope, will be seen to be octahedral crystals.

Their fluorescent property depends upon perfect crystallization. The liquid above the sediment is decanted and the latter washed two or three times with clean cold water, to remove all nitrate of ammonium. The oxyfluorides are insoluble in cold water, but readily dissolved in hot water. The sediment may then be collected and dried upon filtering paper.

The amount obtained, using the above method, will be about 128 grains, at a cost of 62 cents, being considerably cheaper than any other fluorescent compound now used, with any success. Owing to the minuteness of the crystals, excellent results taking the usual granular appearance, can be had by lezing a screen prepared with the above in consort with the gelatin film of the dry plate, to shorten the time in making a radiogram.

In comparison with other fluorescent salts, it ranks next to fused pentadecylparatolycetone and is about 7 per cent. better than the caleic preparation. The crystals when dry can be mounted with flexible collodion or gelatin, as in the other screens.

A PREVENTIVE FOR X-RAY BURNS.

THERE have been many reports from various parts of the country that long exposure to X-rays had caused acute maladies of the skin, accompanied by great pain, and that the hands of X-ray operators were swollen and inflamed and that the finger nails often dropped out.

Dr. Danforth Cole, of Minneapolis, corroborates these reports by his own experience. Consequent upon his work around the powerful rays he has lost half a dozen finger nails, his hands were swollen and inflamed, and the right forearm is badly burned. The last-mentioned wound was received while the arm was sheltered by the usual amount of clothing, which was in no way affected. The skin is very red and full of fever and the affected part is slightly swollen.

Dr. Cole was greatly puzzled at first by these undesirable concomitants of the use of the X-rays. He was also much dismayed, because it seems probable that in taking radiographs of sore or diseased parts the trouble might be greatly aggravated by the irritating influence of the rays, which shows itself slowly and lasts a long time. In fact, one patient complained that the soreness in a lame joint was much increased immediately after exposure to the rays, though the exposure was not long enough to have a lasting effect.

Investigation showed, says the Minneapolis "Journal," that the harm was not due to the X-rays themselves, but to a static electrical discharge accompanying them and induced by the bodily warmth of the subject. The heat of the body, while inducing the discharges, is not potent enough to make them visible, but when an alcohol lamp is brought near to the Crookes tube, the feathery discharges into the flame may be clearly discerned.

Having ascertained the cause of the trouble, it was easily overcome. Dr. Cole now uses an aluminum screen which entirely shuts off the static discharge and ensures the patient against burns. But as the operator's hands are constantly on all parts of the apparatus, adjusting and arranging, it is difficult for him to get complete immunity himself.

Dr. Cole also claims to have made several discoveries regarding the use of electricity, including X-rays, for carrying medicines into the body, his idea being that healthy tissues will eliminate the medicine without anything more than temporary effect, while the diseased tissues cannot throw it off so easily; hence the medicine is placed effectually.

A PEN LIGHT.—The "Optician" gives an account of an invention by a man named Wilcox, in which a minute incandescent lamp is fastened to a pen near its point in order to illuminate the writing. "A little reflector," it says, "placed behind it, prevents the light from dazzling the eyes, and directs it toward the paper, This arrangement . . . may be applied also to a pencil or to any instrument of the same sort."

THE BURTON ELECTRIC SMELTING CO., has been formed at Portland, Me., with a capital stock of $1,000,000 of which $60 is paid in. The object is to make, deal in and operate electric smelting apparatus. G. D. Barton, of Boston, is president, and H. D. Tudor, treasurer.

ELECTRIC LIGHTING

THE BOSSERT SHEET STEEL SWITCH BOXES.

THE use of cast iron for wall, outlet and switch boxes for conduit work has been the subject of some important discussions by electrical engineers and contractors. These boxes have generally been made of cast iron with holes cut in various places for the insertion of conduit, and for the want of something different or better have been in general use. One criticism which has been made is that if the construction man desired to enter the box at a different place with the conduit than the hole provided, he had either to break another hole in the box, have one drilled in or finally to discard the box altogether or find a new. A further argument against cast iron boxes has been that many of them break while being placed in position and are oftentimes left there by careless workmen

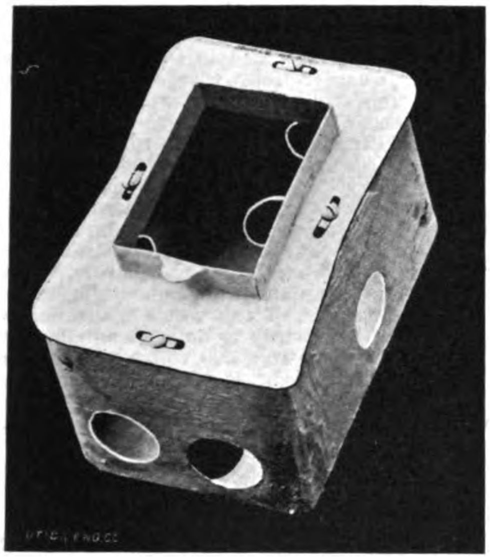


FIG. 1.

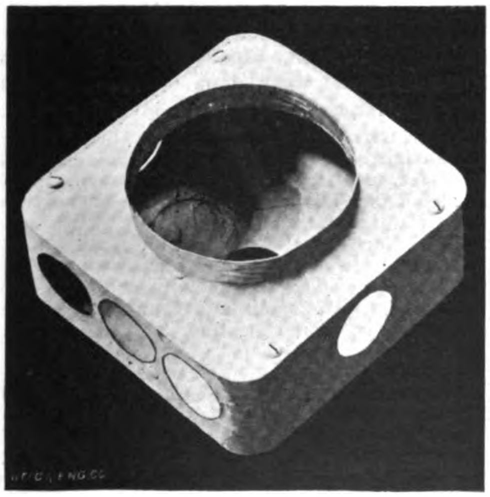


FIG. 2.

The Bossert Electric Construction Company, of Utica, N. Y., believing that a better material and one which was absolutely indestructible might be secured, and that a more convenient form of construction of these boxes could be found, have recently made a decided innovation in these goods. All their forms of switch, wall and outlet boxes are drawn from one piece of sheet steel. They also provide in these boxes a number of holes in the sides and bottom which are securely pluggedup again and areguaranteed to be water-tight and fireproof. Hence, should the workman choose to enter the box from a different point from that on which he had calculated, he has but to drive out the steel plug at the point he desires. Holes are made for any size conduit and the boxes are heavily insulated. This company also make a special steel drawn switch box for the Cutter switch, the Hart switch and the Gibbs switch, provided with holes in the same manner as above described. This new appliance is admirably illustrated in Figs. 1, 2 and 3. Claiming as they now do that these boxes are the best, the cheapest and most convenient of any now upon the market, general approval may be expected.

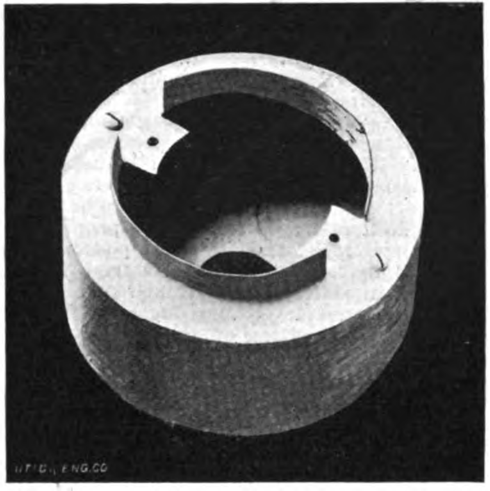


FIG. 3.

The Bossert company also make steel clad slate lined junction boxes and distributing boxes of every description, marine and underground boxes, and, in fact, any box which an electrical contractor may be required to furnish.

INSURANCE AS AFFECTED BY ELECTRICAL CONSTRUCTION.

BY G. S. McLAREN.

IN giving a paper on electricity as viewed from an insurance standpoint, I desire briefly to discuss the position taken by the underwriters in regard to its use and to mention a few of the greatest dangers to be avoided. Immediately that insurance is suggested as a subject, either for conversation or as the topic of a paper, there arises a loud and prolonged wail against these grinding, far-reaching monopolists. The trouble with us all is that each thinks everyone else is making too much money and that he is making too little. The insurance companies do the same as any commercial house. They try to write a large number of risks, and probably owing to the peculiar nature of their business they protect it more than any other organization. It is for these reasons that insurance companies have organized an electrical inspection department, trusting that by so doing they will benefit the insured and therefore better protect themselves. It seems to me that the more insurance companies insist upon good, practical, safe wiring and use of electrical apparatus, the better it will be for the central station owners, the supply men and all concerned.

Let us take first the benefit to the station owner of a careful inspection of electrical equipments. When a building is being wired he does not have to keep a man constantly watching the work to see that it is done correctly, but when the time comes to connect the installation to his system, he simply inquires if the work has been approved by the underwriters, and upon an affirmative reply, the connection is made. But that is only the beginning; he knows that the building is inspected ever so often; he knows that there is some one constantly on the lookout for trouble and defects

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[1] Abstract of a paper read before the Northwestern Electrical Association Jan. 20, 22, 1897.

over his entire system, and even watching the work of his own men, and many a leak and many a cause for serious trouble is brought to the notice of station owners by insurance inspectors.

And how evident it is to us all that the less trouble there is on an electrical system the cheaper it can run. If the mains and branches throughout the building are large enough to amply carry the current, and if there is no leak in the insulation, you can certainly furnish cheaper and more satisfactory light.

Then again the person erecting a building receives a great benefit from the underwriters in the electrical line as well as in many others. He knows in the first place that there will be no danger from the wiring, and that the work will be done according to the most approved ideas. He has, gratis, someone who watches his contractors and their workmen, and who is constantly looking out for his interests, and he always has the satisfaction of knowing his equipment is thoroughly surveyed at least once a year. Even the supply man and the contractor (provided they sell good material and do good, careful work)) are aided by the insurance companies, for the underwriters are always ready to recommend the best goods and the most reliable workmen.

I would like to ask if, as an association, we cannot do something to raise the standard of electrical work and electrical workers. Why should there not be as severe a law in regard to the efficiency of electrical workers as there is concerning plumbers? Why should contractors be allowed to hire small boys to do a man's work? Many people consider that the greatest danger to be avoided is the possibility of a direct short circuit. I do not believe this is true, for it has been my experience that short circuits almost invariably take care of themselves by immediately blowing a fuse or melting one of the wires and thus cutting off the current.

More important points in wiring are, the correct location of fuses, the grounding of wires, the wiring of fixtures, the use of flexible cord, and the placing of inflammable material near electrical apparatus. Let us discuss them briefly in the order mentioned.

Cutouts should be centrally located, of easy access, and entirely separated from inflammable material. They should never be scattered promiscuously throughout a building. Then where a wooden cabinet is used to hold cutouts, you will often see the back and sides of the cabinet lined with asbestos, while the door, which closes almost against the fuse, is left bare. I do not believe in even placing fuses in the canopies of fixtures or in rosettes for cord drops, especially not in damp places.

Slow leaks and the grounding of wires on gas and other pipes cause a considerable loss each year. They do not take sufficient current to blow a fuse, but instead either form an arc or slowly work on the surrounding substance until they have become thoroughly charred and at last ignited.

I have as yet failed to find an entirely satisfactory wire and insulation for fixture work. If some manufacturer would introduce an insulation of small diameter, which could not be easily cut, and was still moisture proof, it would find a ready market. The fixture men should use more care that all burrs are removed from the fixture stems, that the insulation is not peeled from the wire by drawing it through the fixture, and that their joints are correctly made.

The use of flexible cord in electrical wiring is a matter of much concern to the underwriters. The number of fires caused by its use is surprising. We are now advocating the use of a cord with a solid rubber insulation of at least 1-32 of an inch in thickness, which in turn shall be covered by a braid. The principal troubles with cords occur in show windows and in draping designs in stores. Electric lights certainly look very pretty peeping out from under a mass of cotton batting or from a pile of ribbons, but that such use of them is dangerous few seem to realize. The danger arises from three sources, namely, bad insulation of wire and defective strand; defective lamp sockets, and direct heating effect of the lamps. Several examples of the latter were mentioned.

There are many more points in the use of electrical apparatus which cause trouble and which might be brought up for discussion, but I think four-fifths of the electrical fires originate from those mentioned.

In closing I would like to speak of the actual insurance of buildings and the effect electrical wiring and apparatus bear on the "make up" of their rates. To explain more fully I will briefly give an outline of how rates on buildings are determined. First please understand that buildings are not rated by any mere guesswork; they are compiled by carefully consulted, accurate tables which have been deduced from statistics taken of all fire losses that have occurred for many years.

To illustrate this, the basis rate on a four story building, whose area is not over 3,000 square feet, is 55 cents. If the building has a larger area, we add five cents for each 1,500 square feet or fractional 500 square feet. If the building has deficient walls five cents is added for each story where they are deficient. Ten cents is added for a shingle roof and five cents for wooden cornices. For skylights, well holes and stairways we add five cents each, and for elevators 10 cents. Adjoining buildings cause an exposure rate of from 5 to 20 cents or even higher, to be added. To all this is added a rate for the occupancy. Then the improvements on the risk are considered. Ten cents are taken off for electrical alarm connected with fire department, 5 cents for combined standpipe and ladder, 10 cents for automatic hatchways, 20 cents for watchman and clock, etc. The deficit rates are then added and from them is deducted the sum of the amounts taken off for improvements. The result is the rate charged.

As electricity is comparatively a new feature in insurance there are comparatively few statistics in regard to losses from its use, so it would be almost impossible to state how much increase should be added to the rate on a risk where, for illustration, weather-proof wire is used instead of the best grade of rubber insulation, or when no spark arresters are placed on the arc lights. Moreover it would necessitate large tables and considerable trouble to add or deduct very small percentages from a risk for every defect or improvement in electrical apparatus, therefore, it has seemed best to have a standard or set of requirements governing all electrical equipments and to require that this standard be strictly enforced. Where it is not carried out the insurance is cancelled. There are a few exceptions to this rule, viz., where the general condition of the plant is not good a decided increase is sometimes added instead of the whole insurance being cancelled. This more frequently is done in smaller towns than in large cities. Then where a 500 volt current from the trolley wire is used one per cent. is added to the regular rate.

ELECTRICAL SUPPLIES.[1]

BY W. W. LOW.

THE author made some pertinent remarks on the maintenance of the electrical supply business, giving some practical hints derived from his own experience. He dwelt on the advantages of membership in the association, and the pleasure derived from attending its meetings. He claimed that the supply man is at once the guide, philosopher and friend of the central station manager. Their interests are identical, and there are many ways in which they can work together for their mutual benefit, especially in the discountenancing of bad practice in their trade relationship. He predicted that in a few years, it will be much easier than at present for the central station buyer to know exactly what he wants for every purpose, and what the price should be. He urged the members of the association to do their utmost to bring about such a condition.

ELECTRICITY IN OMAHA.

The annual report of City Electrician Schurig affords a very thorough detail of the work done by the electrician during 1896 and of the improvements that have been accomplished in the electrical wiring of the city and in the removal of superfluous and unsightly poles and wires. The report shows that 193 permits for electric wiring were issued. Under these were installed 5,066 incandescent lamps, fifty-five arc lamps and seventy-four motors and dynamos, with a combined capacity of 897 horse-power. Under the direction of the electrical department 440 miles of aerial wire were removed from the streets and ninety-seven poles were taken down. The wires of the Nebraska Telephone Company in the business district were placed under ground, 825 miles of wire being thus removed from the streets.

A portion of the report is devoted to municipal lighting. The electrician says that he has made inquiries of the officials of other cities in regard to the expense of their public lighting and has been convinced that the present contract in Omaha is a fair one for the city.

Some extensive improvements are recommended in the fire and police alarm department. In the first place a chloride storage battery is wanted in place of the gravity battery now in use. The latter costs about $400 per year to operate and requires the attention of one man the greater part of the time. The operation of the storage battery would not cost over $60 per year and would give far more satisfactory service. The cost of making the change, including the purchase of a new charging switchboard, is estimated at $850.

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[1] Abstract of a paper read before the Northwest. Elec. Assoc.

THE ENCLOSED ARC LIGHT.—III.

BY L. B. MARKS, M. M. E.

Having thus reviewed the fundamental conditions governing the operation of enclosed arcs, we will now confine our attention to the most important phase of the subject, namely, the high potential enclosed arc.

"Pioneer" (Marks) High Potential Enclosed Arc Lamp.—We have seen that all the types of enclosed arc lamps described up to this point have been deficient in various particulars. As far as commercial operation is concerned, none of them has been a success. It remained for a lamp operating on a new principle to fulfill the requirements exacted by the commercial practice of the day. Such a lamp had to satisfy the following conditions: First, standard steady light of uniform distribution; second, efficient arc; third, long life of the carbons; fourth, no blackening or discoloration due to the disintegration of the carbon.

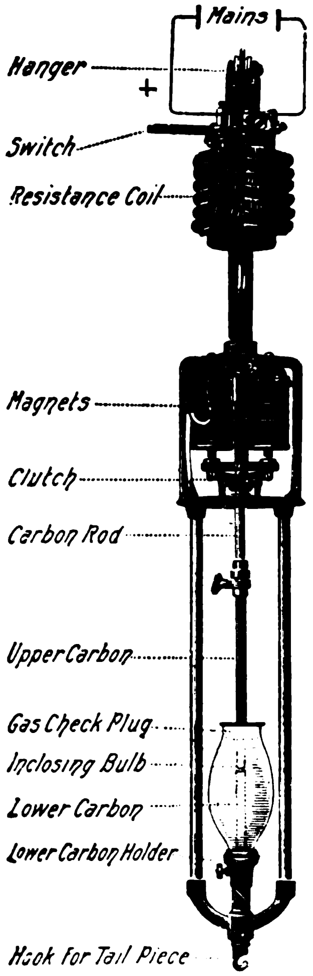
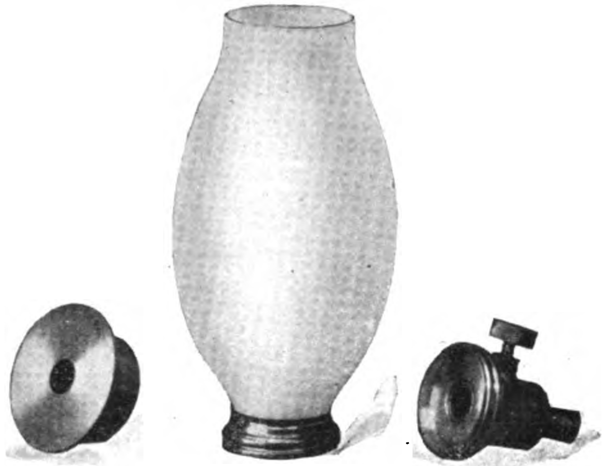


Fig. 4.

These conditions were fulfilled in a lamp, an account of which I presented for the first time before the National Electric Light Association of America in February, 1894, and which I called the high potential incandescent arc. The high potential enclosed arc, as its name indicates, was so called on account of the high voltage of the arc. High voltage is of course a relative term and is applied in this case in contrast to the usual voltage of the arc, viz., 40 to 45 volts. In experimenting in this line I found that arcs could be steadily maintained at double the voltage of the ordinary arc, and under some conditions even at three or four times the voltage. Arcs of such high voltage are naturally quite long, and require apparatus specially adapted to operate them. I found that under proper conditions these long arcs could not only be maintained continuously, but so operated with a remarkably small current thus resulting in high efficiency and long life of the electrodes. Experience has shown that this method of operation is the only one which has been successfully applied to existing commercial circuits. A glance at Fig. 4 in which marginal notes indicate the principal parts of the lamp will show that the operating mechanism consists simply of a pair of solenoids; armature and cores; lazy clutch and carbon rod. This mechanism is designed so as to spring a long arc of about 10 millimetres or more. The design of the solenoid is such that the current consumed by the lamp will be very small and quite uniform throughout the range of the lamp. The enclosing bulb is mounted in the lower carbon holder and, as will be seen from the notation on the cut, is closed at the top by a special device known as a gas-check plug. The lower carbon in this lamp is 12 centimetres long and the upper carbon 30.5 centimetres long; both pencils have a diameter of 11.11 millimetres. At the top of the lamp is mounted a small resistance coil. The standard lamp is designed to pass a current of from 4 to 5 amperes, 80 to 85 volts being the drop across the arc. Fig. 5 shows the bulb and gas check plug in perspective.



Gas-check Plug; (fits in mouth of Bulb). Enclosing Bulb; (surrounds the Carbons.) Lower Carbon Holder; (supports the Bulb.)

Fig. 5.

The Gas-Check Plug.—The plug which forms a closure for the bulb is such a unique device that I have deemed it worthy of a special representation in another illustration, Fig. 6, where you will note the gas-check plug is shown in cross section mounted in the mouth of a cylinder. If we close the mouth of the bulb simply by a flat metal disc having an opening in it sufficiently large to allow for variation in diameter of commercial carbons, we find it difficult to prevent an abnormal access to oxygen into the enclosure. The gas plug was

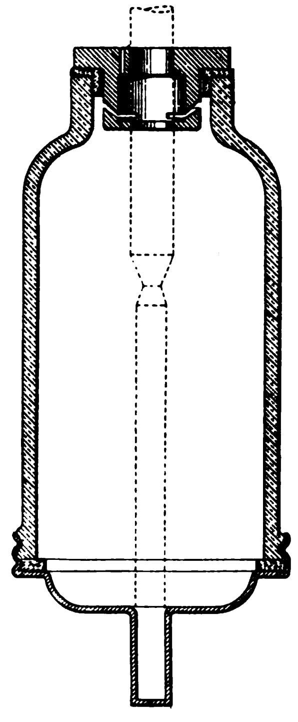


Fig. 6.

devised to check the circulation of ingress and egress and still have the same sized opening leading into the enclosure. The comparative measurements with and without the gas-checking device will be given later on.

It will be noted that in order to retard or check the flow of gases into and out of the bulb, the plug is provided with a depending cylindrical metal tube about 1½ centimetres long, the lower end of which is slotted so as to allow of communication between the gases on either side of the wall formed by the tube. The opening around the carbon may with advantage be enlarged so as to form a secondary chamber for the gases, as shown in the cut. Now after the lamp has been in operation for a few moments, the heated gases from the arc instead of having an unobstructed egress, are met by another body of gas at the plug, resulting in the production of eddy currents which tend to check the circulation of the outgoing and incoming gases. I have in my hand a model illustrating the principle of the gas-check plug. Instead of the lower carbon I use an ordinary wax candle. Instead of the upper carbon I use a strip of metal to serve as a longitudinal diaphragm adapted to show the circulation of the gases. The depending cylindrical metal tube which projects into the bulb is provided at its lower end with slots just as explained before. In order to show the gas-checking action very distinctly I have arranged to open and close the slots at will. The conditions you will see represent exactly those which exist in the case of the lamp. I now light the candle. If I remove the metal strip which forms a dividing wall for the gases, the circulation of air into the enclosure will be stopped almost instantly and the candle goes out. If the strip be inserted, thus representing the upper carbon in its normal position in the lamp, and the candle be relighted, you will note that the flame continues to play, the cool air finding a path for admission on the one side and the heated gases having an unobstructed egress on the other. Thus far the slots in the depending tube have been closed. I now open these. You will note that the circulation of gases is quickly checked and the flame grows dimmer and finally becomes extinguished. The heated gases are diverted in their course, and instead of passing freely out of the enclosure, tend to fill the bulb with a deoxygenated atmosphere, thus illustrating the action of the gas-check plug of the enclosed arc lamp.

TABLE III.

LIFE TESTS WITH AND WITHOUT GAS-CHECKING ATTACHMENT. CARBONS 11.11 MM. ($\frac{7}{16}$ IN.) IN DIAMETER.

Mean current. (amperes)	Mean arc tension. (volts)	Mean energy. (watts)	Consumption of (+) carbon per hour in mm.	Consumption of (—) carbon per hour in mm.	Total consumption of carbon per hour in mm.	Remarks.
7.98	63.86	509.65	2.118	.538	2.656	No gas-check.
7.99	63.4	506.56	1.483	(—).152	1.331	Gas-check
8.03	61.77	496.12	2.751	.424	3.175	No gas-check.
8.06	63.5	511.81	1.161	(—).076	1.085	Gas-check

TABLE IV.

Life Test of Carbons 11.11 mm. in diameter, in "Pioneer" 5-ampere enclosed lamp.

" " (+) carbon = 109.537 "
Original length (+) carbon = 306.387 millimetres.
" " (—) carbon = 121.10 "
Final " (+) carbon = 109.537 "
" " (—) carbon = 82.55 "
Total run = 121. hours.
Consumption (+) carbon per hour = 1.652 millimetres.
" (—) " " " = .319 "
Maximum current = 5.25 amperes.
Minimum " = 4.65 "
Average " = 4.95 "

Life Tests.—First, with and without gas-checking attachment. The use of the gas-check plug makes it possible to prolong the life of the carbons far beyond that which can be reached without employing this device. In the accompanying Table III. I give the results of tests made with and without the gas-checking attachment, other conditions being practically the same. You will note that in one of the tests the total consumption of carbon with the gas-checking plug was only a trifle over one-half and in the other a shade more than one-third of that resulting from the omission of the gas-checking attachment. The prolongation in the life of the negative electrode was exceedingly marked, the latter having increased in length in each case when the gas-checking attachment was used.

Second, with carbons 11.11 mm. in diameter in 5 ampere lamp. A pair of carbons which in the ordinary open arc will burn from 6 to 8 hours, will last from 100 to 150 hours in commercial practice in the high potential enclosed lamp which I have already described to you. A life test of a pair of carbons 11.11 mm. in diameter, operated in the standard lamp is given below. This is a report on the performance of a lamp, which is in service about four hours every day. The total run was 121 hours. See Table IV.

Third, with carbons 12.7 mm (½ inch) in diameter, in 4 ampere lamp. When the diameter of the carbons is increased the longevity is greater, but other objections are introduced which will be treated of under the heading of "Efficiency of the Enclosed Arc." The life test of a pair of carbons 12.7 mm. in diameter running about 12 hours per day in a 4 ampere lamp is given in Table V.

TABLE V.

Life test of carbons 12.7 mm. in diameter, in "Pioneer" 4 ampere enclosed arc lamp.

Original length (+) carbon = 304.80 millimetres.
" " (—) carbon = 128.587 "
Final " (+) carbon = 114.30 "
" " (—) carbon = 77.787 "
Total run = 199. hours
Consumption (+) carbon per hour = .957 millimetres
" (—) " " " = .255 "
Maximum current = 4.5 amperes
Minimum " = 3.8 "
Average " = 4.15 "

LIGHT; ITS DISTRIBUTION AND DIFFUSION AS RELATED TO QUALITY AND EFFICIENCY.—II.

BY E. LEAVENWORTH ELLIOT.

THE lighting engineer—a hypothetical personal who we hope will actually exist some day—has at his disposal five different light sources—viz., the oil lamp, gas flames, incandescent gas, incandescent electric and electric arcs. With the exception of the incandescent electric, all these must be placed in a vertical position, and except the electric arc cannot be inverted. Now, it is a common idea, due to some extent perhaps to a careless statement in the text books—to-wit: "from a given source light proceeds equally in all directions," that such is actually the case, when in fact it is not the case at all. Each source of light distributes its rays according to its own peculiar law. These laws are most easily expressed as polar curves, which are given in Fig. 1, the plane of the curve being vertical.

It will be observed that the lights produced by gas and oil send a large part of their light upward: the direct current arc sends most its light downward, the larger part included between the angles of 30 degrees and 50 degrees; while the alternating arc sends its light equally upward and downward, but mostly between the angles of 50 degrees above and below the horizontal; while the distribution from the incandescent electric is by no means uniform it is of less importance since the lamp may be placed at any angle. With the exception of the flat flame, the distribution of all these sources in a horizontal plane may be considered uniform.

The objects which we wish particularly to illuminate are generally below the level of the eye, as reading matter, or articles being worked at with the hands. In practically all cases they are below the sources of light. The first step toward efficiency and economy will be therefore to direct the larger part of the flux of light below the plane of the source. In exterior lighting we may consider all light above this plane as absolute waste.

The prime requisite of illumination is, as already stated, that it shall be uniform. Whatever source of light is to be used therefore a better distribution must be obtained, if economy is to be considered. Having secured this result to as great a degree as possible, the problem then becomes comparactively simple. Knowing the illuminating power of the sources to be used, the general brilliancy to be required, and the extent of space to be illuminated, the distribution of the light unit is readily determined.

The intelligent engineer will now look to the quality of the light. In this regard we can do little more at present than to provide the most economical means possible for the diffusion of the luminous rays, leaving no naked light sources visible. In case arc lamps or Welsbach burners were to be used for interior lighting, he would doubtless seek to reduce the excessive blue and violet of the former, and the yellowish green of the latter, by means of suitably tinted globes.

For securing a better distribution and diffusion of the light, advantage must be taken of the well-known properties of refraction and reflection. In diverting the upward flux into the lower hemisphere, reflection is, within certain limits, the only means possible. Regular reflectors, either of silvered glass or polished metal, have long been used for this purpose; but they have several serious defects. Glass is fragile, polished metal tarnishes, and neither produce any diffusion, but rather increase the glare. Irregular reflecting surfaces, as the so-called porcelain and white enameled metal, correct some of these defects, and give about an equal efficiency, reflecting about 80 per cent. of the incident light.

The most common method of securing diffusion, and partially correcting the distribution, is by means of globes, either roughened on the surface by sand-blasting or etching, or rendered translucent and milky in the process of manufacture, "opal," or "opaline" glass. While the diffusion produced by these means is good, the method is extravagantly wasteful. Clean ground glass will absorb 30 per cent. to 50 per cent. while opal glass absorbs from 50 per cent. to 80 per cent. of the light.

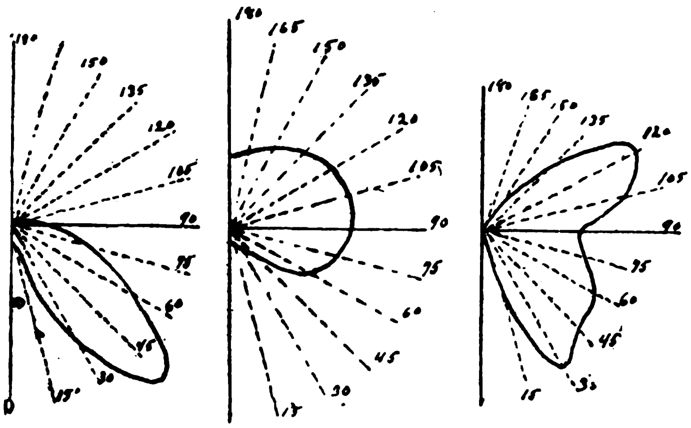


FIG. 1.—CURVES OF DISTRIBUTION.
I.—*Direct Current Arc.* II.—*Flame.* III.—*Alternating Arc.*

Besides this loss by absorption, such glass causes an additional practical loss by diverting more light into the upper hemisphere, when used with the arc light. In this case the globe itelf becomes the practical source of light, each point on the surface giving out light in all directions, outside the tangent plane. With the direct-current arc most of the light would fall on the lower half of the globe; but for the reason just given, this lower half would throw considerable light in the upper hemisphere which would otherwise continue its downward course. The higher the arc is placed in the globe, the greater the loss in this way.

On account of the serious objections to the means just described various attempts have been made to secure better results by the systematic use of refraction and total reflection. Ribbed glass was the earliest attempt in this direction, and its use is very old. Glass of this kind was used in the electric lanterns in the streets of London. Mr. Edward Atkinson has recently revived interest in the use of such glass by applying it to the windows of factories. The results were very satisfactory, the corners and spaces between the windows being much better illuminated.

The next step was the use of two such panes placed together, with the flutings crossed at right angles, suggested by Raffard in 1881. This was simplified by Trotter in 1883, by ribbing a single sheet of glass on both sides, a method which Cooper and Richardson had suggested 10 years before. The method is still quite commonly applied to lamp "shades," or globes. Seaver has brought out a globe having interior meridianal prisms, which have the effect of widening the apparent source of light. As might be expected, they show the prismatic colors at the edges of the light. Shades having similar prisms on the outside are also to be found, and produce a similar result.

An attempt has been made to apply this principle to blown glass lamp chimneys, but as the process of blowing is incapable of producing appreciable variations of thickness, it is evident that such attempt must be practically useless.

The idea of giving a special form to the ribs or flutings, so as to distribute the light according to a predetermined law, was suggested by Fresnel more than 50 years ago, and has been very highly developed for light-house purposes. Comparatively little attention, however, has been given to applying the principle to the problem of securing a better distribution for general illumination.

LITERATURE

THE COMMERCIAL ORGANIZATION OF FACTORIES.—By J. Slater Lewis. New York. Spon & Chamberlain. (Sold also by The Electrical Engineer.) Large octavo. Illus., including loose plates. 540 pages. Cloth, $12.

This is, indeed, a superb and masterly treatise, covering the entire ground suggested by its title and going into many branches of the subject that are pertinent and cognate, but which would not at once occur, even to a student of economics. The broad principles are well noted, with a quiet shrewdness that often strikes the reader as falling little short of inventive genius; and at the same time, a multitude of details are dealt with in a close, hard, practical way that evinces the most intimate acquaintance with manufacturing as done on the modern large and clean-cut style.

Mr. Lewis is not in any wise satisfied with a few chapters on running work through the shops, but deals even with the officers and the organization of the company, and has many points of information and interest at each step. He devotes serious attention, for example, to the use of reply postals, the phonograph, filing of letters, and makes some excellent comments on advertising, being in favor of the "full page" as a sure sign of enterprise, and recommending that if smaller "ads" are carried in several papers they should have a marked family likeness, rendering them readily recognizable. In fact, all the minutiae of correspondence and publicity are dealt with, and as the book is based primarily on English practice there are here, and in all the other sections, important differences to note, not at all the advantage being in our American way by any manner of means.

When we get into the factory, Mr. Lewis is perhaps at his best, and one follows the men through their daily toil, the goods, from the raw material to the finished product, in every conceivable fashion that may be considered orderly. Forms, blanks, tables, diagrams, are given at every step, and while Mr. Lewis has his preferences, his whole treatment of shop practice and methods is luminous, harmonious and soundly philosophic. Of course, it is understood that there is no Procrustean bed proposed for every manufacturer to measure himself on. Any well conducted shop has a system of its own stamped with the sagacity and experience of somebody, but there is always gain in uniformity and in studying the technique of other people who have proved successful. We imagine it to be difficult for any factory owner or manager to go through this valuable and interesting book without picking up innumerable hints, or being shown how various improvements can be made in his own well established system.

The book is beautifully printed in plain, large type on good paper, and the illustrations are excellent. The frontispiece is a colored diagram, showing by means of a "tree" the proper and natural course of business through the various channels and departments.

THE A B C OF THE X-RAYS.—By W. H. Meadowcroft. New York. The American Technical Book Co. 5 x 7½ in. 189 pp. Price, cloth, 75 cents; paper, 50 cents.

In this little work Mr. Meadowcroft has followed the same style of exposition as that pursued in his deservedly popular "A B C of Electricity." In both, nothing has been sacrificed to accuracy, with the result that those well up in electrical work as well as the layman, can read it to advantage.

The author introduces his subject with a brief sketch of the history of the Röntgen ray and then explains in succession the principles of operation as well as the details of construction of the various parts of an X-ray apparatus, including Ruhmkorff and high frequency coils, tubes, circuit-breakers, etc., all made thoroughly clear by diagram and pictorial reproductions. The chapters on manipulation and practical suggestions, as well as that on photographic plates will prove all-sufficient for the obtaining of the most satisfactory results.

The book ought to be in the hands of every one interested in X-ray work.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - - 1564 Monadnock Block, Chicago, Ill.
Philadelphia Office - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - - per year.	$3.00
Four or more Copies in Clubs (each) - - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

Vol. XXIII. NEW YORK, FEBRUARY 10, 1897. No. 458.

DO ISOLATED PLANTS PAY?

NEXT to the municipal plant question, there is perhaps no topic of more pressing interest to the owners of electric lighting properties than the future status of their holdings. Of late attempts have been made in various quarters to sound an alarm to the effect that electric central stations are doomed, and but a few weeks ago we had occasion to notice and comment upon an article in which this assumption was taken as the text. At that time we showed,—as far as the limits of a brief editorial could do so—some of the errors into which the writer referred to had fallen, and the serious omissions, all of which made the conclusions arrived at of doubtful, if not of completely negative, value. That the position taken by us in this matter was justified is, we are glad to say, confirmed by the statements which appear in an exceedingly interesting article contributed by Mr. R. S. Hale to the "Engineering Magazine" for February. Mr. Hale defines his position as a critic at once, by stating that for the last three years his work has been chiefly in the line of analyzing records and tests in general engineering, but chiefly in electric station work for the Boston Edison Company, in order to find out why theoretical and practical results should be so different. Here certainly was an equipment for work which perhaps few investigators and engineering accountants have at their command.

Mr. Hale first points out an arithmetical error made by the advocate of the isolated plant, but we pass that over and come to the question of the cost of coal for the plant under discussion, which is capable of supplying 2,500 lamp hours per day, and requiring the generation of 186½ kilowatt hours. The original writer assumed that by utilizing part of the exhaust steam for heating, the coal consumption could be brought down to 5 lbs. of coal per horse-power per hour. This figure is very properly considered by Mr. Hale to be absurdly low for a plant of the size under discussion, since it would have a single expansion non-condensing engine of small size for which there are no exact records of output in coal consumption of a plant of the size given. But he refers to the report of the Committee on Data of the National Electric Light Association for May, 1896, in which it is shown that the average consumption of coal per horse-power hour for a large number of central stations is 12.2 lbs. Even assuming that one-half of the heat contained in coal would be employed for heating during six winter months the average would still be 6.1 lbs. of coal as the average per horse-power hour chargeable to electricity, without considering the extra cost due to the fact that an isolated plant is smaller and worse managed than a central station using similar engines.

Mr. Hale then takes up the cost of labor, which the previous writer had taken at $2.50 per day, and which proves to be about as low in proportion to the actual cost as is the five pounds of coal per h. p. hour. As Mr. Hale points out, a responsible engineer who can take charge of the plant, run the engine,, take care of dynamos and look after storage batteries, and be satisfied with $2.50 a day, would be hard to find. If storage batteries are not used, then, in order to give the same quality of service as that supplied by the central station, two engineers would of course be required to be on duty twelve hours a day each. In addition, though the labor of the fireman during the winter is, of course, chargeable against steam heat, during the summer his wages must be an extra expense.

Mr. Hale then takes up the question of the relative investments required for central station and isolated plants of like capacity, and the items of depreciation, taxes, insurance, interest, etc. Without following him through all these details, we may state briefly that his conclusions are that the isolated plant is very seldom charged with any part of its share of the taxes, insurance, depreciation or interest, and that large portions of the management, accounting, repairs, labor and miscellaneous expenses of an isolated plant are also charged against other accounts. He finds, however, that the first cost of an isolated plant is actually less than that of a central station only in items of boilers and electric street conductors, the isolated plant being more expensive in the first cost for engines, dynamos, real estate, and other capital accounts.

As a matter of fact a comparison of the real expense of an isolated plant with those of a central station shows that not only is the total first cost practically as much as for the central station in proportion to the current supplied, but that if all the expenses are included, the cost of operation of an isolated plant is far greater than that of a central station. We cannot help referring to what appears to us a very apt remark in Mr. Hale's résumé, namely, that it is cheaper for the real estate man, the hotel keeper, or the dry goods merchant to devote his brains and intelligence to making money in his own field, where he is an expert, than to waste his time on a small electric plant, provided he can get station current at a fair and moderate price. No matter how skillfully he may run his isolated plant, he generally will lose money or—which comes to the same thing—not make as much money as he would have made had he employed his time, his capital and his brains where they are most effective. Mr. Hale has evidently treated the subject in a thoroughly unbiased manner, and we are certain that his conclusions will carry due weight among those who are now, or are contemplating, operating isolated plants. As a matter of fact there are few isloated plants of any size installed nowadays without making provision on the switchboard for connection with the street mains, and although it may take some time to bring about such a result we are pretty well convinced that sooner or later the street connection switch will remain permanently closed. There was a time, we are sorry to say, when central stations objected to furnish current to isolated plants, and possibly their early refusal may have determined not a few owners of buildings to declare their independence; but with the more liberal views adopted by the companies on this point during recent years, owners of buildings have been placed in a better frame of mind and are willing to listen to the representations of central station companies, looking towards the entire supply of current from outside.

ALUMINUM.

WHEN the production of aluminum on a commercial scale became an accomplished fact some years ago, it was predicted that this metal would in time displace others, which had theretofore held their own in the arts from time immemorial; but until recently the high price of aluminum has always militated against its use for many purposes. That we are approaching the realization of the predictions, however, is evident, and it is now only a question of time when we shall see aluminum freely substituted for brass, copper, iron and steel in many situations. What has undoubtedly hastened the substitution is the continued reduction in the price of aluminum, and the recent cut made a few weeks ago will further accelerate the process. Sheet aluminum has been reduced in price from ten cents a pound in the heavier gauges to twenty cents a pound in the lighter. Thus No. 20 gauge has been reduced from 62 cents to 52 cents a pound, and No. 30 gauge from 93 cents to 73 cents a pound. When one considers that counting the weight of aluminum as equal to 1, sheet copper is 3.3; brass, 3.1 and steel 2.9; it follows that taking into account the difference in the weight, aluminum is now brought almost directly in competition with sheet brass, while, as a matter of fact at the present time it is actually cheaper than nickeled brass. As to the status of aluminum, in the elctrical industries more particularly, and its probable use as a conductor, the article by Mr. C. C. Burr, which appeared in our last issue, is deserving of more than passing attention. As Mr. Burr shows, the relative conductivity of copper and aluminum is as 100 to 63, but owing to the difference in weight, which is in the ratio of 1 to 3.3 in favor of aluminum, weight for weight, the latter has a conductivity relative to copper as 208 to 200. This may make it a determining factor in using it as a conductor, as was the case in the equipment of the Pittsburg Reduction Company, at Niagara Falls. This is a fact which will probably be borne in mind by electrical engineers, in special work. We believe that with the further reductions which will probably be brought about in the price of aluminum, this metal will find a still greater variety of applications than it enjoys at the present day.

TELEGRAPHIC HEROES.

THE dinner of the Magnetic Club in this city last week served as a formal acceptance on the part of the telegraphic and electrical fraternity of the gracious though tardy act of Congress in honoring the worth and valor of the gallant old U. S. Military Telegraph Corps. The effort to secure this recognition has run through many years and has been the more creditable for the reason that it was not a mere hunt for pensions, but a simple, earnest insistence on the fact that the noble work done by the telegraph boys in the Civil War should at least be signalized by the country for whose preservation it did so much. In a sense, the bill signed by President Cleveland constitutes a distinct or separate order of valor and good service. So far as we are aware, it is the first action of the kind anywhere, on service of this nature; and, perhaps, with the near coming of a time of perpetual peace, there may never be another. To the handful of two hundred survivors of the original twelve hundred, we are delighted to be able to extend our congratulations. Telegraphy has been the mother country of all the other electrical arts, and such examples as these heroes presented are a precious common heritage for us all.

Steps have been taken from time to time to place all the skill of electricians at the disposal of the government in time of national peril, just as all the resources of the telegraph were in 1861. But we confess our deep disappointment at the result. The Naval Reserve is a fine body, but if electrical men think they are getting into condition for helping their country materially by tumbling around in clumsy dingies and superannuated training brigs we must very respectfully differ from them. What is wanted is a special corps that can protect by electric mine and torpedo our whole coast line and harborage and do for the Government that which in this respect the U. S. Military Telegraph Corps did for it on land in other times of need. Here is genuine opportunity for youthful electrical patriotism, so far as the frontiers on the sea are concerned.

MR. TESLA AS A BUG KILLER.

THERE can be no doubt as to the invasion of the domain of agriculture by electricity. Last week we noted the results obtained on a farm in Germany, and hardly a week goes by without its news of farmers using the telephone in their operations, experiments at agricultural stations with all kinds of current in stimulating seeds and plants, or the use of power from lighting or trolley circuits in running farm machinery. Indeed, it may be said to be doubtful whether the factory or the farm is to be the new scene of electricity's next triumphs.

It will be remembered that not long ago, Mr. Tesla suggested that part of the energy of powers like that of Niagara might be applied to furnishing nitrogenous elements to the soil, so that better crops could be secured. This may explain why a Mr. S. S. Harvey in the South wrote to him asking if electricity could not be used in a general pervasive way to kill off the bugs that are such a pest in orchards and vineyards. Mr. Tesla, with wonted courtesy, admitted the importance of the subject and said in response to the inquiry: "It is sure that we can destroy these detrimental insects in certain ways by the help of electricity, but to what extent the trees would be affected by the application of these means I do not know, and it could only be settled by a series of experiments. I have some ideas on the subject, and think that an apparatus for experimentation could be produced in a short time. I am resolved to think over the matter in the hope to arrive at some tangible result."

We have no doubt that to some people the idea of a notable electrical inventor devoting his time to devising bug traps and "sure deaths" smacks rather of the grotesque and ridiculous; but in reality Mr. Tesla could not undertake anything of more real and practical value. When one stops to consider how famine, ruin and devastation afflict the human race because of such pests as the locust, phylloxera, army worm and potato bug, it is evident there is work to do of real vital importance to a great many people.

ROENTGEN TUBE CONTROL.

THE enthusiasm with which the Röntgen ray has been taken up, especially in the United States, has led to the design of excellent apparatus for this work at a reasonable cost. It has thus placed in the hands of the scientist and surgeon a powerful instrument of research, and given the amateur a new and attractive instrument for his diversion. But, perfect as the mechanical and electrical part of such apparatus has been made, the weak spot in the combination is still the tube, which has to be constantly coaxed, as it were, to bring out the desired form of rays. The variability in the working of the Röntgen ray tubes is accompanied by and has been ascribed to the change in the vacuum, and various devices have been employed to overcome it; such as heating the tube, and in the case of the Bowdoin tube, coating the interior surface with a fluorescent material. It would seem, however, that another effective device is now available for keeping tubes in normal action, due to a discovery described by Mr. Max Osterberg on another page. The simple device there described ought to go far towards making X-ray work more reliable and expeditious than it has been in the past.

ONE OR TWO ALLEGED ELECTRIC FIRES.

IT is one of the present propensities of the average reporter to attribute every fire to an electric wire. During the past week, two such instances have occurred. In New York City on Feb. 1, the drapery in a ballroom caught fire, and was at once attributed to electricity without any evidence, as there were no wires adjacent to the stuff. The "Evening Post" says: "Somebody turned in an alarm and the fire engines responded. When they arrived they found the orchestra still playing and the fire out. It was said that the fire started from a defective electric wire, but it is also believed that some one of the young men tossed a lighted cigarette into the folds of the drapery. The damage amounted to about $50." The other instance was that of the Pennsylvania capitol at Harrisburg, to which damage to the extent of $500,000 was done, practically destroying the edifice. Every report that went out at first said that the fire was due to a defective wire, but there is absolutely not a single proof of this. The Philadelphia "Ledger" says: "The origin of the fire is a mystery. It was said in the afternoon that it was caused by an electrc light wire which had no insulation. The officers of the Harrisburg Electric Light Company declared that it could not have originated in that way.

"'The building,' one of them said, 'was re-wired several years ago at the time the insurance was placed. The wiring was installed under the rules and regulations of the Board of Underwriters and was carefully inspected and approved. The odor of smoke was apparent to a number of the Senators and employés from one to two hours before the fire was discovered. Had it been caused by contact of wires the fire would have been apparent in a very short time.

"'The theory which has the most foundation in fact, is that it originated from the open hearth fire in the Lieutenant Governor's room, and burned under the floor along the joists to the hall partition, where it was discovered. This hearth was ordered rebuilt last summer by Senate Librarian. Miller, as he deemed it unsafe at that time. The accumulation of the dust of many years and inflammable particles made the progress of the fire under the floor an easy matter.'" From all the other evidence, this seems to be the correct version, but as to electricity, no evidence whatever has been brought forward implicating it.

THE signing of the ordinance in Chicago for some sixty miles of underground conduit railway marks another big advance of that system. The recent reports from Washington show that the conduit roads there ran well through the recent heavy snow and rain storms, and it was open to general observation that in this city the Lenox avenue line and that which Mr. Law is operating further out were both doing good work all through the time of blizzard. What we would like to see, however, is a fair stretch of sealed conduit in operation. The snow packs in the open conduits in a remarkable way, and it takes an awful lot of power to pull through. A sealed conduit, to say nothing of other advantages, is at least free from that strain and drain of current.

ELECTRIC TRANSPORTATION

TROLLEY ON A STEAM RAILROAD IN CALIFORNIA.

A VERY interesting adaptation of the electric motor to the steam car has recently been made on a railroad in California. The California Railway Co. operates a short line of road some three miles in length, which runs from the junction of the Southern Pacific Railroad, to Leona Heights, passing on the way Mills Seminary, the California equivalent of Vassar College. The road serves Alameda and Fruitvale, which are both located just across San Francisco Bay opposite San Francisco itself.

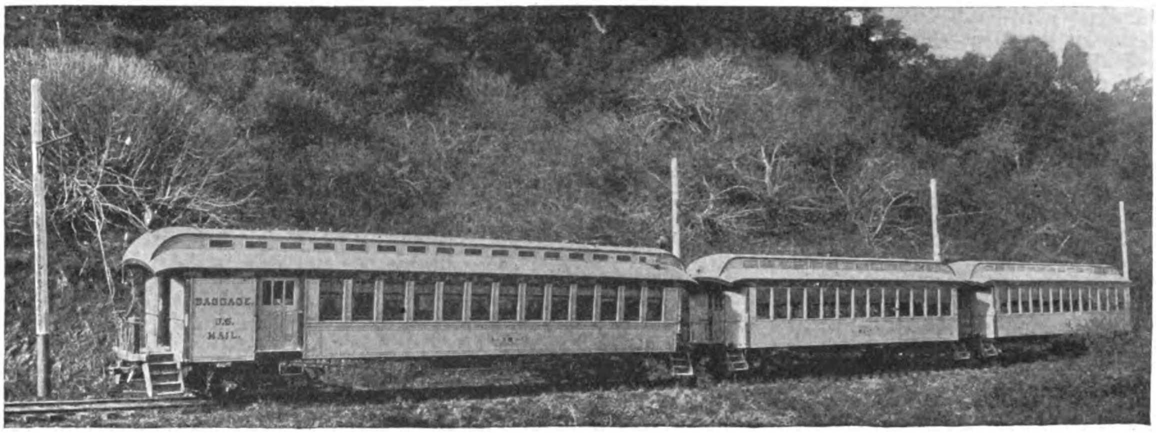


FIG. 1.—THE TROLLEY IN STEAM RAILROAD TRAFFIC, CALIFORNIA.

The cars used are standard steam railroad cars. The motor cars of the trains, of which one is shown run out, for the purpose of being photographed, are composite baggage and passenger cars. Motor car No. 11 is vestibuled at each end and carries on each hood an electric headlight. It takes current from an overhead wire by two trolleys, one of which only is in contact during operation. Each motor car is fitted with an automatic air pump to operate the brakes and the chime whistles, of which there are two, one on each hood.

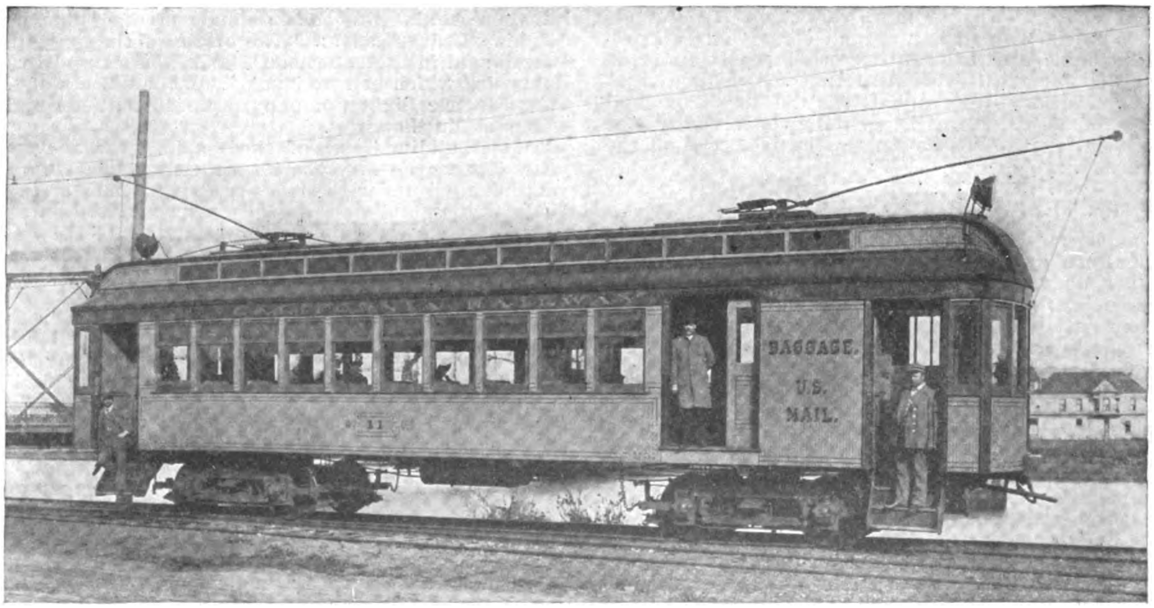


FIG. 2.—THE TROLLEY IN STEAM RAILROAD TRAFFIC, CALIFORNIA.

The motor equipments consist of four G. E. 1,000 motors, two mounted upon each truck, made by the General Electric Company. The controllers are of the K type and are provided, of course, with a magnetic blow-out. Each car is provided with automatic circuit breakers and resistances, and the interior by incandescent lamps in groups of three.

Motor car No. 21, which is shown coupled to its train, is also a composite car and is similarly equipped so far as its electrical apparatus is concerned. It is not vestibuled, however, and was one of the first to receive its electrical equipment.

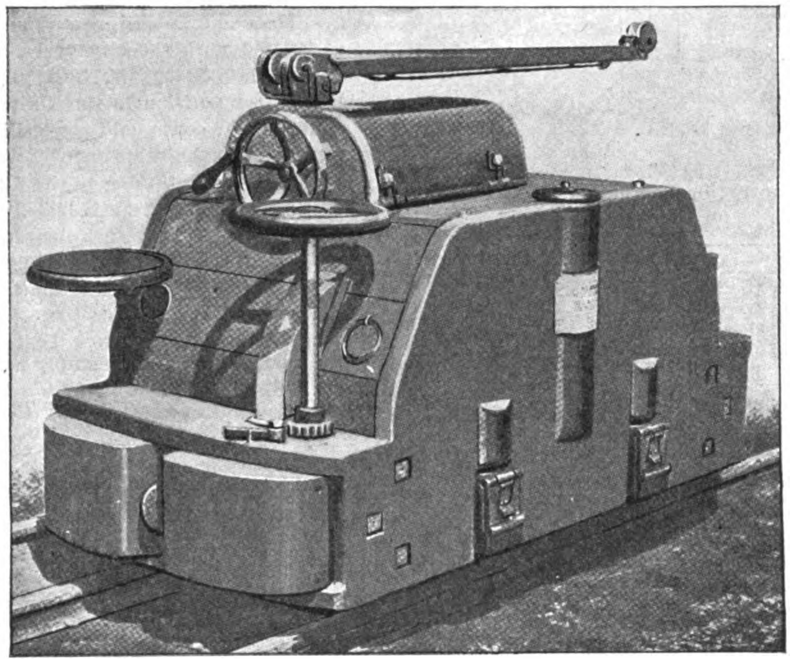
The track is of standard steam railroad construction bonded for the return. The overhead line is suspended from iron brackets swung from round poles for part of the way; for the balance of the distance it is suspended from span wires. The general character of the equipment of this road is similar to that in operation on the New York, New Haven and Hartford, with the exception of the motors, and it will be recalled that the cars of this latter line and their equipment served as models, both in the design of the car itself and the arrangements of the motors, for the locomotive designed by the late D. L. Barnes.

The General Electric Company, which carried out the equipment of the California Railway Company, through its Pacific coast office, will equip another locomotive for use on the Alameda and Fruitvale line, using, however, two or four G. E. 2,000 motors instead of G. E. 1,000 motors as on the other cars.

THE THOFEHRN ELECTRIC MINE LOCOMOTIVE.

A VERY compact and powerful little electric locomotive for use in mines and workshops was some time ago suggested by Mr. Hermann Thofehrn, the well-known consulting engineer and expert in electrolysis. This locomotive represents some excellent features; its construction is shown in the accompanying illustration, taken from two now employed in the refinery of the Anaconda Copper Mining Company.

These locomotives, says the "Engineering and Mining Journal," were installed some three years ago for conveying the copper from the railroad cars to and from the different charging points and for transporting the refinery slimes from the tanks to the silver mill. In this way they handle a large quantity of material every day without any trouble and to the entire satisfaction of the company. The General Electric Company has recently constructed two more locomotives of the same type with a draw-bar pull of 1,000 lbs., to be operated at 120 volts. These locomotives are now at work in the mines of the Anaconda Copper Mining Company at Anaconda, Mont.



THOFEHRN ELECTRIC LOCOMOTIVE

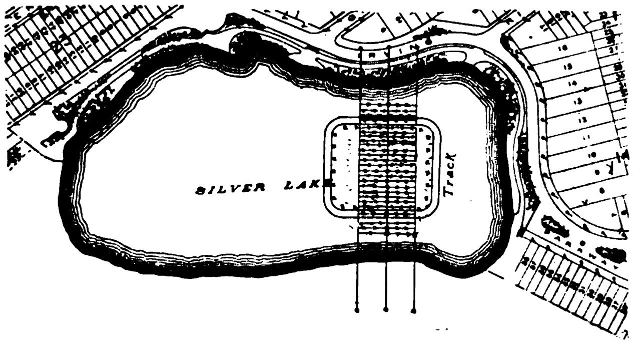
The locomotive is less than 6 feet in length, is built entirely of iron, and can pass through a tunnel 4 feet high by 3 feet wide. It can be operated at small expense, as it does not require a special electric plant to generate the power, an ordinary incandescent light plant being able to furnish the needed current. The low voltage makes the locomotive entirely inoffensive externally, while on the other hand the sensation felt when touching the contacts or the trolley wire is sufficiently disagreeable to call for caution. The danger of fire in wet mines where this locomotive may be employed is also very small in consequence of the low voltage.. The gauge of these locomotives is 20 inch and the wheels are 14 inch diameter. Besides passing through a tunnel 4 x 3 feet, these engines can run over a curve of 8 feet radius, the wheel-base being only 22 inch.

DEVELOPING TROLLEY TRAFFIC BY A SKATING CARNIVAL.

AN illustration of what can be done in fostering special travel by means of ordinary resources has just been given by the Staten Island Electric Railway Company, through the shrewdness of its general manager, Mr. A. D. Chandler, who as an old journalist is quick to see the possibilities of every passing hour and make the most of them. On the outskirts of Brighton is a beautiful spot called Brighton Heights, which is being built up by the New York and Staten Island Land Co., into a very handsome suburb. The heart of this district is Silver Lake, a lovely little sheet of water hitherto quite unknown to most New Yorkers. Trolley traffic in that undeveloped region is necessarily very light in winter, but the sharp frost early in January set Mr. Chandler thinking, and the result was that all of a sudden Silver Lake loomed up with a celebrity that became national among the skating fraternity. Over the lake, which lies a few hundred yards from the trolley line along the Richmond turnpike, were strung three strands of ⅜-inch wire, giving a total 600-foot span, anchored each end. To this was run a circuit from the trolley line and between the two sides were stretched and suspended 25 cross spans of copper wire each of which carried 5 incandescent lamps, so as to take up the 500 volts of the trolley line. These lamps were red, white and blue intermixed, and made a bewitchingly pretty canopy when swinging galley in the night air over the glistening ice and the merry throngs of skaters. Under this canopy of lamps there ran, as shown in one of the cuts, a race track of one-quarter mile lap, with the corners curved or blunted so as to make them easy for the competitors. All the races took place at night, under the auspices of the Amateur Skating Association, and to define the line of track 24 gasoline torches accentuated its inner edge.

NIGHT SCENE, SILVER LAKE, STATEN ISLAND.
Showing Lines of Incandescent Lamps Run from Trolley Circuit.

The whole thing was tremendously successful, and the lake will draw crowds all through winter while skating lasts, besides making the region known favorably for miles around. Out of nothing, Mr. Chandler built up a traffic of 30,000 people in the 20 days from Jan. 10 to Feb. 1. In order to lengthen out the dispersal of the crowds, there were novel fireworks after the races, and the band continued to play until but few of the visitors were left. Altogether, the enterprise has been a great hit and has elicited the attention of street railway managers all over the country; besides filling many columns in the daily newspapers.



ELECTRICALLY ILLUMINATED ICE RACE TRACK, SILVER LAKE, STATEN ISLAND.

TELEPHONY AND TELEGRAPHY

THERE ARE SOLID TELEPHONE COMPANIES—AND OTHERS.

SOME time last fall a concern started in business in this city, says the Youngstown "Telegram," under the name of the Central Telephone Company. The men in the company were from Alliance, and they located their plant over the Hub Bicycle Company's room on Central square. The business of the company was to make telephones and although they started in in a modest way, they expected to grow. The transactions of the company were all square, and they entered into correspondence with a number of concerns to secure quotations on different articles which they used in the manufacture of telephones. Among these was a Philadelphia electrical supply company which does a large business throughout the country. Quotations were asked on generators.

The Philadelphia firm looked up the standing of the Youngstown firm in Dun's, and found the Central Union Telephone Company rated at $7,500,000. That was enough. Not stopping for the slow vehicle of correspondence to bring the order for the large number of generators which a company rated at $7,500,000 would use, a member of the firm came to the city with visions of mammoth orders before him.

When he got here he at once found his way to the office of the Central Union Telephone Company. He met Manager Johnson.

"I have come," he explained, after handing his card to the manager, "to give you quotations on generators."

"Well, you'll have to go to our Columbus office, the headquarters for the State," responded Manager Johnson.

"Have to what?" asked the Philadelphia man.

"Go to Columbus. They do all of the buying for the State."

"But didn't you write to us for prices on generators?" asked the Philadelphia man.

"Why, no," said the manager.

"Isn't this the Central Union Telephone Company?"

"Yes."

"Well, I have——" here the Philadelphia man took out of his pocket a letter and found that the concern he was to deal with was the Central Telephone Company. Explanations followed and the Philadelphian took his way to the office of the Central Telephone Company, which he found closed. The business of manufacturing telephones had not been prosperous and the Alliance men had wound up their affairs before his arrival.

The Philadelphia man returned home minus the order from the Bell telephone syndicate, which he had so confidently expected to secure.

WEST INDIAN CABLES.

A special dispatch from London, of February 1, says: The Secretary of State for the Colonies, Joseph Chamberlain, in the House of Commons to-day, replying to a question relative to the construction of a cable under British control to the West Indies, said that negotiations on the subject were proceeding. He was unable to say when it would be completed, and he admitted that he was aware that a French-American company had recently laid a cable which would compete with the proposed British cable.

CABLE OVERCHARGES IN SOUTH AMERICA.

A SPECIAL cable dispatch from Buenos Ayres, of January 31, says: The Western and Brazilian Telegraph Company, an English concern, which has a monopoly of the telegraphic communication on the coast of Brazil until 1913, is connected with the city of Buenos Ayres by the lines of the River Plate Telegraph Company of Montevideo. In order to harass competition in the United States and Europe an overcharge of 57 cents gold a word beyond Buenos Ayres has been imposed on telegrams sent by way of Galveston to Brazil since 1892. Representations to the different governments concerned produced no effect until last June, when this government ordered the River Plate Telegraph Company to stop collecting the overcharge in Argentine territory. Protests and proposals for an arrangement of the matter followed, all tending to elude the jurisdicton of Argentina. Last October the Argentine government gave the River Plate Telegraph Company twenty-four hours' notice to comply with its decrees. The company replied, stating that it had obeyed and always would obey the orders of the government. This has since been found to be false, because on the occasion of the reduction of rates in January the overcharge on messages to Brazil figured along with the new tariffs submitted for approval, according to law. The government sent a representative to the office of the River Plate Telegraph Company to prove that a violation of its decrees was being insisted upon, and at 3 o'clock yesterday afternoon the government stopped the service here of that company in consequence of the evidence of insubordination. Since then the River Plate Telegraph Company has inquired of the government on what terms the reopening of its office would be permitted, and the government has replied that only on unconditional surrender, without any reserve expressed or implied, will the company be allowed to resume business. This the company has failed to agree to, and consequently its office here will remain closed until such time as it sees fit to comply with the order of the government to make the tariff uniform, charging all the public alike and stopping the discriminating rate hitherto imposed on telegrams by way of Galveston.

ERIE TELOPHONE.

The Erie Telephone directors have declared the regular quarterly dividend of 1 per cent., payable February 15.

The annual report, to be published early in April, will show an increase of 2,798 in the number of subscribers during the year, making the total number connected December 31, 1896, 21,389, against 18,591 December 31, 1895, and 16, 174 December 31, 1894.

The report also will give detailed statistics concerning the wire mileage, showing a gratifying growth. The actual wire mileage now including the long distance toll lines is 42,000 miles. The company's largest single line in the Northwest now is 750 miles and in the Southwest 650 miles.

BELL TELEPHONE OUTPUT.

The Bell Telephone statement, issued for the month ended January 20, shows an increase of 4,197 instruments over the 3,839 net output for the previous month. For the first six months of 1896 the net output averaged 11,819; for the last six months, 4,399. The statement for January 20, 1897, shows 73 instruments under the 8,109 average monthly output for 1896.

COMMENT ON THE HAWAIIAN CABLE.

The Hawaiian cable scheme or schemes again occupied the attention of the House committee this week. Two rival companies are seeking a government charter with incidental subsidy. Each, according to itself, is a pure and patriotic and wholly American organization; each, according to the other, is but a cat's paw of England. What with preventing Nicaraguan canals from being built and covering the Pacific with a network of "military" submarine cables, British gold would appear to be having an unusually busy winter. What the poor Hawaiians want is, of course, altogether a secondary consideration. They exist only to be annexed and have cables landed on their territory. It may be worth saying, however, merely as a matter of curiosity, that they are heartily opposed to any such cable monopoly as is being urged at Washington. The Spalding concession, which will lapse in a month or two, the Hawaiian government refused to extend or amplify when ex-Secretary Foster was sent to the islands in November to secure a new contract. A rather tempting bribe of $375,000 cash down was dangled before President Dole, but the Chief Justice told him he had no right to make an exclusive contract, the business and commercial interests of Honolulu pronounced strongly against the scheme, and Mr. Foster had to come away empty-handed. All this will, of course, be regarded as wholly irrelevant at Washington, where the process of voting away the lands and franchises of other nations is one of the chief occupations of some of our leading statesmen and lobbyists.—New York "Evening Post."

LETTERS TO THE EDITOR

PROF. ANTHONY'S METHOD OF MOTOR SPEED CONTROL.

REFERRING to Mr. Blood's communication, page 146, of your issue of February 3, I have been unable to find the German and French patents to which he refers, but upon examining the catalogue in which Mr. Blood claims that motors embodying the idea are listed, I find that four pole machines are among those listed as variable speed motors, and, as my method of control is not practically applicable to four-pole machines, but only to machines having an odd number of pairs of poles, it is evident that the method of speed control employed in the motors catalogued is not the method that I described.

I have looked through the patents to Wightman and the only one I find that describes a method of control bearing any resemblance to mine, is No. 542,667, of July 16, 1895, a patent with which I was before entirely familiar, and in which the resemblance is superficial only. In reality his method and mine are totally unlike in principle and results.

His method necessitates the use of a multiple path or "parallel" multipolar armature winding. Mine requires a multipolar armature winding of the two-path or "series" type. His method gives the high speed for the normal multipolar working of the machine. Mine gives the slowest speed under the same conditions. In his method applied to a four-pole machine, the change of speed is obtained by reversing one pair of poles and at the same time, by means of the controlling switch, disconnecting from the circuit one pair of (opposite) brushes and connecting the two remaining brushes, which are now of opposite polarity to opposite sides of the circuit. In other words changing the machine from a four-pole to a two-pole machine.

In my method the change of speed is effected by changes in the field only, no change being made in armature connections. Moreover, my method permits of every gradation of speed from the highest to the lowest.

Before applying for a patent I had a search made at the Patent Office, which disclosed nothing really like mine, although several patents were found which seemed to bear some resemblance, but which upon examination proved to relate to bipolar machines having each pole in two or more sections, so as to look in the drawings like multipolar machines. My application passed through the Patent Office without any question as to the novelty of the method, without a single citation against or objection to any of the claims.

In relation to my explanation of sparking, it is a fact that, when the speed of a motor is increased by weakening the field, troublesome sparking sooner or later occurs.

No one doubts that the weakening of the field is the cause. But to say that a field is weak is the same as saying that some of its lines have disappeared. Moreover, it is a fact that as a field is weakened the density around the corners and angles diminishes, in general, more rapidly than the average density. In a motor this disappearance of some of the pole corner lines, leaves the lines due to the armature current free to act to produce sparking.

Mr. Blood may, if it seems plainer to him, call this "distortion into the region of commutation," but the distortion occurs because one of the components, the lines of the pole fringe due to the field, have, partially at least, disappeared.

WM. A. ANTHONY.

New York, February 4, 1897.

THE KELLY STATIC INSTRUMENT FOR DETECTING GROUNDS.

At the last meeting of the Northwestern Electrical Association, Mr. H. C. Wirt, of the General Electric Company, recommended the use of a static instrument as a means of detecting grounds and stated that such an instrument would be on the market in six weeks. Allow me to call your attention to the fact that such an instrument has been on the market for two years and that its use is fully covered by United States patent, No. 554,275, dated February 11, 1896, granted to me.

JOHN F. KELLY,
Stanley Electric Manufacturing Co.

Pittsfield, Mass., February 1, 1897.

PATENTS ON COUNTER ELECTROMOTIVE FORCE REGULATION.

REGRETTING that I feel it necessary to trespass further upon your valuable space, I think it proper that the facts relative to the counter electromotive force regulation situation should be more fully stated in view of Mr. H. Ward Leonard's reply on page 34 of your issue of January 6, to my criticism of your article implying that he stands as the inventor of the broad invention.

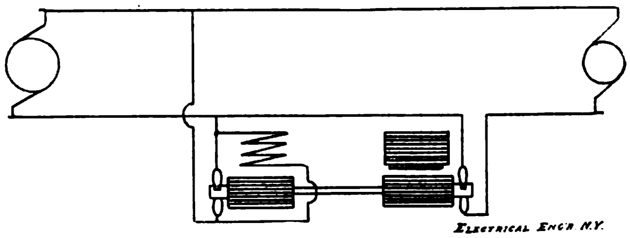
Mr. Leonard had three interferences with me, two on broad issues and one specific. No testimony was taken in any of them. The issues of the broad interferences read:

> The method of controlling motors which consists in supplying to the motor a current of electricity, producing by magnetic induction in the circuit between the source of supply and motor a varying magentically induced counter electromotive force independently of that of the motor, and opposing the current of electricity supplied to the motor by varying the magnetically induced counter electromotive force.

This was one of some fifty of my claims. This was interference No. 16836. Mr. Leonard was, in effect, defeated in this, as it was adjudged that he had no right to make the claim. It is still in my application. The next interference had the following issue:

> In combination with an electric motor, a counter electromotive force regulator consisting of a second dynamo-electric machine whose armature is in series with the motor to be regulated, and independent means for varying the counter electromotive force of said second dynamo-electric machine.

This was interference No. 16837, and besides including Mr. Leonard, it included Wheeler, Bancroft, Lundell, Wightman, Burke, Blauvelt and Woods. On motion to dissolve it brought by Mr. Leonard, I alone opposed the motion and insisted upon, as my right, the patent for it. The rest relinquished their claim to it. When a man voluntarily pulls down the edifice with his own destruction it needs no argument to show where he stands, for that shows in his fear of defeat he attempts to destroy his adversary with his own suicide.


ELECTRICAL ENG'R N.Y.

The third interference, No. 16838, reads:

> In combination with an electric motor, a counter electromotive force regulator, consisting of a dyna-motor, whose motor armature is in shunt with the line, and whose generator armature is in shunt to the line and in series with the motor to be regulated.

This interference was not contested, and so far as Mr. Leonard's construction was concerned was fully anticipated, among others, by German patent, No. 59494, of 1890, to Anspach, which shows the above drawing.

No testimony was taken in any of the interferences. This particular interference, No. 16,838, was decided in favor of Leonard on the record before the Patent Office discovered its error, and the judgment is to be vacated. This is the so-called interference Mr. Leonard refers to as having defeated me.

I have no desire or wish to detract from the work of others, but I strenuously object to them clothing themselves with so-called honors to which they have no right and which they attempt to hold at my expense. I was somewhat amused at Mr. Leonard's suggestion to "discuss the results" with me "after the Patent Office has issued a patent to the first inventor," as the time for discussion or contest, in my opinion, is before the decision as to who is the first inventor.

In "The Electrical World", on pages 67 and 68, of January 9, will be found information as to the art and its bearing upon the Leonard patent of December 8, 1896. Mr. Leonard's personal attack upon me for standing up for my rights does not strengthen his position. He so sarcastically refers to my antedating a reference as a means of establishing my right, yet in his reply to me in "The Electrical World," page 68, he there says he himself resorted to that practice in securing his patent. His words are, "my date of conception enabled me to antedate the references." In my case it was "reduction to practice" and not "conception" merely. The public are interested in facts, and are entitled to the truth where their position in the future is likely to be affected.

R. M. HUNTER.

Philadelphia, Pa.

AMERICAN BOOKS AND ENGLISH REVIEWERS.

The timely letter of Prof. Trowbridge, quoted in your issue of January 13, calls to mind a notice in an English electrical periodical, of Prof. J. J. Thomson's book, which relates almost exclusively to his own researches, and to his inferences and theories. This admirable treatise, which I have known to be cited by the Patent Office as an authority, was caused to appear defective, because Prof. Thomson had omitted to mention certain experiments of others. This letter is written partly in favor of the British reviewers, for in this instance, it was an English author, and not an American whose book lacked irrelevant material. In another instance, a certain book was alleged to contain too much.

The formula employed by one or two English editors, in reviewing, seems to be one in which the equation is to be satisfied by showing that a book contains too much or too little.

EDWARD P. THOMPSON.

New York, January 18, 1897.

NEWS AND NOTES.

THE NEW HAVEN STEAM RAILROAD TO COMPETE FOR LIGHTING.

A high officer connected with the New Haven Railroad Company says that a part of the plan in the operation of the electric power house at Berlin is the supply of light at New Britain in competiton with the existing local company. As the local trolley companies in a number of Connecticut cities operate plants for lighting also, the competition in electric lighting seems to be a phase of the warfare of the trolley and steam companies as soon as the latter adopt electrical equipment at competing points. It will serve to make the lighting and street railway companies allies and common foes to the Consolidated.

CHEAP POWER FOR EAU CLAIRE, WIS.

H. M. Byllesby of St. Paul, Arthur S. Huey, of Minneapolis, David Douglas of Eau Claire, and others, have asked the city council for a franchise to develop the water power on the Eau Claire River and for the erection of a power house for furnishing light and power. The gentlemen named have an option on the power and all necessary lands now owned by the Northwestern Lumber Company. The enterprise involves an investment of about $300,000.

PROF. GALILEO FERRARIS, the distinguished Italian electrician and member of the Italian Senate, is reported dead, by a special cable despatch received Monday.

THE NEWARK (N. J.) TELEPHONE COMPANY started to do an independent opposition telephone service, had a lively meeting last week, when a lot of stockholders insisted on asking questions, to which apparently they got few satisfactory answers. J. M. Gwinnell was elected president; S. Klotz, treasurer, and G. H. Atkinson, secretary. The company's plant is still incomplete, but is mortgaged with the franchise for $300,000.

MISCELLANEOUS

DEAD WIRE ON ARMATURES.

BY RICHARD PFUND.

WHILE looking over some old volumes of The Electrical Engineer the writer came across two articles by Prof. Anthony[1] and Mr. Carl Hering[2] on the so-called "dead" wire on dynamo armatures and that on armatures of the Gramme type in particular.

Prof. Anthony claims that the wire on the inside and ends is not dead because the e. m. f. developed in the coils of wire or an armature is determined by the rate at which lines of force are taken into or excluded from the area enclosed by the wire. Mr. Hering says that an e. m. f. is generated only in that part of the wire which cuts across the lines of force and that the wire on the inside of a ring is dead because, being shielded by the iron of the ring, it does not cut any lines of force, therefore develops no e. m. f. and simply acts as a conductor. He backs up this statement with a diagram, Fig. 1, showing an experiment in which brushes were applied at opposite ends of a wire on the outside surface and on the inside of a Gramme ring. The wire on the face gave a current in the proper direction, but no current whatever could be detected in the wire on the inside until the field was made very intense so as to oversaturate the core of the armature, thus causing some lines of force to leak through the air space in the inside of the ring. In this case the current induced in the inside wire was in the reverse direction to that induced in the wire on the face and tended to neutralize it, etc.

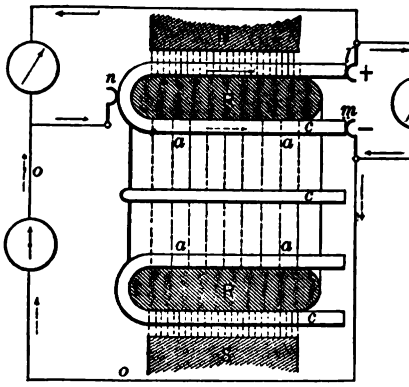


FIG. 1.

The writer thinks that there is another way of looking at this matter and that there may be an entirely different reason for the wire on the inside being dead or not as active in developing e. m. f. as that on the outside. Also that the larger the diameter of the ring, and the nearer the cross section of the ring corresponds to the carrying capacity for lines of force with reference to the total number generated by the field, the more active the wire on the inside becomes; but in no case can it be entirely equal to the wire on the outside.

Consider first Fig. 2. If lines of force are suddenly shot over the wire A in the direction shown, the current induced will be in a direction away from the observer. If the lines of force travel under the wire in the same direction as before, the current induced will be in the opposite direction, or towards the observer. Now if the wire is placed in the position shown in Fig. 3 and lines of force are shot across as before, no current, or rather no e. m. f., will be developed, because as many lines go over as go under the wire, each stream neutralizing the effect of the other.

Now consider Fig. 4. Applying the same reasoning as above, e. m. f. will be induced in the wire at the top and bottom of the ring, but none, or nearly none, in the wire on the inside at the top of the ring, because the same number of lines travel past its under side at A as go over the top at B. Furthermore no e. m. f. will be induced in the inside wire at the bottom of the ring, because as many lines go over it at B as under it at A. The two streams in each case neutralizing each other.

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[1] Elec. Eng'r. February, 1887.

[2] Elec. Eng'r. May, 1887.

Of course the distance from the wire between the two streams of lines would make considerable difference were there no leakage across the inside of the ring and through the shaft. As such leakage actually exists and is very often considerable it appears quite reasonable to assume that it makes up, or nearly so, for the difference in distance referred to above.

The fact that Mr. Hering obtained a current in the opposite direction in the wire on the inside to that on the outside when he oversaturated the ring was no doubt due to the excess of the total number of lines passing the under side of the wire through bottom of ring and air space in center of ring, over the total number passing over the top of the same wire through the portion marked B in Fig. 4.. With rings of sufficient cross-section to carry all the lines of force generated by the field magnets without undue crowding and with sufficient diameter of ring to make the path through its center and shaft of very high resistance compared with the nearly saturated ring itself the wire on the inside certainly will be active to a certain extent. Prof. Anthony's claim no doubt holds good with all practical cylinder armatures, but in applying it to ring armatures allowance must be made for the reaction of the lines of force leaking through the center of the ring and those in the ring diametrically opposite the coil under consideration.

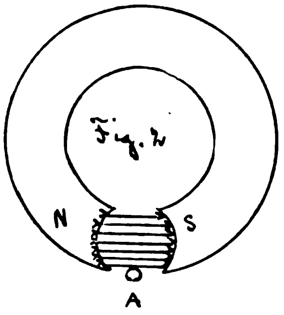

FIG. 2.

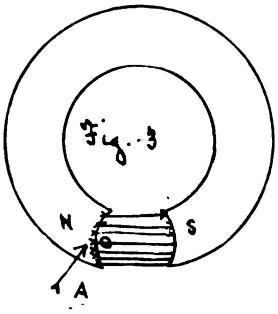

FIG. 3.

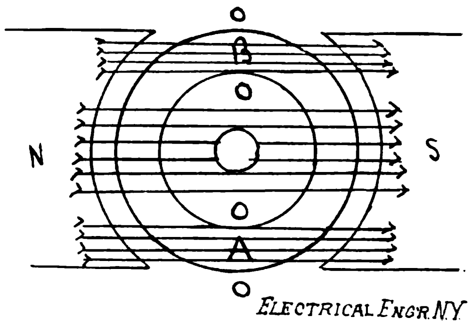

FIG. 4.

ELECTRIC POWER IN THE KEATING BICYCLE FACTORY.

AN installation interesting to bicycle manufacturers in particular and to all other manufacturers in general, is now under way at Middletown, Conn., where the Keating Wheel Co., have just completed a factory unique in its construction and in the application of its motive power. When complete the factory and offices will cover a floor space of 168,250 square feet, of which about 150,000 square feet will be devoted entirely to the manufacture of the well-known Keating bicycle.

The factory is situated on the west bank of the Connecticut River, between the river itself and the Hartford-Middletown branch of the New York, New Haven and Hartford system. The establishment is divided into three buildings of brick and stone. The main building is 1,000 feet long, 50 feet wide and two stories high. Projecting from this on the river side are six L's, each of which is devoted to some special operation on the wheel. Reference to the plan shows the different departments which occupy these L's. The main L, 200 feet long, 50 feet wide and two stories high is the repair department and the store room. The others are respectively, the blacksmith shop, the brazing shop, the polishing shop, the plating shop, and the enameling shop, each of them about 100 feet long and about 50 feet wide.

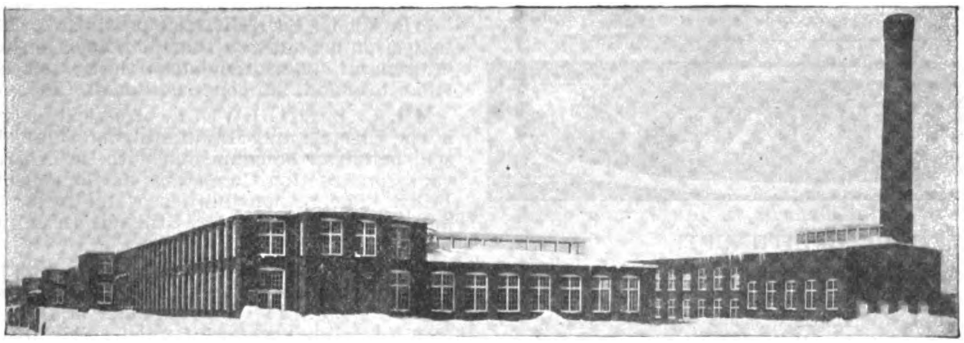

FIG. 2.—VIEW OF KEATING FACTORY, JANUARY 30, 1897.

The northeast corner of the plot will be occupied by spacious offices, 100 feet long by 50 feet wide and two stories high, entirely separate from the factory and yet in sufficiently close touch to make it an integral part of the main factory building.

The unique feature of this factory lies in the fact that it will be entirely operated by electricity, not an engine or a main belt coming into the factory proper. The method chosen is the three-phase system of the General Electric Company. The engine and generating plant is located in the southeast corner of the plot in a two-story brick and stone building. Steam is generated by a Babcock & Wilcox boiler of 250 horse-power, separated by a brick partition from the engine room. The engine, a cross compound condensing Greene engine, of 500 horse-power, the high pressure side only of which is installed, is erected upon the second floor upon brick and stone cap piers built up from the ground. On the same floor is a General Electric three-phase generator, known as an A-T, 16-pole, 250 kilowatt, 450 revolution, 60 cycle machine, also placed on piers carried up from the ground. The main belt from the engine and flywheel passes down to the ground floor, where a countershaft runs in bearings set upon brick and stone piers. The shaft is carried the entire length of the room and from it will be driven eventually another three-phase machine probably of similar capacity, as well as a set of lighting machines, to be erected at Middletown, as soon as they can be removed from the present factory of the Keating Wheel Company, at Holyoke. This countershaft is arranged with couplings so that any portion may be cut in or out as may be required.

The exciter for the generator is a 4½ kilowatt machine of the I. B. type, run from a pulley on the shaft of the three-phase machine. Facing the generator is a Vermont marble switchboard carrying packed card rheostats, current indicator, voltmeter and the necessary switches for controlling the exciter and the generator. From the switchboard, six wires, forming two circuits, issue from one of the windows of the power house and pass to the main factory, supported on one pole only. They are carried above one of the windows on the second floor of the factory and there three of the wires terminate, while the other three, which constitute the circuit in service, follow the center of the roof of the second story for about three-fourths of the length of the whole building. At the proper place they are tapped off, descending their respective pillars and passing through the floor of the second story to the motors suspended from the ceiling of the first story.

The main building 1,000 feet long is one great hall, supported on rows of pine pillars set ten feet apart. It will be seen by the diagram of the building that the main shafting is about 800 feet long and runs down the central aisle, being divided into three sections between each of which is a 50 horse-power G. E. induction motor of the inverted type. There are other shorter lines of shafting which are about 350 feet long, one on each side of the main shafting in the north part of the building. Still another line of shafting about 200 feet long runs through the repair department. The motors that drive the shafting in the main building are two 50 horse-power, while the line of shafting running through the repair shop is driven by a 20 horse-power motor, secured to the ceiling of the first floor in the main building.

All of the motors are equipped with two pulleys on each end so that four independent shafts can be driven from each motor. The extent of this shafting and the method of driving the motors can be gathered from the illustration made from a photograph taken from one end of the main building. There is about 160 feet of shafting on the other side of the far motor shown in the picture; this will give some idea of the extent of the installation.

The entire factory has been laid out by Mr. R. M. Keating himself with all the care which a man can bestow upon a child of his own creation.

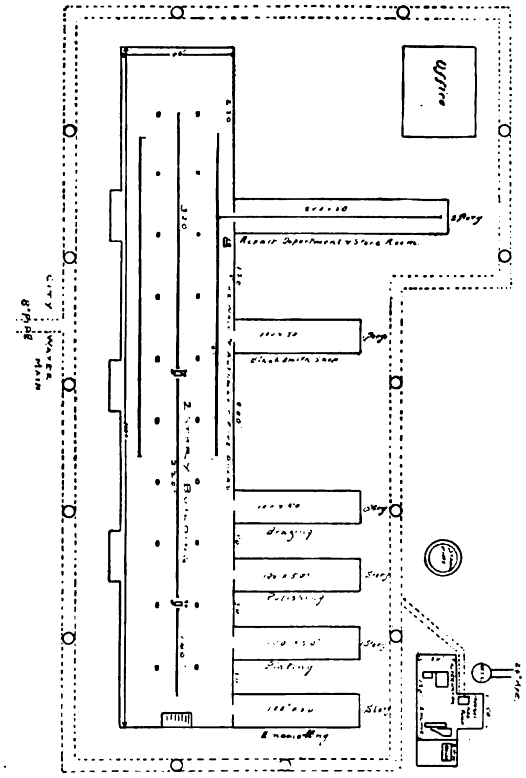

FIG. 1.—LAYOUT OF THE KEATING FACTORY AT MIDDLETOWN, CONN.

OBITUARY

E. CARL BREITHAUPT.

Mr. Carl Breithaupt, an electrical engineer of Berlin, Ontario, Canada, died there on January 27, aged about thirty years. Mr. Breithaupt was for two years a post-graduate student in the electrical department of the Johns Hopkins University, from which he was graduated in June, 1892. His preliminary education was obtained at the Northwestern College, Illinois. After graduating from the Johns Hopkins University he became a member of the Beta Theta Pi fraternity of that institution. Mr. Breithaupt went to Berlin and became the electrical engineer of the Berlin Gas and Electric Light Company and president and general manager of the Berlin and Waterloo Railway Company. He was for some years a member of the executive committee of the Canadian Electrical Association and was last year elected vice-president of the association. He was also a member of the American Institute of Electrical Engineers.

SAMUEL R. WILMOT.

We regret to note that Mr. Samuel R. Wilmot, senior partner of Wilmot & Hobbs, Bridgeport, Conn., dropped dead on February 4. He came to this country from England in 1837. He lived in Brooklyn until 1877, and then went to Bridgeport. He was the pioneer maker in this country of cold-rolled steel tubing, and a very able manufacturer of tools and other specialties. The products of his company have gained a high reputation in the electrical field.

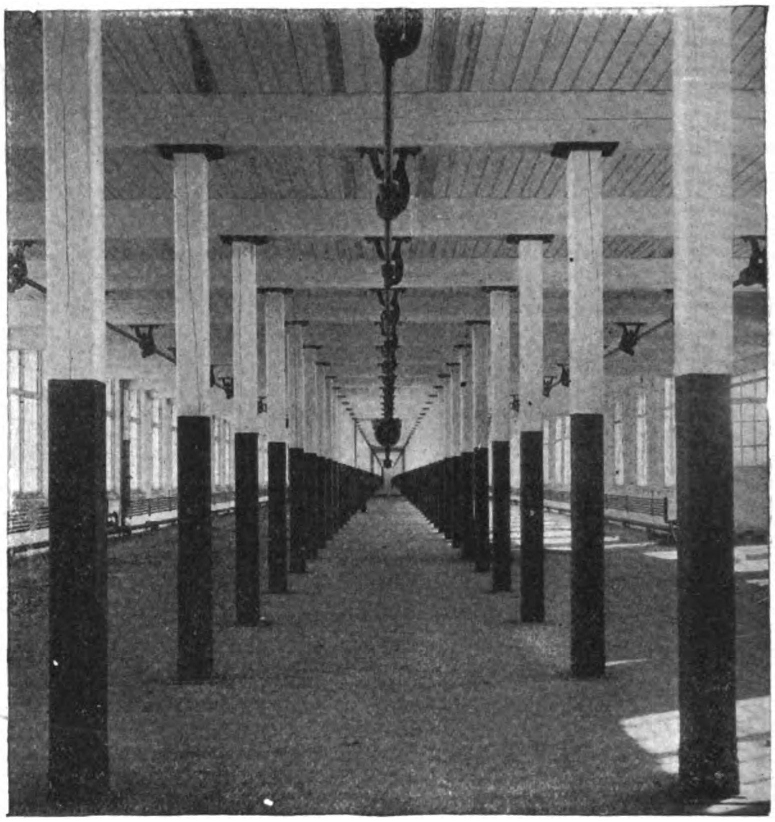

FIG. 3.—FIRST FLOOR OF MAIN BUILDING, 1,000 FEET LONG.

PERSONAL

MR. W. H. BAKER, vice-president of the Postal Telegraph Co., is on a Southern tour of inspection with Mr. L. D. Parker, general superintendent of the system and Mr. C. M. Baker, superintendent of construction at Chicago headquarters.

MR. L. B. STILLWELL, electrical engineer of the Westinghouse Electric and Manufacturing Company, has resigned, and will hereafter be connected with the Niagara Power and Cataract Construction Companies as their electrical director at the Falls. The responsibilities of the new position will be large and growing; but in Mr. Stillwell an eminently wise selection has been made.

MR. T. M. NICHOLL has been appointed general manager of the Rochester Railway Co., in the place of Mr. F. O. Rushling resigned. The new manager is an experienced steam and electric railway superintendent. Mr. Rusling retires to look after some large personal electric railway interests in Canada.

MR. F. S. TERRY, of the Sunbeam Lamp Company, was a welcome visitor in New York last week.

BINGHAMTON, N. Y.—Mayor Green in his annual message pays a very high compliment to the Binghamton Railroad Co. and to its good work under the leadership of President Rogers.

SOCIETY & CLUB NOTES

A NOTABLE DINNER OF THE MAGNETIC CLUB.

THE dinner of the Magnetic Club held on February 3 at the Transportation Club in the Manhattan Hotel, will long be remembered by the participants as one of the most enjoyable of the many meetings held by the club since it was started some six or seven years ago. One notable feature was that it served for the inauguration of the new president, Mr. E. H. Johnson. Another was that it witnessed the presentation of a handsome magnet shaped diamond pin to Secretary George Fagan. A third feature was the celebration of the passing of the bill by Congress and its signing by President Cleveland, which recognizes formally the services during the Civil War of the United States Military Telegraph Corps. All this was capped by a splendid programme of music.

After an excellent menu had been disposed of by about 150 diners, Mr. T. Fleming read a hearty dispatch of congratulations from Past President Mr. W. H. Baker, and introduced the new president, Mr. E. H. Johnson, who was received with the Chautauqua salute of waving napkins and with two rounds of tremendous cheering. Mr. Johnson made a terse and happy address in allusion to his great pleasure in being thus associated with so many old associates of the key, and then referred in glowing terms to the work done by telegraphers in the Civil War. Mr. J. R. Van Wormer, the well-known secretary of the Union League Club, then made an equally eloquent speech laudatory of the United States Military Telegraph Corps and read a series of resolutions congratulating the survivors of the Corps and the families of deceased members of it, on the fact that at last this measure of justice had been accorded. These resolutions were seconded by Mr. Hutchinson, received with great applause, and acknowledged with his wonted dignity and felicity by President A. B. Chandler of the Postal Telegraph Company, who had had the honor of serving at headquarters with Mr. Lincoln as a member of the Corps. He said that had Lincoln and Stanton lived, the recognition would have come long ago.

The Congressional Record of January 20, 1897, page 1012, contains the announcement of the passage of the following bill: "Be it enacted, etc., That the Secretary of War is hereby authorized and directed to prepare a roll of all persons who served not less than ninety days in the operation of the military telegraph lines during the late civil war, and to issue to each, upon application, unless it appears that his service was not creditably performed, or to the representatives of those who are dead. suitable certificates of honorable service in the military telegraph corps of the Army of the United States, stating the service rendered, the length of such service, and the dates, as near as may be, between which such service was performed; provided, That this law shall not be construed to entitle the person herein mentioned to any pay, pension, bounty or rights not herein specifically provided for." The resolutions were as follows: Resolved, That the Magnetic Club of New York conveys to the surviving operators of the military telegraph service of the late civil war, and to the relatives of those who are deceased, its most cordial congratulations and the expression of its profound satisfaction at this official and enduring acknowledgment on the part of the Congress of the United States of brave deeds, efficient service and patriotic devotion to duty. partial and inadequate though the acknowledgment may be when compared with the achievements of those for whom it is designed.

"Resolved, That a copy of this resolution be forwarded to the secretary of the United States Military Telegraph Corps."

Mr. W. J. Dealy then read a number of letters of regret for absence from Gen. Eckert, who has been ill; C. A. Tinker, D. Doren, W. B. Somerville, Gen. McElvey and others, who had served so loyally in the stirring times of old. After this, the audience sang "Columbia," and then Mr. C. C. Cockey presented Secretary George Fagan with a diamond pin. A very earnest and strong speech was made also by Col. W. B. Wilson, one of the leading members of the United States Military Telegraph Corps, who paid a fitting compliment to the steady and arduous work of Mr. W. R. Plum in securing the passage of the bill.

The musical programme had been well selected and comprised songs by Miss Carrie Roma, Mr. J. Stanford Brown and Mr. Fischer Miller; and piano selections by Mr. John Francis Gilder. The proceedings closed with the singing of "Auld Lang Syne." Among those present, other than already mentioned, were President Weir, of the Adams Express Co.; F. J. Sprague, J. H. Bunnell, John Bogart, late State Engineer; C. Cuttriss, C. P. Bruch, C. A. Benton, T. R. Taltavall, J. B. Taltavall, E. L. Powers, C. T. Rittenhouse, A. C. Shaw, T. C. Martin, N. D. Webster, John Brant, P. H. Alexander, W. Marshall, E. C. Platt, W. Maver, Jr., J. H. Emerick, J. E. Ham, A. Henderson, A. P. Eckert, E. Davidson, M. M. Davis, Francis W. Jones. Great credit is due to Messrs. T. A. Brooks and O'Leary for the success of all the arrangements.

PROF. PECKHAM ON THE SPACE SURROUNDING A WIRE.

A LECTURE on the space surrounding a wire over which an electric current is flowing was given in the Physical Lecture Room of Adelphi College on Friday evening, February 5, before the Department of Electricity of the Brooklyn Institute, by Professor W. C. Peckham. Both the direct and alternating currents were used. The effects of currents on each other and on magnet poles were experimented upon. The attraction and repulsion of parallel currents were shown by a long wire doubled in the middle and hung in the room. When the current was sent through the wire the two sides bent away from each other six inches. To show the effect of a current on a magnet, a wire was passed through the bottom of a glass tank placed over the lantern, and a magnetized sewing needle was floated on the water in the tank. By reversing the current in the wire the needle was made to sail upon the water and to whirl on its axis. This experiment was original with the lecturer.

The phenomena of the alternating current field of force were shown by rings, coils of wire, and by the glowing filaments of incandescent lamps. The electric waves from an induction coil which was operating an X-ray tube in an adjoining room were traced by a coil and telephone, 30 feet from the coil. The induction of one coil or another was shown, making a telephone emit a note so that it could be heard in all parts of the room. The alternations of the electric current were used to make the filament of a lighted lamp vibrate in most beautiful forms.

The lecture closed with a description of the present condition of the problem of telegraphing without wires. and of signaling to ships off shore in a fog.

THE STOCK MARKET

MIDWINTER CONDITIONS.

ONE of the current reports in electrical circles has been that a selling company may be organized to handle all the General Electric products, but the rumor entirely lacks confirmation from the inside, although it may be one of the means adopted for "reorganization." The fact also that lamp makers were being licensed under the Weston group of patents has become generally known. It is regarded in many quarters as likely to have a good influence in keeping up prices of lamps, and restoring them to a living level. It may also lead to lamp importations from abroad, particularly Germany. If the license system had been adopted long ago, everybody in the business would have been better off, the General Electric Co. included.

The Albany "Argus" has the following in regard to General Electric finances: "It comes from good authorities that the gross business of the General Electric Company for the past year has been about $11,000,000, or some $2,000,000 less than expected, and likewise $2,000,000 less than in 1895, but the company has improved its fiscal and financial position and is now in shape to quickly do a business of $1,500,000 per month as soon as it shall be offering. At present it is doing about $1,000,000 gross business per month. The net returns for the fiscal year closing at the end of January will be just about the same as last year—$1,900,000 net earnings and $1,100,000 surplus after interest and charging up of accumulated dividends on preferred stock. The surplus will of course go toward the reduction of the capital impairment. The capital account will also be improved by about $300,000 as the company has made sales of assets during the year of $300,000 above last year's book valuations."

The stock market was inactive last week, with very few wide fluctuations. Of Western Union, 11,965 shares were sold, between 84¼ and 83; of American Bell, 751 shares with a rise of 4¼ points to 217; of General Electric, 23,404 shares around 35¾ for the week. The rise in Bell stock is attributed to the adjourning of the United States Supreme Court without a decision in the Berliner case.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

BY MAX OSTERBERG.

Accumulators:

THE BLOT ACCUMULATOR.—A new type of accumulator consisting of lead, Planté type, formed in the usual way without paste. Plates consist of a lead frame in which are suspended a number of spools of corrugated and embossed lead tape wound on a long lead core, the axis of the core being perpendicular to the plane of the plate.—Lond. "Elec. Eng'r.," Jan. 15, '97.

Biographical:

JACOB BRETT.—An obituary notice with a short review of the life of one of the pioneers of telegraphy in England.—Lond. "Elec. Eng'r.," Jan. 15, '97.

Central Stations:

ELECTRIC LIGHT STATIONS AND GAS ENGINES.—A short abstract of the central station in Leyton, England, where producer gas is used to drive gas engines.—"Elec. Rev.," Jan. 27, '97.

BROOKLYN BRIDGE NEW ELECTRIC POWER PLANT.—Detailed description of the plant with a number of views and diagrams showing the special features in this undertaking. Six feeder cables are laid for distributing the current to three sections, the total length of feeders being between 3½ to 4 miles. They are laid parallel to the tracks on the top of glass insulators set on wooden cross-arms, and tied to the insulators so as to prevent their beeing displaced. In addition to these feeders there are four return conductors each of 500,000 circular mils.—"Elec. World," Jan. 23, '97.

CENTRAL ELECTRIC STATION OF THE DAVIS COAL AND COKE COMPANY.—By Timothy W. Sprague. This company is the first in W. Va. to adopt electricity in connection with mining operations. The generator running at 900 revolutions per minute, has a 100 kilowatt capacity, a potential of 500 volts, and is of the three-phase alternating current type. The power is at present used in coal cutting, and in the operation of five elevators and conveyors. The coal-cutting circuit runs a distance of a little over one-half mile in two directions.—"Eng. and Min. Jour.," Jan. 23, '97.

BIRKENHEAD ELECTRICITY WORKS.—A municipal plant working on a two-wire 230 volt system, with switchboard, feeders, and distributing mains designed for a three-wire system. Three 80 horse-power steam dynamos now erected are wound to give about 250 volts, and hence will eventually supply one side of the system only. The larger units to be added will, of course, deliver current to the two outside wires at something over 460 volts. Three Lancashire two-flue boilers working at 160 pounds pressure are installed. The steam engines are of the Willans single acting central valve type, compound non-condensing. The storage battery outfit having a capacity of 750 ampere hours, capable of discharging for five hours consecutively at the rate of 150 amperes, or for one hour at the rate of 400 amperes, is part of the central station outfit. For further details of switchboard, mains, load of station etc., see Lond. "Elec. Eng'r.," July 15, '97.

ST. HELEN'S ELECTRICITY WORKS.—Detailed description of the plant and buildings. The principal features are as follows: Two Lancashire boilers at 140 lbs. pressure, two engines for driving alternators, one of 180, the other 50 i. h. p., when running 98 revolutions per minute. Two alternators, one 25 kilowatt, 2,000 volt alternator, 350 revolutions per minute, and one 100 kilowatt 2,000 volt alternator, 100 revolutions per minute supply the electricity for the town. Several diagrams indicate the position of the distributing mains and feeders.—Lond. "Elec. Eng'r.," Jan. 15, '97.

Dynamos and Motors:

CALCULATION OF THE IRON LOSSES IN ALTERNATORS OF THE SO-CALLED INDUCTION TYPE.—By Dr. Behn-Eschenburg. Author deduces a mathematical formula from which the iron losses can be calculated.—"Elek. Zeit.," Jan. 14, '97.

THE DESIGN OF A 100 KILOWATT 500 VOLT POWER GENERATOR.—By H. J. Ryan and I. J. Macomber. Authors explain that two methods may be used for designing a dynamo. In the first the e. m. f., current and speed are specified, and the desired electrical and commercial efficiency assumed. In the second method the designer has given the desired output of the electrical generator at some required pressure and the condition of operation. Here the designer keeps in mind mainly the duty of the machine, and the necessary mechanical and electrical features that will provide the proper behavior and durability consistent with practical commercial efficiency. No machine can be successfully made by adhering strictly to either one of these methods, but rather by a combination of the two. Following the introductory remarks is an outline with explanatory notes for the design of direct current generators and motors, ending with a numerical example fulfilling the conditions under the heading.—"Sib. Jour. of Eng.," Jan., '97.

TWO-PHASE ALTERNATORS.—Description of the dynamos of the Electric Light and Power Company in France, giving details of construction with a diagram of the armature connections.—"L'Ind. Elec.," Jan. 10, '97.

Electro-Chemistry:

ON THE APPLICATION OF ELECTROLYSIS FOR THE PREPARATION OF BLEACHING COMPOUNDS AND ALKALIES.—By Dr. Carl Kellner. A number of patent abstracts explaining methods best suited for different purposes, such as for the bleaching on a small or large scale, or for bleaching compounds prepared for immediate or for future use.—"Elek. Echo," Jan. 9, '97.

ELECTROLYTIC DECOMPOSITION OF FUSED ZINC CHLORIDE.—By Richard Lorenz. A determination of the voltage required to decompose pure fused zinc chloride gives the number 1.49 to 1.50 volts. Three different strengths of current were employed in the experiments, and the result obtained from each agree closely. The theoretical voltage is 2.1, but it must be remembered that the temperature at which the experiments were carried out was 500 to 600 degs.—Zeit. f. Anorg. Chem., 1896, Vol. 12. Note in Lond. "Elec. Rev.," Jan. 15, '97.

Electric Heating:

ELECTRIC HEATING.—A system patented by Helberger prevents the air from coming in contact with heated wires in the electrical heaters by surrounding the heated surface with a thin insulating and fireproof material. The cost per hektowatt is 4-10 cent. A coffee machine, for example, holding 100 cups or 22 litres requires 40 amperes for 30 minutes at a cost of 8 cents, current keeping the same warm costs 4-10 of a cent per hour.—"Elek. Anz.," Jan. 14, '97.

Electro-Physics:

VISCOSITY OF POLARIZED DIELECTRICS.—Non-conducting liquids when subjected to electrostatic stress undergo mechanical changes. The principal observers in this line of research are Quincke, Röntgen, Kerr, König, Pagliani, and lately A. Wilmer Duff. The latter's experiments consist in testing the change of viscosity in fluids, such as castor and paraffine oils. A drop of mercury is allowed to drop through a small tube, and the time of fall observed while the condensor plates highly charged are at opposite sides of the glass tube, and then while no electrical conditions are applied to influence the fall. In some cases a change as much as ½ of 1 per cent. in the viscosity has been observed.—Lond. "Elec. Rev.," Jan. 15, '97.

ON THE RELATION BETWEEN THE HALL EFFECT AND THERMOELECTRICITY IN BISMUTH AND IN VARIOUS ALLOYS.—By J. C. Beattie. On arranging metals in the thermoelectric series it appears that those with an extreme position thermoelectrically have a corresponding extreme position as regards the Hall effect, although various irregularities appear. The author adds measurements at varying temperatures of the Hall effect with bismuth, and the electromotive force of the thermocouple Bi-Pb, and remarks that we may not yet maintain the transverse effect to be a function of the thermoelectric force. Proc. Roy. Soc. Edinb. No. 21, '96. Note from Jour. Phys. Chem., Jan. '97.

Lighting:

DISTRIBUTION AND DIFFUSION OF LIGHT.—By E. L. Elliott. Abstract of a paper read before the N. Y. Elec. Soc. The principle of the holophane globe is described and its advantages over other types of diffusing globes demonstrated. Illus. "Elec. World, Jan. 23, '97.—"Elec. Engr.," Feb. 3, et seq. more fully.

ELECTRIC LIGHTING AT BROWN'S HOTEL, ALBERMARLE STREET, LONDON.—Two 16 brake horse power Crossley gas engines with tube ignition, drive the dynamos as well as a line of shafting. The main flywheels drive two 185 ampere, 130 volt dynamos at a speed of 500 revolutions per minute. Three sets of accumulators are used, 55 cells in each set.—Lond. "Elecy.," Jan. 15, '97.

Mechanical;

ELECTRICALLY DRIVEN AIR COMPRESSOR.—A short description with illustration of a machine furnishing 15 feet of free air per minute, on a pressure of 60 lbs. per square inch. —"Rail'y Rev.," Jan. 23, '97.

ENGINE TESTS.—Some interesting figures of two tests made with the Pollit and Wigzell engines which are of the compound horizontal tandem type of about 400 indicated horse power capacity, show 1 9-10 lb. of coal per indicated horse power hour with 7 4-10 lbs. of feed water evaporated per lb. of coal under actual conditions.—"Lt'ng.," Jan. 14, '97.

HAND PRESSURE ELECTRIC DRILL.—This drill, weighing 46 pounds, capable of boring holes up to three-eighths inch in diameter, runs at about 300 revolutions per minute and consumes 2 amperes at 110 volts. Thirty-five holes can be drilled per hour, while but about 8 can be drilled by hand. The drill spindle is driven by reducing gear by an electric motor, which can be carried around and held in any position required.—Lond. "Elec. Rev.," Jan. 15, '97.

Miscellaneous:

TESLA ON ELECTRICITY.—An address on the occasion of the commemoration of the introduction of Niagara Falls power into Buffalo, delivered Jan. 12, '97. The speaker reviewed the great progress made in transmission of power, and gives in popular language his reasons for calling this the Electrical Age.—"Elec. Rev.," Jan. 27, '97.

Railways:

THE APPLICATION OF MOTORS FOR STREET RAILWAYS, ESPECIALLY WHERE UNDERGROUND FEEDERS ARE USED.—By Eduard Lachmann. The general tendency of the railway companies appears to be to work at higher voltage. He believes that larger cars, or cars with a number of trailers will be in common use shortly. Of the storage batteries for use on cars he does not think favorably since they would occupy, especially on the high voltage, too much space.—"Elek. Rund.," Jan. 15, '97.

Roentgen Rays:

THE FIRST RADIOGRAPH SHOWING ARTERIAL CIRCULATION.—An illustration showing the brachial artery and its bifurcation at, or near the elbow into the radial, and ulnar arteries. It is believed that the reason why the artery has been made visible is due to the fact that the patient had an unusual supply of lime salts in the blood.—"Elec. Rev.," Jan. 27, '97.

DR. FLEMING'S LECTURE ON THE X-RAY.—In a lecture delivered at the London Institution Prof. J. A. Fleming reviewed the development of the X-ray, and showed among others a picture of the bones of a mummy 4,000 years old.—Rep. in the Wld. of Sci. Abst. in "Elec. Rev.," Jan. 27, '97.

NEW CROOKES TUBES.—By Drs. Oudin and Barthelemy. A short description of a double focus tube to be used on an alternating current dynamo, low or high frequency.—"La Nat.," Jan. 9, '97.

EFFECT OF ROENTGEN RAY ON PARAFFINE IN RESPECT TO ELECTRIC CONDUCTANCE.—By Lord Kelvin, Dr. Beattie and Dr. Smolan. A series of careful electrometer tests show that there is no appreciable change in the conductivity of paraffine when under Röntgen ray influence.—Lond. "Elec. Rev.," Jan. 15, '97.

Wires, Wiring, etc:

PRINCIPLES OF ELECTRICAL DISTRIBUTION.—By Prof. Francis B. Crocker. The sixth of a series of articles describing feeder regulation. After considering that the sole merit of the three-wire system lies in the saving of copper, which, of course, is so great an advantage that it makes the use of the system imperative, the following disadvantages are enumerated: (1) It is usually necessary to operate at least two dynamos, or other sources of current. (2) It is necessary to lay and take care of three wires instead of two. (3) The switches, cut-outs, measuring instruments, etc., are more complicated. (4) The saving of copper stated assumes that the neutral wire carries no current. (5) The variation in potential is aggravated by the increase that sometimes takes place, which is impossible on a two-wire circuit.—"Elec. World," Jan. 23, '97.

A NEW SYSTEM OF INSTALLATION AND SAFETY MATERIALS ACCORDING TO THE RULES PRESCRIBED BY VERB. DEUTSCHER ELEKTROTECHN.—By Hundhausen. Author explains a great many details consisting of cutouts, switches, fuses, etc.—"Elek. Zeits.," Jan. 14, '97.

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BUFFALO.—The Buffalo General Electric Co. bids 33 cents a year for city lamps per night, 2,000 candle-power, or 30 cents if given a five years' contract, or $100 per year, for five years if over 2,500 lamps are used, without extra charge for underground conduits to the extent of 75 continuous lamps.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JANUARY 12, 1897.

Alarms and Signals:—

AUTOMATIC BLOCK SYSTEM. J. Shoencraft, Harveyville, Kan., 576,166. Filed May 7, 1896.

Provided with a closed electric circuit comprising a ground-wire containing a battery and the signal magnets, and a second wire connected with the ground-wire at the station at the end of the section, each wire containing a relay, of which the armature forms part of the other wire.

ALARM FOR ELECTRIC CIRCUITS. C. B. Sterling, New York, 576,383. Filed June 24, 1895.

Means whereby an attendant will be informed when a switch has been burned out by reason of the overloading of the line.

ELECTRICAL CIRCUIT FOR OPERATING AUTOMATIC RAILWAY GATES. J. S. Biggar, Chicago, Ill., 576,493. Filed Jan. 22, 1895.

Employs two electrical circuits successively closed by the movements of a car to close and open the gate, and an intervening circuit, also, closed by the car, which holds the second circuit open until the entire train has passed a predetermined point.

Batteries, Primary:—

BATTERY. W. S. Doe, Brooklyn, N. Y., 576,095. Filed Feb. 29, 1896.

Comprises a hollow cathode, a perforated tube of non-conducting material suspended therein, an anode in the tube having a side opening, a depolarizer in the anode, a conductor-wire for engagement with the anode, and means for yieldingly holding the anode against said wire.

Batteries, Secondary:—

PASTE CARRYING MACHINE FOR ELECTRIC ACCUMULATORS. F. W. Schneider, Triberg, Germany, 576,163. Filed Jan. 13, 1896.

Consists of a frame and paralleled bars therein having lateral projections, and being connected each to the next by bridges in form of undulating or zigzag bands, the bridges having respectively on their front and rear sides lateral openings and central projections perpendicular to the faces of the plate.

CONSTRUCTION OF CELLS FOR ELECTRIC ACCUMULATORS. F. W. Schneider, Triberg, Germany, 576,164. Filed May 2, 196.

Intended for accumulators for use in vehicles.

ELECTRODE FOR STORAGE OR OTHER BATTERIES. T. A. Willard, Norwalk, Ohio, 576,177. Filed Nov. 7, 1895.

Similar to above.

BATTERY PLATE. T. A. Willard, Cleveland, Ohio, 576,178. Filed May 4, 1896.

A battery plate having its sides provided with extremely thin parallel shaved leaves of equal thickness with a uniform space between the leaves in which the material is enabled to form and expand.

Connectors, Conduits and Insulators:—

INSULATOR. H. E. Billings, Hartford, Conn., 576,392. Filed Nov. 21, 1896.

Trolley hanger.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. P. H. Fielding, New York, 576,103. Filed April 23, 1896.

Enclosed arc projection lamp.

ELECTRIC ARC LAMP. D. A. Shesler, Toledo, Ohio, 576,475. Filed Feb. 13, 1896.

Mechanism for effecting an extension of the arc between the tips of the carbons.

Measurement:

ELECTRIC METER. J. R. Tucker and C. C. Hinckley, Aurora, Ill., 576,240. Filed Jan. 25, 1896.

Employs a planimeter wheel in connection with a registering device.

ELECTRIC METER. Reissued. J. Harris, Lynn, Mass., 11,588 Filed Aug. 6, 1895.

Comprises a pressure coil and its supporting shaft in combination with a spring connected to the shaft and brought under tension by the torque of the coil.

Miscellaneous:—

ELECTRICAL ADVERTISING DEVICE. L. Julig, San Francisco, Cal., 576,129. Filed Dec. 26, 1895.

Details of construction.

AUTOMATIC STREET OR STATION INDICATOR AND ADVERTISING MEDIUM. M. B. Leece and A. R. Bullock, Cleveland, O., 576,201. Filed June 2, 1896.

Details of construction.

SOUNDING APPARATUS. A. M. Lozier, New York, 576,208. Filed April 24, 1896.

Employs a sinker containing a device which is moved by the variations of a hydrostatic pressure, a rheostat varied by the movement of the device, and electrical devices adapted to respond to variations of resistance.

MUSIC RECORDING APPARATUS. E. K. Adams, New York, 576,245. Filed Oct. 21, 1896.

Apparatus for producing patterns for the sheets of Regina music boxes.

ADVERTISING DEVICE. H. Green, Hartford, Conn., 576,266. Filed Feb. 8, 1896.

An incandescent light globe having a capped or coated surface and provided with a letter on one or more of its sides.

ADVERTISING DEVICE. H. Green, Hartford, Conn., 576,267. Filed May 2, 1896.

Comprises an incandescent electric light globe and a freely removable letter plate having means for directly engaging the globe.

ELECTRICALLY OPERATED MUSICAL INSTRUMENT. G. H. Davis, New York, 576,342. Filed March 25, 196.

Means for effecting economy in the electrical energy necessary to actuate the sounding mechanism.

ELECTRIC HEATER. F. A. Johnson, Binghamton, N. Y., 576,347. Filed Feb. 24, 1896.

A magnetic-induction heater, comprising a case having an opening to receive the article to be heated.

APPARATUS FOR STOPPING ENGINES. G. W. Brown, West Newbury, Mass., 576,514. Filed Oct. 4, 1895.

Details of construction.

Railways and Appliances:—

AUTOMATIC SWITCH. J. P. Alexander, Jackson, Tenn., 576,082. Filed May 29, 1896.

Comprises a divided and balanced circuit, switching devices connected in a bridge across the circuit, mechanical means for disturbing the balance of the circuit, and connections controlled by the switching devices for closing a supply circuit whenever the balance of the balanced circuit is disturbed.

METHOD OF AND APPARATUS FOR ELECTRICAL PROPULSION. L. H. Nash, South Norwalk, Conn., 576,145. Filed Nov. 16, 1895.

Comprises an electric generator having shunt and series coils, the currents through which flow in opposite directions with a series wound motor.

CONTACT BOX FOR DEPRESSIBLE CONDUCTOR RAILS. W. Grunow, Jr., Bridgeport, Conn., 576,268. Filed May 8, 1896.

Details of construction.

LOCKING DEVICE FOR ELECTRIC CONTROLLERS. G. Valley, Johnstown, Pa., 576,332. Filed Nov. 10, 1896.

Comprises two contiguous rotatable discs, one of the discs having a plurality of lunes about its periphery, the other having a plurality of suitably connected concentric arcs composing its periphery.

ELECTRIC CONTROLLER. G. Valley, Johnstown, Pa., 576,333. Filed Nov. 10, 1896.

Consists of two operating drums and an electric switch which affords means whereby either drum alone or both drums together may be used to supply electric current for propelling the vehicle.

BRAKE MECHANISM AND CONTROLLER FOR ELECTRIC CARS. W. D. Thomas and L. R. Gignilliat, Savannah, Ga., 576,384. Filed June 2,1896.

Means whereby the brake mechanism and current regulator may both be operated from a single operating shaft.

TROLLEY FOR ELECTRIC CARS. G. L. Campbell, Shunk, Pa., 576,394. Filed March 18, 1896.

Device for keeping trolley on wire.

SPIRAL TROLLEY WHEEL. C. A. Langford, St. Louis, Mo., 576,405. Filed May 25, 1896.

Details of construction.

Switches, Cut-Outs, Etc.:—

RHEOSTAT. H. W. Leonard, East Orange, N. J., 576,202. Filed July 30, 1896.

Comprise a cast-iron plate or support, a layer of infusible material thereon, and a conductor embedded in a layer of glass adherent to the fusible layer.

AUTOMATIC ELECTRIC CUT-OUT. C. C. Kritzer, Newaygo, Mich., 576,369. Filed Nov. 13, 1895.

Comprises an electromagnet in the main circuit, an armature adapted to respond to an abnormal current, a spring actuated frame pivoted at one end, contact plates on the base plate, contacts mounted on the free end of the frame, a hook to hold the frame, and a latch released by the action of the armature, the hook being carried by the latch.

Telegraphs:—

CONTACT APPARATUS FOR TELEGRAPHING. C. Vreede, Rotterdam, Netherlands, 576,243. Filed Jan. 6, 1896.

Adapted for use in conjunction with semaphoric signaling.

Telephones:—

AUTOMATIC ELECTRIC CUT-OUT FOR MAGNETO-BELLS. J. Z. Miller, Baltimore, Md., 576,372. Filed Sept. 23, 1896.

Mechanical means adapted for attachment to any bell for automatically cutting into the telephone circuit both sides of the magneto-generator bell by the act of turning the magneto bell crank, and of cutting out the generator by the act of releasing the bell crank.

SPRING JACK. W. S. Paca, Baltimore, Md., 576,375. Filed Sept. 23, 1896.

Details of construction.

SWITCH PLUG. W. S. Paca, Baltimore, Md., 576,469. Filed Sept. 23, 1896.

Comprises alternate sections of metal and insulating material provided with screw and socket joints and abutting shoulders, the ends of the wire being secured between the abutting shoulders in electrical contact with the metallic sections.

TELEPHONE SIGNAL TRANSMITTER. E. C. Robes, Medford, Mass., 576,472. Filed July 25, 1896.

Means for sending successive independent arbitrary signals, motor mechanism actuating the same, a telephone hook switch controlling the motor mechanism and means for simultaneously closing the circuit and locking the transmitter mechanism.

LEGAL NOTES

INFRINGEMENT TELEPHONE SUIT IN PHILADELPHIA—ROSE PATENTS AND OTHERS.

The Philadelphia Standard Telephone Company, Joseph H. Mann, president, and Richard W. Clay, treasurer, has filed answer to the bill in equity of the Standard Telephone Company and Mutual Standard Telegraph and Telephone Company, in which infringement of patent is charged. In the answer it is admitted that Allen W. Rose is the inventor of certain improvements in telephone transmitters, for which he obtained a patent in December, 1886. The patent, it was stated, afterwards was transferred to the National Telephone Company, which subsequently sold and assigned it to Allen T. Nye, who sold it on May 1, 1895, to the Standard Telephone Company.

The defendant company annexed to the answer its license, as requested in the interrogatories to the bill, and concluded by asking the court to dismiss the plaintiff's bill.

The Standard Telephone Company, the Union Traction Company and Allen T. Nye filed answers in the same court to the bill in equity of the Western Telephone Construction Company, in which infringement of patented improvement of combined annunciator and spring-jack is alleged. The defendants deny that they made, used or vended switchboards containing and embodying the patented invention.

THOSE SIX INCHES.

Senator Lexow introduced in the New York State Senate a bill aimed to settle the difficulty over the ownership of six inches of land occupied by the Western Union Company in New York, in Broad street, and claimed by the Postal Telegraph Company. It says that where real property consists of a strip of land not exceeding six inches in width, upon which there stands the exterior wall of a building erected partly on such strip and partly on the adjoining lot, and the defendant has been in possession of said strip, enjoying the use of said wall, for upward of one year prior to the commencement of the action, and the plaintiff has erected a building on the lot abutting on the wall, an action cannot be maintained for recovery of the six inches. The site is that on which the new building of the Commercial Cable Co. is going up.

THE TESLA PATENTS REVOKED IN GERMANY.

As was announced in these columns several weeks ago, two of Mr. Tesla's patents have been revoked in Germany. We now learn that these patents are numbered 47,012 and 47,885, respectively, and entitled "Combination of a Transformer and a Source of Current," and "Connection of the Coils of Current Generators with Motors."

KANSAS.—A bill has been introduced in the legislature creating a board to examine telegraph operators with the object of preventing accidents due to incompetency.

W. K. FREEMAN has been sentenced to 7 years and 9 months in State prison for assault on the girl, Sarah Work. On his previous trial, he was sentenced to ten years. The attempt to fix conspiracy on Mr. C. A. Terry and other officials of the Westinghouse Company, failed utterly.

REPORTS OF COMPANIES

OTTAWA, CAN., ELECTRIC CO.

The report of the directors of the Ottawa Electric Company for 1896 is a most encouraging one. The amount of business done is steadily growing, the number of passengers carried last year having been 4,583,235. The gross receipts were $212,105 and the net profits $67,745. The sum of $60,369 is now standing to the rest account of the company. At the annual meeting attention was drawn to the fact that the mileage of the company is greater than that of any other city in Canada, according to population, and twice that called for by the agreement with the corporation. Four quarterly dividends of 2 per cent. have been declared.

STANDARD UNDERGROUND CABLE CO.

THE annual meeting of the stockholders of the Standard Underground Cable Company was held at Pittsburg, on January 26, over 90 per cent. of the capital stock of $7,000,000 being represented in person or by proxies. The old board of directors was re-elected for the ensuing year, among them being one prominent gentleman who entered the board during 1896, namely, Hon. B. F. Jones, of Jones & Laughlins, Ltd., one of the largest iron manufacturers in the United States.

The report showed a total business of nearly three-quarters of a million dollars for the year 1896. Four dividends of two per cent. each were paid out of the earnings for the year, and the remainder was added to the surplus account.

The assets of the company aggregate $1,412,046.06, and the liabilities, exclusive of capital stock, are $106,928.08, while the surplus over and above all liabilities (including capital stock of $1,000,000) is $308,107.19.

The company's factories are reported in first-class condition for economic and rapid manufacture of wires and cables of all kinds, all departments running, and the rubber department being especially crowded with orders at this time.

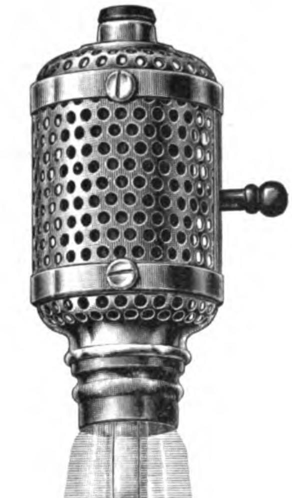
The prospects for 1897 are considered very flattering, a number of large contracts, aggregating nearly $250,000 being now on the company's books, most of which have been secured since January 1, and covering all classes of the company's products. A specially gratifying feature pointed out by the board of directors, is that the number of customers on the company's books for the year 1896 is 50 per cent. greater than for any previous year.

TRADE NOTES & NOVELTIES

BRUNT AND THOMPSON'S NEW REGULATING SOCKET.

We illustrate herewith a regulating socket for incandescent lamps, which is now being placed upon the market by Brunt & Thompson, East Liverpool, O. These sockets are made for either direct or alternating current of 110 volts for use in connection with 16 candle-power lamps.

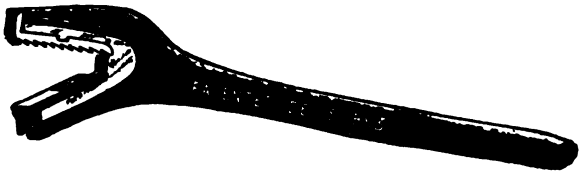
The Chicago Edison Company and the Western Electric Company have made thorough tests of these sockets, and it is asserted that the socket effects a saving of 40 per cent. in current when turned down. These sockets permit of the light being turned down to a lower degree of brilliancy and are especially adapted, therefore, for use in office, sick room, hotels, closets, etc. The light can be turned up and down from 2 candle-power to 16 candle-power, the same as one would operate a gas jet. The firm believes that it has in this socket overcome all difficulties hitherto experienced in the use of apparatus of this class and it guarantees the device to do all that is claimed for it, providing it is used in the manner directed. The sockets are finished in lacquered brass, antique copper and nickel plated.



New Regulating Socket

MARTINI'S PATENT LAG AND PIPE WRENCH.

The Martini's patent lag and pipe wrench shown herewith is a new departure in the line of an automatic wrench, and has a number of very desirable features. The movable jaw at the top causes it to tighten as the pressure on the handle is increased. It will not slip, takes hold and lets go suddenly and is always ready. In the operation of this wrench there is no lost motion, and no time is lost in adjusting. The wrench is made of drop forged steel, and the jaws of the best tool steel hardened and tempered and can be replaced when necessary at a very little expense.



Martini's Patent Lag and Pipe Wrench.

This specialty has had the approval of practical men familiar with this class of tools, and is already being very extensively used. It promises to be a very desirable specialty, as it accomplishes all the purposes of a much more complicated and expensive tool. The Electric Appliance Company have undertaken to put this wrench on the market, have the exclusive sale for same, and report that prospects for a big business on it are very encouraging.

A. E. H. CORPORATION LAUNDRY IRON.

The almost universal use of electric lights in hotels and apartment houses interferes seriously with the use of many of the old-fashioned household conveniences, and being alive to the needs of the times the American Electric Heating Corporation of Boston in addition to providing small portable stoves, chafing dishes and curling iron heaters (which may be attached to lamp sockets), now offer to the trade a small laundry iron of very convenient form and handsome finish. It is especially designed for the sewing room and for ironing laces, handkerchiefs and other light work, for shining up the master's silk hat, and pressing his trousers, on a pinch, though a heavier iron would be better for that. The current required is two amperes on 110 volt circuits and the iron is made for direct or alternating current and for all the usual voltages, as, in fact, are all of their appliances. A feature of all of the new electric heating appliances is that they reach the desired temperature in from two to three minutes and because of their perfect cleanliness and other conspicuous advantages over the older methods, seem to be ideal.

JOHN SIMMONS CO.

The above firm, of 106—110 Centre street, had a very interesting and artistically arranged exhibit at the gas exhibition recently held at Madison Square Garden. Their exhibit comprised a large line of special cocks for gas, full weight wrought iron pipe, all styles gas log valves, fancy handles, a complete line of the Dart Manufacturing Company's special self-lubricatng cocks and the Erie Patent Union. For the last two specialties they are the New York agents. A pipe cutting machine in full operation was also shown, the power furnished by a small Vreeland gas engine. The Jno. Simmons Company cut and prepared in their shops the columns supporting the magnificent Tiffany glass tower. There were a large number of them and every column had to be cut and fitted absolutely perfect. The work was admired by all and will prove a lasting advertisement for the John Simmons Company. Quite a number of orders were taken at the exhibition. In the electric trade this company is supplying wrought and cast iron pipe, valves, fittings and supplies, also the Excelsior railway bracket for trolley roads, etc.

MR. H. K. GORKE.

Mr. H. J. Gorke, who for a long time held the position of secretary and general manager for the Electrical Engineering and Supply Company, of Syracuse, N. Y., has resigned from that company and entered into business for himself at 120 The Bastable, Syracuse, as manufacturer's agent handling electric light and power machinery and general electric supplies. Mr. Gorke will represent a number of the leading houses of this country, such as the Eddy Electric Manufacturing Company, the Perkins Electric Switch Manufacturing Company, the Electric Construction and Supply Company and many others. He is well known throughout electrical circles, and is thoroughly familiar with electrical conditions.

ADVERTISERS' HINTS

THE STANDARD THERMOMETER AND ELECTRIC COMPANY, Peabody, Mass., state their Upton low tension arc lamps are equally adapted for inverted arc service for mill work, or where a reflected light is desirable.

EDW. F. WHITE, 136 Liberty street, New York, furnishes completed steam condensing equipments.

THE PURITAN ELECTRIC COMPANY, 150 Nassau street, city, call attention to the ease with which their long-burning lamps may be trimmed.

KEASBEY & MATTISON COMPANY, Ambler, Pa., advertise sectional magnesia coverings for steam pipes, tanks, boilers, heaters, cylinders, etc.

BRUNT & THOMPSON, East Liverpool, Ohio, carry any desired size of porcelain insulating tube in stock. The business in their regulating sockets grows daily.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., are introducing a lag and pipe wrench combining simplicity and automatic adjustment.

PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren street, New York, say their "Hercules" packing leaves the stem clean.

THE ELECTRICAL BROKERAGE COMPANY, Elkhart, Ind., offer bargains in everything electrical.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, Pa., show a cut of their type "K" instrument.

THE GENERAL ELECTRIC COMPANY, 44 Broad street, city, manufacture every variety of socket, cut-out, etc.

WHITMAN & COUCH, 196 Summer street, Boston, Mass., remind the trade that they are the sole special selling agents of the Ericsson Swedish microphone for the United States.

THE McDERMID MANUFACTURING COMPANY, Chicago, announce that they have a supply of all sizes of battery coppers and will send prices on application.

WESTERN NOTES

LOUIS R. COMSTOCK COMPANY, of Chicago, have made an assignment, which is attributed to hard times and bad collections. The assets are put at $52,000, and the liabilities at $38,000.

THE EVANS ELECTRIC COMPANY, to make electrical supplies, has been formed at Chicago, with a capital stock of $2,000 by A. T. Evans, T. Durham and W. Simpson.

THE ST. LOUIS ELECTRICAL EXCHANGE is reported by the local papers to have had a Seeley dinner at its fifth annual celebration, one of the performers appearing only in the voluminous garb of a pair of dancing slippers.

NEW YORK NOTES.

MR. JOHN C. KNIGHT, of the Diehl Manufacturing Company, has accepted the position of treasurer and manager of the People's Electric Light and Power Company, of Oswego, N. Y. His many friends wish him abundant success in his new enterprise.

A. L. BOGART, of Union Square, had a very interesting exhibit at the gas exhibition just come to a close at the Madison Square Garden. In a very neat booth were displayed his full line of improved gas lighting apparatus and notably his Bartholdi automatic gas burner, of which there are now over 100,000 in use.

MR. FRED. M. LOCKE, of Victor, N. Y., has just been advised that his patent triple petticoat china insulators and steel pins have been in use for two months giving splendid satisfaction on the power transmision line between Newcastle and Sacramento, Cal., carrying 1,000 horse-power 30 miles at 15,000 volts. There is not the slightest sign of leakage on the line.

TUCKER ELECTRIC CONSTRUCTION COMPANY., Whitehall street, report a satisfactory local trade. Among the recent buildings installed by this firm are the New York Life on Broadway, and nearly all the buildings now in course of construction on University Heights.

MR. W. McCULLOUGH, who has been looking after the Canadian General Electric Company's interests for the past three years in the West, is now representing Mr. Hugo Reisinger, No. 38 Beaver street, New York, sole importer of the celebrated "Electra" highest grade Nuernberg carbons. While the Canadian General Electric Company regret parting with one who has always been to the front where anything electrical was required, Mr. Reisinger is to be congratulated on his good fortune in securing the services of such an energetic salesman. His numerous friends will be pleased to learn of his new connection and will wish him much success in his new position.

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The Electrical Engineer.

Vol. XXIII. FEBRUARY 17, 1897. No. 459.

ELECTRIC LIGHTING

REPORT TO THE SPECIAL INVESTIGATING COMMITTEE ON COMMERCIAL ELECTRIC LIGHTING, SOUTH NORWALK, CONN.

BY A. E. WINCHESTER, E. E.
(Member of the Board of Electric Light Commissioners.)

THE undersigned member of your committee, selected by you to obtain information upon the subject of producing and supplying electric current for commercial lighting from the city's electric works, begs to submit this report as the result of his investigations.

Municipalities have been engaged in supplying water for public and private needs since the date of civilization, and have maintained their water departments from a revenue collected for water privileges. Public lighting has also been supplied by public corporations from the earliest days, and the time since private companies first attempted to handle these two great public necessities, dates back but little more than a century, but, during that time up to within a few years ago, privately owned works for supplying water and light increased so rapidly that municipalities owning such works are now in the minority, especially in this country, and especially so with regard to publicly owned lighting plants. When electricity came into practical use, however, municipal electric light plants began to appear in England and Europe, and now in the former country municipalities equipped with their own electric light plants are in the majority. In this country we have no such showing, but to indicate that the idea is growing, it may be interesting to point out the fact that ten or a dozen years ago such a thing as a municipal electric light plant was almost unknown, and when finally some cities were bold enough to try the experiment, the overture was much criticised and looked upon with no little distrust; however, about two years ago statistics showed that the municipal electric light plants had reached the number of 150, and to-day we have in the United States over 300 such plants, an increase of 100 per cent. in about two years, nearly all of which are selling electric current for commercial consumption as well as supplying it for public lighting, affording with but rare exceptions most gratifying results in the way of economy and satisfaction to the localities possessing them, as is attested by the large number of answers received to some 200 letters of inquiry that I sent out to every municipal electric light plant that could be reached in this country. There is now hardly to be found a city of any importance not already possessed of such a plant but what is either building one or conducting investigations to that end, except in very large cities having large, well-managed private electric light plants which are conducted on broad principles, fair and satisfactory to the people, supplying excellent service at low rates, such as we find in New York, Brooklyn, Philadelphia, Boston, Chicago, San Francisco, and such places, which give the citizens a service as good as can be had. The small cities are the ones that suffer, containing miserable, cheap private plants that are run cheaply and charge high rates for poor service.

In the columns of electrical periodicals are constantly to be found news items describing new municipal plants being built in just such places, small cities as a rule, though but few of these papers dare to encourage or defend such undertakings, generally lamenting the fact editorially, and endeavor to persuade municipalities to give up the idea as one that they allege can only result in failure, referring with great stress to a few such instances which have been worn threadbare by editors' pens. If they can get their hands upon a good report of a municipal plant, they assume the right to distort it so that it reads the way they would have it; this is probably because the electrical journals are largely dependent upon and stand in fear of the great army of small private plant owners, who naturally welcome any means condemnatory of municipal plants for the best of reasons; they are not in the business for love or to advance public economy, and cannot live with a competitor in the field which is only intended to be self-sustaining and which places them in an unfair light by comparison, when it is considered that they must and should make a profit or go out of business.

The cost of lighting the streets of our city from its own plant, though known to be much lower than the same class of service would be if supplied by a private company, amounts to nearly 20% of the city's taxes, including the interest on the investment and the chargeable depreciation against the machinery. It is therefore obvious that any reduction in this item of expense would be of benefit to the taxpayer. For a private corporation to undertake to run a business which would only be self-sustaining at best and likely to run at a loss would be folly indeed, but when an institution is conducted by the public for the purpose of supplying a costly public necessity, such as water or light, the difference is at once apparent, for it will be seen at a glance that if it can by any means be made to contribute anything toward reducing its cost of maintenance, even though small at first, a certain source of public economy has been reached. There is also another reason favorable to a municipal plant. Inasmuch as it would not be intended to turn out dividends, it would be possible for it to supply the demands for commercial lighting low enough to be within the reach of many who could not otherwise afford to use it, and the consumer would not only have the advantage of low lighting rates, but would also enjoy a lower rate of taxation. This being so, the proportion of consumers would naturally be greater than if the supply was derived from a private plant at ordinary profit earning prices, and it is also true that the proportional cost of production would become less as the demand increased.

Municipal plants have two dangerous enemies to contest against. The first is, political corruption—which though more often exposed is undoubtedly no worse or more frequent than the dishonest intrigues employed among some men in conducting private business enterprises, but the second and most difficult to deal with is the combined influence of the owners of small private plants, usually controlled by trusts. The first, if allowed to obtain a foothold, is bound to result in failure in the conduct of any public institution, but the people have the means at hand to prevent any such condition if they do their public duty and are careful whom they place in office; if not, they deserve to be imposed upon. There is no good reason why a public business cannot be managed with as great care as a private one, and it is a shameful assertion for any one to say that it cannot. All public officers are not rascals any more than are the heads of private concerns.

The exceptional instances of corruption and mismanagement are what are usually magnified and waved before the public by the second enemy, the owner of the small private plant as a horrible example of what he wishes to prevent them from following. He has even used his influence, money if you will, with such telling effect before the Legislatures of nearly every State in the Union as to have laws passed heaping such rigid restrictions upon municipalities that almost prohibit them from establishing electric light plants, but even so, they are constantly increasing. In his arguments, he appeals for the capital invested in the private local plant, which nine times out of ten is owned by outside capital that has no other interest in local affairs than as a means of revenue. He calls our attention to the fact that the private plant pays taxes and water rent, the total amount of which at most would form but a small percentage of the saving otherwise to be derived from a plant owned by the people in which every taxpayer would be a shareholder and receive his dividends in reduced taxes. The owner of the private plant also knows but too well that each municipal plant that springs into existence becomes widely known and is carefully watched by other municipalities far and near, and if successful the idea will spread as it has already, to the detriment of one of the deepest-rooted monopolies of the times.

I have given this subject a most searching and prolonged study, having gleaned every source for information that has reached my notice, including an extensive correspondence with Mayors and public officials of localities having municipal plants, but as it would consume too much space to give in full the answers to my queries, I will quote such facts as will be of use to this report, as follows, from municipal plants returns:

ANALYSIS OF MUNICIPAL PLANT REPORTS.

NEWARK, DEL. No street lamps. Five hundred 16-candle-power commercial incandescent lamps in service. Lights and water supplied from same department. Operating expenses equally divided. Interest on investment included in expenses, depreciation excluded:

Income of plant, per year	$3,143.75
Expenses of plant, per year	2,617.91
Income over expenses	$525.84

Remarks of Manager: "I myself say that where the water and electric light plants are operated together they are a success for municipal plants with proper management. We have only a population of about 1,500."—(Signed) A. Homewood, Superintendent and Manager.

GRIFFIN, GA.—Fifty 2,000 candle-power arc lamps on streets; 1,500 10 and 16 candle-power commercial incandescent lamps in service. Light and water supplied from same department. Division of expenses estimated. Interest on investment and depreciation included in expenses.

Income of plant, per year	$15,000.00
Expenses, per year	8,000.00
Income over expenses	$7,000.00

Remarks by Superintendent: "This plant is just in its second year, but I believe in municipal plants if run on business principles and kept out of politics."—(Signed) W. Key Howard, Superintendent.

CRAWFORDSVILLE, IND.—One hundred and forty-four 2,000 candle-power arc lamps on streets; 2,600 16, 25, 32 and 50 candle-power commercial incandescent lamps in service. Electric light plant independent of any other department. Interest and insurance included in expenses, depreciation not stated.

Expenses of plant, per year	$13,000.00
Income, per year	7,000.00
Expenses over income	$6,000.00

Remarks by Superintendent: "It's the only thing a city should do."—(Signed) Fred S. Brown, Superintendent.

LOGANSPORT, IND.—One hundred and fifty-seven 2,000-candle-power arc lamps in streets, 30 2,000-candle-power commercial arc lamps, 4,000 16-candle-power commercial incandescent lamps in service. Electric light plant independent of any other department. Bonds paid, no interest charged. Depreciation not included in expenses.

Income of plant, per year	$15,000,00
Expenses, per year	12,000.00
Income over expenses	$3,000.00

Remarks by Chairman:"My opinion is that every city should own and operate her own electric light plant. Our income from last year's private lighting was half the entire operating expenses. This year the income from this source will more than pay the entire running expenses, lighting our streets for nothing."—(Signed) S. B. Boyer, Chairman Electric Light Committe.

KENDALLVILLE, IND.—Forty-three 2,-000-candle-power arc lamps in streets, 17 2,000-candle-power commercial arc lamps in service, no incandescent lamps. Lights and water supplied from same department. Division of expenses estimated. Interest on investment included in expense; depreciation not stated.

Expenses of plant, per year	$3,000.00
Income of plant, per year	1,000.00
Expenses over income	$2,000.00

Remarks by Superintendent: "For a city to operate its own water works system and also electric lighting is the proper thing, but a detriment to those wishing to speculate on city franchises."—(Signed) W. S. Osborne, Superintendent.

GOSHEN, IND.—City does only street lighting. Remarks by Chairman: "We do no commercial lighting; we think the only way to light a city is for the city to own her electric light plant."—(Signed) Edward Kelly, Chairman Water Committee.

MUNCIE, IND.—City does only street lighting. Remarks by Superintendent: "If municipal electric light plants are kept out of politics, they can be economically run. I think as a general rule they are unsatisfactory."—(Signed) W. F. Warner, Superintendent.

CHARITON, IOWA.—One hundred and ten 32-candle-power incandescent lamps in streets, 1,180 16-candle-power incandescent commercial lamps in service. Electric light plant independent of any other department. Interest on investment and depreciation not included in expenses.

Income of plant, per year	$6,000.00
Expenses of plant, per year	5,500.00
Income over expenses	$500.00

Remarks by City Clerk: "I am a strong believer in municipal ownership of its own electric light and water works."—(Signed) Don. E. Lewis, City Clerk.

CITY OF WINTERSET, PA.—Four 1,000 candle-power arc lamps in streets, 130 16-candle-power incandescent lamps in streets, 30 1,000-candle-power commercial arc lamps in service. Electric light plant independent of any other department. Interest and sinking fund included in expenses.

Income of plant, per year	$4,500.00
Expenses of plant, per year	3,600.00
Income over expenses	$900.00

Remarks by Superintendent: "My opinion of municipal lighting; it will pay in any town providing you put in good apparatus and then have a good man to run it and take care of it."—(Signed) S. O. Klein, Superintendent.

ATLANTIC, IOWA.—One hundred and fifty-six 30-candle-power incandescent lamps in streets, 3,000 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and insurance included in expenses, depreciation not stated.

Income of plant, per year	$12,600.00
Expenses of plant per year	8,300.00
Income over expenses	$4,300.00

Remarks by Mayor: "We are making money out of ours, but get plenty of capacity in engines, etc. Our plant is quite satisfactory."—(Signed) J. B. Jones, Mayor.

LISBON, IOWA.—Fourteen 2,000-candle-power arc lamps in streets, 8 2,000-candle-power arc lamps in commercial service, 500 16-candle-power incandescent lamps in commercial service, 1,400 16-candle-power commercial incandescent lamps in service. Electric light plant independent of any other department. No division of expenses. Interest and depreciation not included in expenses.

Expenses of plant, per year	$3,125.00
Income of plant, per year	3,000.00
Expenses over income	$125.00

Remarks by Mayor and Superintendent: "I think the city should in each case own its plant and services on streets, and supply its citizens at a normal cost. A more foolish thing a city could not well do than give away a franchise for a lighting plant. Can be managed economically by single superintendent at a small cost."—(Signed) W. H. Runkle, Mayor and Superintendent.

WINTON, IOWA.—By a mistake, my letter of inquiry was sent to the owner of a local plant instead of the municipal plant, but as the letter is a good one, I quote it in full: "Dear Sir: You do me and my business too much honor. Though I made careful reports of the workings of my plant, I had to put all the money I got out of it right back into it, and then the city refused to give me street lighting, and put in a plant of its own and cut commercial lighting from 25 per cent. to 60 per cent., so that it run me in debt to run the plant. So I am shut down and trying to sell out for 25 cents on a dollar, as a whole, and having one of the finest dynamos ever run, a Westinghouse, 500 lights, upon which we run 500 to 700 regularly. Yours, etc."—(Signed) C. E. Wilcox.

FAIRFIELD, IOWA.—City does only street lighting. Remarks by Mayor: In speaking of the plant he says: "It is operated along with our water works system, and we think it a success."—(Signed) A. W. Jaques, Mayor.

SANDWICH, ILL.—The Mayor writes: "I am very glad to hear that our plant has as good a reputation as it has, and is heard from in the far away State of Connecticut. I will say that we have an elegant plant and water works, which we run in connection. I will have your blanks filled out properly by our City Clerk and forwarded to you at once, hoping that they may be of advantage to you in your investigations throughout the country."—(Signed) A. G. White, Mayor.

ST. CHARLES, ILL.—Two hundred and twelve 30-candle-power incandescent lamps in streets, 600 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Expenses of plant, per year	$2,771.68
Income of plant, per year	2,622.25
Expenses over income	$149.43

Remarks by City Clerk: "We are well pleased with ours. Would be pleased to have you call."—(Signed) P. Hempstead, City Clerk.

METROPOLIS, ILL.—Thirty-five 2,000-candle-power arc lamps in streets, 700 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. No division of expenses. Interest and depreciation not stated.

Income of plant, per year	$3,812.75
Expenses of plant, per year	3,812.75

Income and expenses balance.

Remarks by Superintendent: "Municipal plants are not as economical as they should be, and are not managed as they should be. It seems as though there is no one to go ahead and carry out the things as they should be; in other words, business is done too low."—(Signed) Henry Shelton, Superintendent.

BENTON, ILL.—Fourteen 1,200-candle-power arc lamps in streets, 650 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not stated.

Income of plant, per year	$2,400.00
Expenses of plant, per year	1,300.00
Income over expenses	$1,100.00

Remarks by Superintendent: "Plant is owned by village; our lights cost nothing."—(Signed) C. H. Bassett, Superintendent.

HERINGTON, KAN.—Ten 1,200 candle-power arc lamps in streets, 10 16-candle-power incandescent lamps in streets, 9 1,200-candle-power arc lamps in commercial service, 400 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Division of expenses, 75 per cent. charged to lights and 25 per cent. to water. Interest and depreciation not included in expenses.

Income of plant, per year	$4,200.00
Expenses of plant, per year	4,000.00
Income over expenses	$200.00

Remarks by Superintendent: "Get good men and then keep them; don't be changing men each year; a good man can make a success if given time, but a good man can't do much in one year."—(Signed) I. S. Brundage, Superintendent.

TECUMSEH, NEB.—Seventy-six 16-candle-power incandescent lamps in streets, 422 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Division of expenses proportioned. Interest and depreciation not included in expenses.

Expenses of plant, per year	$1,853.77
Income of plant, per year	1,160.17
Expenses over income	$693.60

Remarks by Mayor: "I think our plant is not of sufficient capacity for the work we have for it to do, and this makes much more expense for us than it would otherwise be."—(Signed) P. H. Hopkins, Mayor.

BANGOR, ME.—City does only street lighting. Remarks by City Clerk: "Municipal lighting has proved very satisfactory to us. We have saved annually about $4,000.00 in expense of lighting over our old gas system, with much better lighted streets."—(Signed) Victor Brell, City Clerk.

LEWISTON, ME.—City does only street lighting. Remarks by Superintendent: "Buy the best apparatus in market, employ good, faithful help, and see that they take good care of apparatus; if they don't attend to business give them the bounce and hire some one who will."—(Signed) Asa T. Green, Superintendent.

MIDDLEBORO, MASS.—One hundred and eight 1,200-candle-power arc lamps in streets, 4 1,200-candle-power arc lamps in commercial service, 1,400 incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation included in expenses.

Expenses of plant, per year	$19,039.88
Income of plant, per year	12,000.00
Expenses over income	$7,039.88

Remarks by Manager: "My opinion after two years' experience in municipal lighting is, that it pays. My experience as Manager for the Thomson-Houston Company is, they make it pay."—(Signed) John W. Main, Manager.

NORTH ATTLEBORO, MASS.—Five hundred and eighty-four 32-candle-power incandescent lamps in streets, 2,158 12 and 16 candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Expenses charged half to lights and half to water. Interest and depreciation not stated.

Expenses of plant, per year	$6,704.04
Income of plant, per year	3,679.60
Expenses over income	$3,024.44

Remarks by Manager: "So far as I can judge, municipal plants ought to and can be run with better advantage than private plants."—(Signed) W. P. Whitmore, Manager.

PEABODY, MASS.—One hundred and fifty-seven 1,200-candle-power arc lamps in streets. Number of commercial arc and incandescent lamps in service not stated. Electric plant independent of any other department. Interest and depreciation in doubt.

Expenses of plant, per year	$11,439.55
Income of plant, per year	4,960.69
Expenses over income	$6,478.86

Manager of plant is P. L. Winchester.

BAINTREE, MASS.—Ninety-two 1,200-candle-power arc lamps in streets, 109 25-candle-power incandescent lamps in streets, 3,800 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest reserve for sinking fund, insurance and water rent included in expenses.

Expenses of plant, per year	$10,500.00
Income of plant, per year	5,600.00
Expenses over income	$4,900.00

Remarks by Superintendent: "Have been connected as constructing engineer of this and three other plants (municipal) in this State, and can truthfully say that properly managed we can give better service for less money than any commercial plant I know of."—(Signed) J. Frank Perry, Superintendent.

SAVANNAH, MO.—Twenty-six 1,200-candle-power arc lamps in streets, 550 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Income of plant, per year	$3,049.98
Expenses of plant, per year	2,966.02
Income over expenses	$83.96

Remarks by Superintendent: "Our plant has been a success thus far, and the citizens are well pleased with it. Municipal electric lighting is all right if you can keep politics out of it."—(Signed) B. S. Cheney, Superintendent.

SALISBURY, MO.—Twenty 2,000-candle-power arc lamps in streets, 20 2,000-candle-power arc lamps in commercial service, 540 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Expenses of plant, per year	$2,840.00
Income of plant, per year	2,000.00
Expenses over income	$840.00

Remarks by ex-Mayor and electrician: "From my experience, I would advise that the plant be owned and operated by the city."—(Signed) D. R. Patterson, ex-Mayor; W. A. Howard, Electrician.

BRUNSWICK, MO.—Twenty 2,000-candle-power arc lamps in streets, 290 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Interest and depreciation not included in expenses.

Income of plant, per year	$2,016.65
Expenses of plant, per year	1,983.40
Income over expenses	$33.25

Manager is C. E. Boston.

ALEXANDRIA, MINN.—Eleven 1,200-candle-power arc lamps in streets, 600 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Interest and depreciation not included in expenses. No division of expenses made.

Income of plant, per year	$4,100.00
Expenses of plant, per year	3,500.00
Income over expenses	$600.00

Remarks by Chief Engineer: "Employ a competent Superintendent, with ample powers as such during good behavior. Keep out of politics, and it should be cheaper than private corporation service."—(Signed) C. A. Johnson, Chief Engineer.

WASECA, MINN.—Thirty-three 2,000-candle-power arc lamps in streets, 40 2,000-candle-power arc lamps in commercial service, 800 16-candle-power incandescent lamps in commercial service. Light and water supplied from same department. Plant not run long enough to give figures covering income and expenses.

Remarks by Mayor: "Our plant is so new that we have not fully systematized it as yet, so are unable to report any funds. We are well satisfied, however, and believe in municipal lighting."—(Signed) D. S. Cummings, Mayor.

WELLS, MINN.—Six 1,200-candle-power arc lamps in streets, 35 24-candle-power incandescent lamps in streets, 16 1,200-candle-power arc lamps in commercial service. 650 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Interest and depreciation not included in expenses. Division of expenses not stated.

Expenses of plant, per year	$4,000.00
Income of plant, per year	3,500.00
Expenses over income	$500.00

Remarks by Superintendent: "I do not believe in municipal ownership of electric plants, as too much political influence is brought to bear on it, and plant suffers from it both as to management and economy."—(Signed) A. C. Johnson, Superintendent.

LUVERNE, MINN.—Sixteen 2,000-candle-power arc lamps in streets, 19 2,000-candle-power arc lamps in commercial service, 1,000 16-candle-power incandescent lamps in commercial service. Light and water supplied from same department. Division of expenses, two-thirds charged to lights and one-third to water. Interest and depreciation not included in expenses.

Income of plant, per year	$4,800.00
Expenses of plant, per year	4,000.00
Income over expenses	$800.00

Remarks by Recorder: "The village is well satisfied both with results and service."—(Signed) E. S. Rogers, Village Recorder.

FULDA, MINN.—Fifty 32-candle-power incandescent lamps in streets, 400 16-candle-power incandescent lamps in commerical service. Electric plant independent of any other department. Interest and depreciation not stated.

Income of plant, per year	$2,500.00
Expenses of plant, per year	2,200.00
Income over expenses	$300.00

Remarks by Recorder: "Municipal electric light plants are the only economical plants in existence as the consumer only pays the safe actual cost of what he consumes."—(Signed) Robert Hyslop, Village Recorder.

ST. PETER, MINN.—Forty-four 2,000-candle-power arc lamps in streets, 500 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Income of plant, per year	$5,193.15
Expenses of plant, per year	4,269.20
Income over expenses	$923.95

Remarks by Clerk: "Is the most satisfactory to people in general."—(Signed) H. T. Slater, Clerk.

ROCHESTER, MINN.—Eighty-one 2,000-candle-power arc lamps in streets, 38 2,000-candle-power arc lamps in commercial service, 1,500 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Expenses of plant, per year	$5,600.00
Income of plant, per year	5,000.00
Expenses over income	$600.00

Remarks by Superintendent: "Much better than if run by private parties, as it is run on a more liberal plan, enabling the employé to give better service, not feeling hampered by excessive economy."—(Signed) W. G. Rowen, Superintendent.

LANSING, MICH.—One hundred and sixteen 2,000-candle-power arc lamps in streets, 60 2,000-candle-power arc lamps in commercial service. Number of incandescent lamps in commercial service not stated. Electric plant independent of any other department. Interest included in expenses, depreciation excluded.

Income of plant, per year	$27,000.00
Expenses of plant, per year	15,000.00
Income over expenses	$12,000.00

Remarks by Secretary: "I bélieve that if municipal authorities will manifest the same zeal in protecting its own plant that is usually shown in protecting a franchise granted to a private corporation, that good results in service and economy will follow; of course a careful management is necessary."—(Signed) Daniel Barringer, Secretary.

MARSHALL, MICH.—Eighty-one 2,000-candle-power arc lamps in streets, 35 2,000-candle-power arc lamps in commercial service, 1,500 16-candle-power incandescent lamps in commercial service. Electric light plant independent of any other department. Interest not included in expenses. Depreciation not stated.

Income of plant, per year	$4,000.00
Expenses of plant, per year	3,500.00
Income over expenses	$500.00

Remarks by Superintendent: "Our plant has been very successful so far; we now pay all running expenses, and the city only has to pay interest at 5 per cent. on bonds and pay bonds that become due each year for its lighting."—(Signed) P. S. Jay, Superintendent.

KALAMAZOO, MICH.—City does only street lighting. Remarks by Superintendent: "A municipal plant operated by manager or superintendent with complete authority can be operated very economically and to a great saving to the city."—(Signed) H. C. Hoagland, Superintendent.

COLD WATER, MICH.—Seventy-seven 2,000-candle-power arc lamps in streets, 11 16-candle-power incandescent lamps in streets, 20 2,000-candle-power arc lamps in commercial service. Number of incandescent lamps in commercial service not stated. Lights and water supplied from same department. Interest included in expenses, depreciation excluded. No division of expenses.

Income of plant, per year	$21,868.65
Expenses of plant, per year	18,804.87
Income over expenses	$3,063.78

Remarks by Superintendent: "For a city of this size (5,500), in connection with water works, I think it advisable for a city to own its light plant and to do commercial lighting. Without water department, it depends on size of city, competition, etc."—(Signed) L. A. Dillingham, Superintendent.

HOLLAND, MICH.—Fifty 2,000-candle-power arc lamps in streets, 15 2,000-candle-power arc lamps in commercial service, 2,550 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Interest included in expenses, depreciation excluded. Division of expenses estimated.

Income of plant, per year	$21,910.46
Expenses of plant, per year	21,551.49
Income over expenses	$358.97

Remarks by President: "So far as my experience goes, I do not particularly favor a city attempting to do any more than public lighting, but see no particular objection to a city or town of moderate size, say, 20,000 inhabitants, or less, doing commercial lighting. As to larger cities, I cannot, of course, speak from experience, but am inclined to the opinion that there would be a chance for corruption and appointment of favorites for political influence, etc."—(Signed) C. J. De Roo, President, Board of Public Works.

PAW PAW, MICH.—Thirty-two 2,000-candle-power arc lamps in streets, 24 1,200-candle-power arc lamps in commercial service, 600 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Income of plant, per year	$2,400.00
Expenses of plant, per year	1,500.00
Income over expenses	$900.00

(Signed) William H. Mason, Village Clerk.

EVART, MICH.—Sixteen 2,000-candle-power arc lamps in streets, 400 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Expenses equally divided. Interest and depreciation included in expenses.

Expenses of plant, per year	$1,500.00
Income of plant, per year	1,200.00
Expenses over income	$300.00

Remarks by Chairman: "We are well satisfied with our plant."—(Signed) C. E. Bill, Chairman Electric Light Committee.

NILES, MICH.—Seventy-three 2,000-candle-power arc lamps in streets, 2 32-candle-power incandescent lamps in streets, 27 2,000-candle-power arc lamps in commercial service. 1,600 16 and 30 candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Interest and depreciation not included in expenses. Expenses equally divided.

Income of plant, per year	$8,000.00
Expenses of plant, per year	5,000.00
Income over expenses	$3,000.00

Remarks by Superintendent: "These plants are now owned by the city, and being run by water power, and both together bring the cost of hydrants at about $30.00 per year and street arc lamps at $40 per year for total cost as named above."—(Signed) M. A. Earl, Superintendent.

HAMILTON, N. Y.—Fifty 1,200-candle-power arc lamps in streets, 1,500 16 and 32 candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Plant has not been run long enough to determine amount of income and expenses. Remarks by Superintendent: "Our plant has been in operation less than ten months. So far as we can determine now, it is successful and profitable. The people are well pleased."—(Signed) E. D. Kingsbury, Superintendent.

DUNKIRK, N. Y.—Quotation from letter: "I am very sorry I cannot give you information on the matter of which you inquire. We are situated very much as you are, having street arc lighting only. We are about taking action to extend our system to incandescent lighting also."—(Signed) R. L. Cary, President Water Board.

WESTFIELD, N. Y.—Seventy-two 2,000-candle-power arc lamps in streets, 450 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation included in expenses.

Expenses of plant, per year	$5,000.00
Income of plant, per year	1,500.00
Expenses over income	$3,500

Remarks by Superintendent: "I think there is no question about municipal plants if they are properly managed and no mistakes made in starting in, as to machinery and rates, contracts, etc."—(Signed) J. G. Finlay, Superintendent.

MADISON, N. J.—Four hundred and twenty 30-candle-power incandescent lamps in streets, 1,800 16-candle-power incandescent lamps in commercial service. Lights and water supplied from same department. Division of expenses proportioned. Interest included in expenses, depreciation excluded. Income and expenses taken from report.

Income of plant, per year	$10,404.80
Expenses of plant, per year	8,784.72
Income over expenses	$1,620.08

Remarks by Manager: "Our style of plant is very satisfactory for scattered population like ours."—(Signed) W. M. Bell, Manager.

REIDSVILLE, N. C.—Twenty-eight 1,200-candle-power arc lamps in streets, 365 16-candle-power incandescent lamps in commercial service. Electric plant independent from any other department. Interest and depreciation not included in expenses.

Income of plant, per year	$7,500.00
Expenses of plant, per year	3,800.00
Income over expenses	$3,700.00

(Signed) John S. Pannill, Superintendent.

ASHTABULA, OHIO.—Sixty-eight 2,000-candle-power arc lamps in streets, 4,008 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and insurance included in expenses, depreciation excluded.

Income of plant, per year	$14,434.00
Expenses of plant, per year	12,267.00
Income over expenses	$2,167.00

Figures taken from report of Superintendent J. A. Manning.

JACKSON, OHIO.—Forty 2,000-candle-power arc lamps in streets, 35 1,200-candle-power arc lamps in commercial service, 1,213 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Income of plant, per year	$7,000.00
Expenses of plant, per year	4,000.00
Income over expenses	$3,000.00

Remarks by Electrician: "Bad. This plant is run by a committee from Council, which is changed every year; so we get new management every year that does not become acquainted with the work until changed; the attention is not paid to details as would be by a private company."—(Signed) George D. Hoop, Electrician.

OXFORD, OHIO.—Forty-two 2,000-candle-power arc lamps in streets, 700 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses.

Income of plant per year	$7,000.00
Expenses of plant, per year	4,000.00
Income over expenses	$3,000.00

Remarks by Trustee: "We believe they can be successfully operated in small towns, say up to 3,000 or 4,000 people, but not in larger, on account of political affairs being so often mixed up with them."—(Signed) S. H. Allen, Trustee.

WELLSTON, OHIO.—Fifty-six 1,200-candle-power arc lamps in streets, 2 1,200-candle-power arc lamps in commercial service, 900 16-candle-power incandescent lamps in commercial service. Light and water supplied from same department. Two-thirds of expenses charged to lights, one-third to water. Interest and depreciation not included in expenses.

Income of plant, per year	$4,000.00
Expenses of plant, per year	3,600.00
Income over expenses	$400.00

Remarks by Secretary: "Believe it pays any city to own its light plant, being cheaper, gives better satisfaction, but probably more difficult management."—(Signed) J. J. Bennett, Secretary.

MARIETTA, OHIO.—City does only street lighting. Remarks by Superintendent: "Our plant has so far cost us about $18,000.00. The City Council are now considering plans to enlarge it to 300 lights. The plant has been overloaded for the past three years. We have no commercial plant in this city. Our electric street railroad company having a franchise to put in a plant for commercial purposes. The street railroad company proposed to buy the city plant at $15,000 cash and make street lighting at $65.00 per light. No sale. No politics, and keep an employé as long as he does his duty, will insure success in any business."—(Signed) Thomas Hancock, Superintendent.

DE GRAFF, OHIO.—Twenty-nine 2,000-candle-power arc lamps in streets, 1,000 16-candle-power incandescent lamps in commercial service. Electric light department run jointly with fire department. Interest and depreciation not included in expenses.

Income of plant, per year	$4,500.00
Expenses of plant, per year	4,000.00
Income over expenses	$500.00

Remarks by ex-Manager: "Have had three years' experience in managing municipal plants and think they can be made a success of, although in many cases they are not, especially if controlled by a whole council instead of a committee of the council, for in nine cases out of ten they will put their judgment up against a man of years of experience in the management of plants."—(Signed) Fred. Rea, ex-Manager.

GALION, OHIO.—Eighty-seven 2,000-candle-power arc lamps in streets, 34 2,000-candle-power arc lamps in commercial service, 900 16, 32 and 50-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation not included in expenses. Superintendent has not run plant long enough to give yearly figures, but says the receipts for February, March and April amounted to $1,106.24. In speaking on the subject of municipal plants the Superintendent says: "Good because cheaper and plant can be run to suit the people without contracts, and changed when desired, and the larger the plant the cheaper the light can be furnished."—(Signed) W. A. Ross, Superintendent.

WILMINGTON, OHIO.—Eighty-six 2,000-candle-power arc lamps in streets, 49 2,000-candle-power arc lamps in commercial service, 700 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation included in expenses.

Income of plant, per year	$3,250.00
Expenses of plant, per year	3,200.00
Income over expenses	$50.00

Remarks by Superintendent: "In my experience, no plant should be run by any municipal corporation for there are so many that want to be boss and too many free lights."—(Signed) H. C. Taylor, Superintendent.

ALLEGHENY, PA.—City does only street lighting. Remarks by Superintendent: "As to municipal ownership, I believe it to be the proper thing, even admitting that there would be no saving financially. Your plant being in your own hands, you may do with it as you see fit, and are free from the incessant troubles due to dealing with corporations. In addition to the above our city saves not less than $25,000 annually comparing with prices paid by our sister city Pittsburg."—(Signed) D. Hunter, Jr., Superintendent Bureau Public Works.

QUAKERTOWN, PA.—Forty 1,200-candle-power arc lamps in streets, 800 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Interest and depreciation included in expenses.

Expenses of plant, per year	$5,272.00
Income of plant, per year	4,320.00
Expenses over income	$952.00

Remarks by Superintendent: "Municipal electric plants are and will be a success if politics can be kept away from them. We have no trouble here. The town of Quakertown would not sell the plant for any money."—(Signed) Gottlieb Frey, Superintendent.

SCHUYLKILL HAVEN, PA.—Forty 2,000-candle-power arc lamps in streets, 500 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Usually high interest and depreciation included in expenses.

Expenses of plant, per year	$4,500.00
Income of plant, per year	2,000.00
Expenses over income	$2,500.00

Remarks by Superintendent: "Where a municipal plant is run with the same care and business methods that are used by corporations, it is bound to save the municipality the profits which go to the corporations. It should be run without political interference or dictation and left in the hands of a competent superintendent."—(Signed) E. N. Hyde, Superintendent.

WEST NEWTON, PA.—Thirty-two 2,000-candle-power arc lamps on streets, 1,000 16-candle-power incandescent lamps in commercial service. Electric plant independent of any other department. Unusually high interest and depreciation included in expenses.

Income of plant, per year	$4,200.00
Expenses of plant, per year	3,400.00
Income over expenses	$1,800.00

Remarks by Superintendent: "I think that a municipal plant, if properly managed, is the cheapest way to light up a city or town. Last year our plant paid the interest on the money invested."—(Signed) A. R. McMillan, Superintendent.

From the numerous replies received to my inquiries, I have selected the foregoing without discrimination and believe they will convey a fair idea as to merits and demerits of the subject under consideration from the most reliable sources of information, the results of actual experience.

A preliminary canvass of the probable commercial lighting territory of South Norwalk was made and it was found that a commercial plant having a capacity of about 2,000 16-candle-power lamps would be of the proper size to meet the probable demand at present and that it could be erected in the space provided for such purpose in the building of the city's electric works without any extensive alterations to the present plant and but few other changes. The present city poles would be sufficient size except in a few instances for all additional electrical conductors that would be necessary. After carefully considering the various systems in use for generating and supplying electric current, the one selected upon which I have based my estimate is known as the direct low tension system on the two or three wire principle, employing 110 or 220 volts at the lamps, as it would not only be the least costly to maintain, but would be free from danger to life and would supply a current equally suitable for motors, arc or incandescent lamps. The narrow limits of our city and the condensed lighting territory together with the nearness of the generating station to the center of distribution makes the system described the most suitable and practical, whereas in a scattered district it would be impracticable, owing to the excessive cost of construction for long distance transmission.

The cost of constructing the system described above, having a normal capacity of 2,000 16-candle-power incandescent electric lamps would be as follows:

ESTIMATE OF CONSTRUCTION.

Steam Plant.—	
1 Improved steel smoke stack,	
1 Foundation for smoke stack,	
1 Smoke flue and connections,	
1 Horizontal tubular boiler 72" x 16',	
1 Boiler setting and furnace,	
2 Automatic high speed engines,	
2 Engine and dynamo foundations,	
Piping connections, alterations, etc.	
Cost of steam plant	$7,150.00
Electric Plant.—	
2 50-kilowatt or 4 25 kilowatt direct connected M. generators,	
1 switchboard and electric appliances,	
Feeders, mains and line construction,	
Cost of electric plant	$8,000.00
Labor, freight, carting, etc.,	
Changes and alterations,	
Labor, engineering, planning and specifications,	
Freight, carting and contingencies,	
Cost of labor, etc.	$2,850.00
Total cost of plant in running order	$18,000.00

ESTIMATE OF YEARLY RUNNING EXPENSES.

Cost of operating the city's present municipal street lighting plant, including interest and depreciation as shown in last report of Oct. 13, 1895		$5,902.25
Cost of operating proposed plant:		
Salaries for additional force	$2,160.00	
Fuel	2,800.00	
Cylinder, engine and dynamo oil and waste	205.00	
Interest, depreciation, repairs, etc.	2,380.00—	7,545.00
Total yearly expenses		$13,447.25

Estimated income of plant, taken from a conservative canvass of the lighting territory of South Norwalk, figured at a very low charge, gives the following results:

Income for commercial incandescent and arc lighting, per year	$10,923.12

RECAPITULATION.

Total yearly expenses	$13,447.25
Total yearly income	10,923.12
Expenses over income	$2,524.13

It will thus be seen by these figures that the cost to the city for lighting its streets which, according to the last report, was $5,902.25, would be reduced to $2,524.13, leaving a net saving to the city of $3,378.12.

As the cost of operation is fixed at a conservative high figure and the source of income is based on a comparatively small proportion of the probable number of consumers of electric current at a very low rate, it is believed that the actual income resulting from practical experience would represent a much larger amount than above stated, and the income to be derived from commercial lighting would undoubtedly within a comparatively short time be sufficient to make the plant self-sustaining, thus reducing the cost of lighting the city's streets to nothing.

In the belief that I have fulfilled the mission assigned me, I take pleasure in submitting the foregoing report for your consideration.

The above report is based upon the blanks sent out by Mr. Winchester, asking for information in regard to all the details of the plant, its operation and its results. In addition to the report, Mr. Winchester furnishes us with the accompanying table in which he has drawn up a comparison of the conditions of a private and a municipal plant, as relative to the question of taxation and the presumable saving to the citizens:

BRIEF FACTS FOR COMPARISON BETWEEN A PRIVATE AND MUNICIPAL PLANT UNDER SIMILAR CONDITIONS. TAKEN FROM 1896 REPORT OF SOUTH NORWALK, CONN., MUNICIPAL PLANT.

PRIVATE PLANT.

Owned by stock company, directors elected without pay by shareholders (as is the custom of a plant of this size), from their own number—

Capital invested		$22,500.00
[1] Income per year, 100 arc lamps, at $70		7,000.00
Expenses per year.—		
New construction	$143.22	
Repairs	246.11	
Tools and equipment	13.42	
Running expenses	1,723.30	
Salaries	2,400.00	
Taxes	192.00	
Water rent	75.00	
[2] Depreciation on $15,576.38 at 5 per cent	778.82	
Total expenses		$ 5,571.87
Earnings to be divided among shareholders		$ 1,428.13

MUNICIPAL PLANT.

Owned by citizens and taxpayers (who are virtually shareholders), commissioners (directors) elected without pay by the citizens and taxpayers from their own number—

Capital invested (bonds)		$22,500.00
[1] Cost to citizens if lights were furnished by contract at $70 per light per year for 100 arc lamps		7,000.00
Expenses per year.—		
New construction	$143.22	
Repairs	246.11	
Tools and equipment	13.42	
Running expenses	1,723.30	
Salaries	2,400.00	
[3] Taxes	192.00	
[3] Water rent	75.00	
[2] Depreciation on $15,576.38 at 5 per cent	778.82	
Interest on bonds, $22,500.00 at 4 per cent	900.00	
Total expenses		$ 6,471.87
Amount saved to taxpayers in reduced taxes		$ 528.13

It should be added that the report, which has been accepted by the committee, is the result of extended investigations conducted by A. E. Winchester, consulting engineer, and an electric light commissioner of the city. He was selected for the work from their number by the following special investigating committee on commercial electric lighting:—Stephen S. Hatch, Frank N. Ferris, Oliver E. Weed, Councilmen; John H. Light, City Attorney; Joseph A. Volk, Leslie Smith, Albert E. Winchester, Electric Light Commissioners. This committee was appointed by Mortimer M. Lee, and the Common Council in response to a strong petition from the citizens of South Norwalk, Conn., urging that commercial electric lights be supplied from the city's existing municipal electric street lighting plant, which has been operating under a high degree of success and economy for several years.

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[1] It should be noted that $70 per year is a very low rate for lamps of 1,200 c. p. under any schedule, but it is used out of courtesy to the private plant.

[2] Depreciation (an item as often forgotten by private as well as municipal plants), represents property subject to deterioration.

[3] Taxes and water rent added to expenses of municipal plants to make comparison fair to private plant.

WHY UTICA, N. Y., PREFERRED BUYING ITS LIGHTS.

Below are given the figures cited in an official report to the city council of Utica, made in 1896, on the subject of municipal lighting. After a most exhaustive investigation the committee of the council recommended that instead of installing a municipal lighting plant, a five-year contract be made at 33 cents per night. The comparative cost between municipal plants and private companies follows:

Cost of lights where plant is owned by municipality:—

CITIES—	Cost per hour.	Candle power per hr. fur. for 1 cent.
Alameda, Cal.	.1458	137
Aurora, Ill.	.0447	447
Bay City, Mich.	.0376	531
Bloomington, Ill.	.0519	385
Crawfordsville, Ind.	.0671	298
Danvers, Mass.	.0520	433
Dunkirk, N. Y.	.2780	718
Easton, Pa.	.4450	449
Elgin, Ill.	.5860	341
Fairfield, Ia.	.0700	288
Galion, O.	.0511	391
Grand Lodge, Mich.	.1100	181
Hannibal, Mo.	.0540	370
Herkimer, N. Y.	.0572	349
Madison, Ind.	.0696	287
Madison, N. J.	.0678	294
Marietta, O.	.0589	339
Bangor, Me.	.0278	719
South Norwalk, Conn.	.0571	280
Council Grove, Kan.	.0779	154
Ypsilanti, Mich.	.0664	298
Frederick, Md.	.0435	495
Galveston, Tex.	.0557	359
St. Peters, Minn.	.0757	264
Portland, Ore.	.0348	574
Statesville, N. C.	.0355	338
Stanton, Va.	.0499	241
Cost of lights where contract is made with a private company:		
San Diego, Cal.	.0874	229
Joliet, Ill.	.0266	751
Jackson, Mich.	.0232	862
Galesburg, Ill.	.0532	375
Chicago, Ill.	.0437	451
Peru, Ind.	.0266	884
Lynn, Mass.	.0365	547
Auburn, N. Y.	.0253	787
Harrisburg, Pa.	.0240	750
Danville, Ill.	.0365	547
Burlington, Ia.	.0454	440
Carterville, O.	.0400	500
Grand Rapids, Mich.	.0360	555
St. Louis, Mo.	.0200	1,000
Batavia, N. Y.	.0240	833
Evansville, Ind.	.0545	366
Camden, N. J.	.0371	539
Columbus, O.	.0365	547
Skowhegan, Mo.	.0187	802
Bridgeport, Conn.	.0368	326
Atchison, Kan.	.0384	312
Lowell, Mich.	.0533	375
Baltimore, Md.	.0319	626
Dallas, Tex.	.0253	787
Minneapolis, Minn.	.0648	309
Salem, Ore.	.0320	625
Charlotte, N. C.	.0325	375
Parkersburg, Va.	.0256	781

A KANSAS COUNTY BONDED INTO INSOLVENCY.

The Board of County Commissioners of Lane County, Kansas, have formally declared the county insolvent and issued instructions to the County Treasurer to refrain from further payment of interest on the county's bonded indebtedness. The funded debt of the county is $125,000. The bonds are held by about forty different corporations and individuals in New York and New England and have been quoted at almost par. Edward Helmie, chairman of the County Board, states that this action was taken simply because the county could not raise money enough by taxation to meet its obligations. He asserts that the settlers of Lane County are not repudiators, and pay their taxes promptly, but that such is not the case with non-resident land-owners. He cites as an example the Jarvis-Conklin Mortgage Company, which owns ninety quarter-sections of land in the county, and has not paid a cent of taxes for nearly three years. About $109,000 of the county's indebtedness is represented by bonds issued to aid in the construction of the Great Bend branch of the Atchison, Topeka and Santa Fé Road.

DISCUSSION OF MUNICIPAL LIGHTING PLANTS IN MASSACHUSETTS.

We append a report as to what some Massachusetts Mayors are thinking about the subject of municipal lighting plants:

Mayor Farnham, of Malden, thinks they can save from 30 to 50 per cent. by purchasing the electric light plant and furnishing its own light. He says the present contract expires next March, and that the city has been paying $25,000 per year for 93 arc lamps and 780 incandescent lights, which burn on an average 25 nights a month. He recommends that the next contract be made for not more than a year, as the city may decide to do its own lighting.

Mayor Fish, of Taunton, favors the appointment of himself and the president of the Common Council as a committee to act in conjunction with the Street Lighting Committee in the establishment of the municipal lighting plant.

Mayor Turner, of Salem, says: "The cost of lighting our streets is more than $40,000 a year. The city would obtain better service at a much cheaper rate if it had a plant of its own. I recommend that Salem apply for the necessary legislation to enable it to construct its own plant."

Mayor Greene, of Fall River, does not deem it advisable at this time for the city to maintain an electric plant of its own.

Mayor Ransdell, of Lynn, in alluding to the matter of street lighting, says that it seems to be a fact that provisions for supplying light can be made on public account at a cost very much less than what is charged by private concerns.

Mayor Hawkins, of Pittsfield, recommends the placing of electric wires underground.

Mayor Brickett, of Haverhill, says: "Our street railways own valuable franchises, granted on terms which sometimes seem too favorable, but no factor is more essential to the growth of the city than a successful street railway service. Such enterprises must be encouraged upon a reciprocal basis. In return, we should expect good service and fair treatment as to the repair and maintenance of streets through which the lines pass. The expediency of a municipal lighting plant should be considered."

Mayor C. P. Bond, of Waltham, advocates a plan whereby the city will receive pay for franchises granted to electric car companies and other privileges in the public streets. He advises an imitation of the systems, whereby such corporations pay the annual rental for the use of the streets. He advises an imitation of the systems whereby such corporations pay an annual rental for the use of the streets.

Mayor Jenkins, of Lawrence, devotes the greater part of his address to the question of municipal franchises, in respect of which he says: "With the exception of the N. E. Telephone and Telegraph Company making a discount of 25 per cent. on telephones used by the city, Lawrence receives nothing in return for many valuable privileges that have been given away. The electric road, gas, telephone and electric light companies all have important franchises, and the city ought certainly to receive some reasonable return for such privileges."

The city of Boston, under the leadership of Mayor Quincy, is establishing isolated electric lighting plants in its various public institutions, and is now installing large plants in the City Hospital and in the Deer Island prisons.

At Brockton recently the Common Council refused to agree with the Aldermanic Board to bind the city by a new contract for five years for the same arc lights as at present, with an additional charge for incandescents. The present contract has about two years to run, and it looks as if Brockton may have its own plant before the end of that time.

LIGHTING COMMISSIONS.—Both in New York State and in Michigan it is proposed to establish commissions having direct control over corporations engaged in lighting.

MAYOR GREEN, OF BINGHAMTON, N. Y. OPPOSES MUNICIPAL PLANTS.

IN his annual message to the city this year, Mayor Green, of Binghamton, N. Y., addresses himself to the municipal plant question and says: "The business of electric lighting is one of recent origin, and many central stations neglect to include the contingent expenses, which expenses from the very nature of the business are in many cases larger than were expected by the most careful estimates. Then, too, from the nature of the business, the life of the apparatus is short, hence the natural desire on the part of private corporations for a long contract, in order that the cost of renewing and maintaining the apparatus may be warranted by a known period for as long a time as possible.

"We have not undertaken to compile recent, statistics on electric lighting outside of New York State, but have submitted enough to convince intelligent beings that the hypocritical howl that your honorable body did the city a grievous wrong by entering into the recent contract is simply ridiculous, since the statistics submitted prove that this city receives 133 more candles per hour for one cent than the average price paid by the several New York State cities mentioned herein.

"Had you favored establishing a municipal plant, it would at first have required State legislation; then it is safe to assume more than one year would have been required to locate and establish the plant. Your action in accepting the three years' proposition was, in my judgment, in the interest of economy. The city is now provided with lights at a fair price, and for a period which will enable thorough investigation to be pursued regarding the advisability of owning and operating a municipal electric lighting plant.

"My experience has demonstrated that it is almost impossible to secure thoroughly reliable data from cities owning municipal plants. So much of uncertainty concerning actual and contingent expenses maintains that it is difficult to restore order from the general chaos. Your honorable body should carefully investigate and keep in touch with the changes, and the moment tangible facts prove that it is sufficiently cheaper for the city to own its lighting plant instead of contracting for its lights, then it becomes your duty, as well as mine, to undertake the preliminary work of establishing a municipal plant, in which case we should first determine if some amicable and favorable plan could be adopted to purchase the plant from the private corporation now located here. The logic of the situation does not demand the killing off of vested interests and the ruination of a private enterprise if such an unhappy result can be avoided with full justice to the city and its manifold interests, any more than it follows that the city should submit to any extortionate demands from said private corporation."

This was accompanied by figures worked out as far as possible, showing that Binghamton is getting its light cheaper than a city plant could furnish it.

A PROPOSED GOVERNMENT INVESTIGATION OF MUNICIPAL PLANTS.

The proposed Federal state investigation into the municipal ownership of big enterprises, is now under way in several of the States. Its chief aim is to ascertain the extent to which municipal ownership has been carried in this country and to this end information is to be collected from all electric light or water works under such control. This amounts to the making of a census of all this class of municipal enterprises.

The secondary object is to collect data bringing the cost to the consumer of water, gas or electric light under municipal management, into comparison with the cost of a like product under private control. An attempt also will be made to find the cost of the different products under the two methods of management.

The inquiry will be carried on by the different State bureaus of labor and the federal department of labor. There are thirty-two State officials. Some, however, are unable to join in the inquiry and from such States the department will collect the facts. The results will be brought together, compiled and analyzed by the department of labor, while each State participating in the canvass, will publish the data belonging to it. In this way thorough co-operation has been secured and the work will be accomplished with the least possible delay.

A LIGHT COMMISSION PROPOSED IN PENNSYLVANIA.

A bill before the Pennsylvania State Senate proposes to create a Board of Gas, Electric and Light and Water Commissioners. The Board is to consist of three members, appointed by the Governor for three years, one of them to belong to the minority party. No person shall be commissioner or hold any position under the commission who is connected in any way with any gas, electric light or water company, or owns stocks or bonds therein.

The board shall have general supervision of all corporations engaged directly or indirectly in the manufacture and sale of gas, electricity for lighting and the furnishing of water for domestic or fire purposes.

It shall have the same right to subpœna witnesses as a Court of Record, and the board may, upon the request of the local authorities, investigate the quantity, quality and price of gas, electric light or water, or may do the same on complaint in writing, signed by 20 customers in a city of less than 10,000 inhabitants or 50 customers in all other cities.

Upon the commissioners' own volition they may investigate the construction of all such plants, particularly those of water companies. After a hearing the board may order any reduction in the price of gas, water or electric light or any improvement in the quantity, quality or service thereof.

The annual salary of the chairman of the board shall be $5,000 and each of the other members $4,500. The secretary, who is to be appointed by the board, would get $3,600. The total annual expenses shall be borne by the corporations involved, proportioned by the Auditor General in the ratio of their net incomes.

THE DISMAL MUNICIPAL PLANT EXPERIENCES OF HAMILTON, O.

A TYPICAL instance of the troubles which fall frequently on municipal lighting plants is furnished by Hamilton, Ohio, where an order was given recently to discontinue the electric light plant because the city was out of funds for it and could only go ahead by borrowing a further large sum of money. The city owns waterworks started in July, 1884, which cost $315,000; gas works started in August, 1889, which cost $160,000, and an electric light plant started in October, 1895, which cost $100,000. This amount of $575,000 was raised by selling city bonds. The situation in Hamilton is an interesting and complex one, and we cannot do better than let the city clerk, Mr. M. O. Barns tell the story. He says:

"The threat of the gas trustees to shut down the electric light plant the first of the year demands some attention from the citizens of Hamilton. It is not assumed that the action of the gas trustees is caused by pique on their part, as much as to the fact they are out of funds.

"Hamilton of all the cities in the United States has been most afflicted with the 'municipal ownership craze' and now having its fill on theory is reaping the result of 'biting off more than it can chaw,' and we must bear and grin as best we can under adverse circumstances.

"But on the condition that now confronts us we ought to try and inject a little common sense into the 'municipal cranium' and try and evolve some scheme whereby we can 'kite' along for the present and perhaps realize some of the fond expectations that were held out in the past. We are deluded in the belief that we have cheap water, gas and electric light, but when we add to these luxuries the fact that we have so raised the rate of municipal taxation until it has become burdensome and then compare with other cities of our size we are not as well off as we think we are.

"We are taxed to pay the interest on the water works bonds as well as to provide for their redemption, but the city is furnishing free water for municipal uses which is a great point in its favor, while on the other hand we are taxed to pay the interest of the gas works and the electric light plant, as well as to provide for the redemption of bonds but we are also taxed for the purpose of 'lighting the corporation' which is nothing more than double taxation. This is a curious situation, but is nevertheless true.

"While the water works tax levy is up to the limit it fails to pay the interest and bonds falling due and the same may be said of the gas and electric light levy, and they also barely pay the interest charges, with no bonds yet falling due. When they do commence to fall due, how they are going to be paid is a serious question. We should realize that the annual interest charge for water works is $15,500; gas works, $7,500, and electric light, $5,000, making a total of $28,000 with $10,000 of water works bonds falling due each year, making a total charge of $38,000 which must be paid annually, and as no assistance is rendered by either of said plants in helping to pay said charges it looks like the city is carrying a heavy burden.

"This leads to a point where some attention should be paid to doing something that would in a measure help the city out of this dilemma.

"If these plants were owned by a private corporation they would certainly be made to pay at least the fixed interest and bonded indebtedness charges or else go into liquidation.

"The city ought to be able to make them do the same as private individuals could do, and backed by the loyalty and patronage of its citizens, they at least ought to be able to pay, say, the interest charges, amounting to $28,000 a year, and in doing this taxes could be reduced about $3 per thousand, and thus give the city a chance to make other improvements that have been neglected for want of funds. The city has reached the condition that comes to every individual who reaches out beyond his means. Maturity comes and protest has been avoided during the past year by using heroic remedies. Refunding bonds as they fall due may be in the opinion of many good financiering but that does not pay the debt or discharge the interest which creeps along just the same as the bonds fall due and which must be paid. Hamilton is being devoured whole by its interest charges. During the coming year the interest owing by the city will amount to the sum of $43,035, bonds falling due $48,000, or a total of $91,125, or nearly 90 per cent. of the entire revenue of the city will be necessary for meeting charges.

"If little higher water, gas and electric light charges could lighten the rate of taxation it should be tried, as the time has come for heroic measures. We have had theory long enough, and we must meet the condition.

"This brings us down to the position assumed by the gas trustees in regard to the money they have on hand and which they refuse to use for the electric light plant. They ask for $15,000 and say if the people vote for the issue they will buy the bonds with the money they have on hand. In other words they want to rob Peter to pay Paul. They want to compel the city to pay interest on its own money; they want to increase the bonded indebtedness of the city as well as the interest account.

"Their position is not well taken, however sincere they may try to appear to the public. If they have money to loan to the city they should do so and not ask the city to pay interest for it as the city has never asked them to pay interest on the $15,000 loaned them to start their plant, or even pay the bonds as they fell due. If they have this surplus they should be compelled to pay it back into the fund of the city and then the city will give it to them again to run the electric plant.

"They claim they must pay the bonds as they fall due, but if they don't or can't, the city must. The water works did it once or twice and then failed and the city stepped in and took up the 'thread' where it broke off.

"A special election advertising it and selling and printing the bonds will cost close onto $800, and it is very doubtful if the citizens will vote any more bonds and this money—nearly a year's interest—would be thrown away.

"The gas trustees should use a little common sense and come down from their high horse and use a little reason and this matter can be amicably adjusted. The gas trustees by law are charged with lighting the corporation and they must do it. The electric light plant was built for the same purpose as the gas works and the consolidation of the two plants makes them one in the eyes of the law, and the trustees can't draw the line and make a fine hair distinction."

MUNICIPAL PLANT CARELESSNESS COSTS JACKSONVILLE, FLA., $1,500 IN AN ACCIDENT SUIT.

In an action brought against the city of Jacksonville, Fla., for accident damages, the local United States Court has just awarded a decision for $1,500, which amount is added to the city indebtedness. The complainant was sent late on the night of March 13, 1896, to deposit letters in a United States letter box. As he came to the place where the box had been for a long time located, he stepped and fell into an excavation, which the city, through its agents or employés, had dug at the place, and which had been negligently suffered and permitted to remain open and uncovered. The excavation had been made within the curb line of the street, and was about three feet in diameter, and five feet deep. The claim was also made that the city electric lights in the vicinity were not burning as usual that night, and that no notice was posted to warn pedestrians of any danger in the excavation. The result of the fall in the dark on the plaintiff was to wrench and sprain his right ankle and severely to sprain the lumbar muscles of his back, from which injuries he suffered seriously and was hindered from the discharge of his customary duties. In addition, he claimed to have expended considerable sums for physicians' services and medicines.

The jury found the case to be proven against the city and brought in a verdict for $1,487.

OPINIONS FROM LEADING MEN AND COMPANIES AS TO MUNICIPAL PLANTS.

We have received from leading companies and from prominent men in the electrical field interesting expressions of opinion on the subject of the municipal ownership of electric light plants. The attitude thus shown toward the subject is of considerable importance.

Mr. S. D. Greene, general manager of the Lighting Department of the General Electric Company, writes:

In reply to your recent inquiry I beg to state that the position of this company with respect to municipal ownership of electric lighting plants has been consistent since the organization of the company. We have always opposed such ownership, not because we believe that a city can be better and more economically served by a private company (under proper regulations and restrictions), but also because we see no more reason why municipal ownership should apply to electricity than to the supply of gas, fuel or any other commodity necessary or useful to the citizens of such city. Private enterprise and capital are always more keenly alive than municipalities to improvements in machinery or methods of manufacture of such a commodity as electricity, and existing competition affords the best possible stimulus to the introduction of such improved methods in order that the cost of production and price to consumer may be reduced.

It is, of course, obvious that a duplication of investments in illuminating plants is undesirable from every point of view, and the establishment of commissions, or the adoption of any other means to restrict such duplication of properties, is to be commended. The inevitable result of such duplication must be to destroy absolutely a considerable portion of such investments, or to place upon the community the burden of high charges required to pay interest on such extraordinary investments. Because of this, we firmly believe that franchise privileges should be very carefully guarded, and that municipal ownership should never be encouraged upon any other basis than that of acquiring the properties already established by municipal encouragement and authority.

We strongly favor a commission, such as the Board of Gas Commissioners of Massachusetts, which has established strict rules with reference to the conduct of local gas and electric light companies, such as increases in the issues of stock or bonds, etc., but which also protects these companies, where they are honestly and properly administered, by refusing to grant franchises to new competing companies which will threaten or destroy the value of the securities of the companies already doing business. The result is that the securities of both the gas and electric light companies of Massachusetts are steadily appreciating in value, the citizens of the cities and towns have good service at reasonable rates, and investors buy the securities of these companies because they feel that the companies are assured of a reasonable future business. At the same time, if the citizens of any particular locality desire to acquire a municipal plant they can do so under the State laws, provided they first acquire existing local plant or plants at a fair valuation.

We do not believe in attempting to hamper the citizens of any city in the exercise of their undoubted right to have their electric lighting furnished as they choose, but we do believe that no city should be allowed to install its own municipal plant where there already exists a private plant or plants operating under franchises, and which are giving good service at reasonable rates, without acquiring such plants at a fair valuation. The stockholders of such a local company, who have invested their money in good faith, on the assumption that the city will protect them under the franchise which it has granted, are certainly entitled to reasonable consideration.

Prof. S. H. Short, of the Walker Manufacturing Company, Cleveland, Ohio, says: I have noticed the agitation in the various papers with reference to the municipal ownership of electric light plants, along with the agitation for the municipal ownership of electric railways, and everything that is owned by private corporations which secure franchises from municipalities. I do not believe that as good service can be secured, or that the service would be as economical, if the electric light plants were owned by the cities, as when owned by corporations.

I, therefore, do not believe in the municipal ownership of electric plants, and would not recommend that this subject be considered favorably. The tendency to change officials and employés with every change in the political aspect of the Council or Board of Control, would probably bring a change in the management of the electric plant, which would very much decrease its efficiency.

Prof. J. P. Barrett, the superintendent of city telegraphs of the city of Chicago, writes us: "In response to your inquiry of the 29th ult., regarding my views on municipal and corporate lighting, I would state that I thoroughly believe in municipal ownership of street lighting. It is also my opinion that the city should have the right of furnishing current to its citizens as a precautionary measure against extortionate rates charged by private corporations. Where, however, fair rates are charged, I think it proper to permit private corporations to retain such privileges."

ST. JOSEPH, MO., SELLING ITS PLANT.

After an unsatisfactory experience with its municipal plant, St. Joseph, Mo., is now selling out. The St. Joseph Light, Heat and Power Company has submitted a proposition to the council to purchase the city's lighting plant and to light the city. The proposition, is to pay the sum of $60,000 for the plant, in twenty annual installments of $3,000 each, and to furnish electric street lighting at the rate of $85 per lamp per year for 400 2,000 candle-power lamps, and at $75 per lamp for all over that number. The proposition was referred to a committee of eight aldermen, the mayor, counselor, engineer and comptroller, and the Commercial club is requested to delegate eight of its members to act with this committee. The plant cost $90,000.

DETROIT MUNICIPAL PLANT COMMISSIONERS OPPOSE PRIVATE LIGHTING.

So far as the Detroit lighting commissioners are concerned, the proposition made by Mayor Pingree in his annual message to the council that the city go into the private lighting business, does not meet with substantial encouragement. In fact, some of the commissioners express themselves as unalterably opposed to such an undertaking. The reasons given are numerous and cover a good deal of ground. The most outspoken member of the commission is J. L. Hudson. His position is that the city has no moral right to enter into competition with a legitimate and established private enterprise, as he considers the business of furnishing light to private consumers. Speaking about the subject, he said:

"There is more than $1,500,000 invested in lighting plants in this city by private individuals and I think the city has no more right to announce to the public that it will furnish light to their customers at what has been stated as the present cost than it would have to go into any other branch of the mercantile business on the same basis. This capital has been invited to the city, and I should not be in favor of throwing cold water in its face. The city should furnish its own lights, as many large private consumers do, but I think it should go no further. So far as private economy is concerned, I think it would be wise if every consumer who uses over 100 lights would put in his own plant and furnish his own light."

Commissioner R. H. Fyfe was opposed to the recommendation on entirely different grounds, although he stated that the rights of the present lighting companies should be considered when the matter comes up for final adjustment. His position was that the city could not extend its present system without largely increasing the expense of the product and that, considered solely as a business venture, the city would make an unwise move in going into private lighting. He said:

"If the city should extend its lines over a greater district, and, after going to all the necessary expense, be obliged to depend on making collections from small consumers to meet its expenses, the cost of furnishing light would be so greatly increased that the consumers would gain but little. The time may come when the city may profitably go into commercial lighting, but I am firmly convinced that the time is not now. We are at present furnishing light only where our returns are sure and the current sent out is steady. To connect the system with a countless number of small consumers, who would use one light part of the time and a dozen another part, is an undertaking the extent of which cannot be accurately estimated. It would necessitate laying an immense amount of wire underground, entailing a correspondingly large expense. Of course, we could do nothing in the matter without State legislation, and I hope none will be enacted at present."

Commissioner Farrand said: "I don't think we should do anything in the matter at present, although something of the kind may be advisable later. There are so many points that necessarily enter into an intelligent consideration of the case that a man cannot express a valuable opinion off-hand. At present we are extending the system to furnish light for some of the more remote city engine houses and it may be that in connection with this work, commercial lighting may at some future time be practicable and advisable. At present, however, I do not think we should rush into the venture."

A STRANGE MUNICIPAL PLANT EXPERIENCE OF HUDSON, MASS.

It is a strange experience which Hudson, Mass., has had with the question of municipal lighting. It has just been compelled to purchase for over $15,000 the plant of the Hudson Electric Light Company, and go into business on its own account and against its will. This comes about as the immediate result of a decision of the Supreme Court after litigation extending over three or four years.

Almost immediately after the Massachusetts municipal lighting law was passed in 1891, Hudson took steps to manage the business. Under the law, a town which votes to do its own lighting must buy the plant of the existing private corporation when there is one, at a valuation to be fixed by commissioners appointed by the Supreme Court. But the law was so framed that unless a town is very very careful about respecting other people's rights it is likely to find itself with an elephant on its hands in the form of a plant which it will not pay to operate.

If the town petitions for a schedule of the plant with the price at which it can be bought before formally deciding that it will go into the business, the company is obliged to furnish the desired information. Then after investigation as to the wisdom of embarking upon the enterprise, the town may vote to do as it sees fit, to buy the plant or not to do so. If it votes to buy the company has no option, but is obliged to sell and go out of business as a private corporation.

But if the town once votes to make its own light, thereby committing itself to the purchase of the existing plant, it appears to be settled that it cannot reverse its decision, and the corporation in turn can then compel the town to purchase at a valuation determined by the courts.

This has been Hudson's experience. Possible without fully comprehending the binding effect of such action, it voted at two town meetings in 1891, on July 1 and again on September 2, in favor of going into the municipal lighting business. Then, after investigation, doubts were expressed as to whether it would pay to purchase the plant of the Hudson Electric Light Company, and so on November 11 a town meeting voted not to embark on the project.

A committee, however, was appointed which reported to the town meeting March 8, 1892, that "in case the town does not desire to operate its own plant, it pass a vote that it will take no action toward the establishment of a plant before May 1, 1897; provided the owners of the existing plant will, within 60 days of the passage of such vote, file in the town clerk's office a waiver and renunciation of all rights, if any, acquired by them by reason of the passage of the town two votes."

A motion to reject this report and to buy the plant was defeated in town meeting by a vote of 79 to 73 and the report was then adopted and approved 80 to 72. But the company, which, by the way, is a Maine corporation, made no such waiver as the town desired it to do. On the contrary it immediately began proceedings in court to compel the town to buy its plant. The town voted to resist these proceedings and engaged counsel.

The court appointed commissioners to set a price upon the plant, and their decision was that the town must pay the electric light company something over $15,000 and take the plant. The valuation set by the company upon its property was about $18,000.

LYNDONVILLE, VT,. PAYING HIGH FOR ITS WHISTLE.

At the Lyndonville, Vt., village meeting on January 28 a resolution was adopted issuing $49,000 in electric light bonds payable in 1913 and 1927. As the bonds sold at 90, this left a deficit of about $5,000, and as this money is needed at once the trustees were authorized to borrow this amount and give a note for the same.

LANSING, MICH., ENGAGED IN "WHOLESALE LARCENY."

Mayor R. C. Ostrander, of Lansing, Mich., has written a sharp article in the Lansing "Republican" on the subject of the municipal electric lighting plant, which he says has now cost all told $106,000 and is far from being worth any such amount. According to him the situation is rather blue. He points out that the city is not selling to the private consumer the quality or value of light that it charges him for, and he says emphatically:

"In thus doing business, the city is really engaged in wholesale larceny. You see, too, that it is impossible to tell what it would have cost the city to furnish the light which it fairly undertook to give the consumer."

Mr. Ostrander goes on to discuss the situation and sums up tersely as follows: "I have said that private lighting should only be undertaken by the city for gain. I did not mean by this that necessarily the account for the year should show a large amount of receipts over expenditures. The plant is operated for gain quite as much when it furnishes its customers good lights at low prices, the consumer being given the benefit of increased efficiency and low cost of operation.

"If the question was now for the first time presented whether the city should embark in the business of furnishing commercial lights, I should most assuredly say that it should not. But we are confronted by a condition. We own the plant, poles and wires. We must either maintain the business or sell it. We cannot hope to sell it for anything like its cost. It seems advisable, therefore, to continue to sell lights if we can do so without loss. I use the word 'loss' in the sense of actual loss. That is to say, the plant ought not only to be operated without loss, but the receipts from the sale of commercial lighting should be equal to the cost of operation and all charges for diminution in value of the plant. If the city cannot furnish a good light to its customers at as low a price as a private corporation could furnish the same light, it ought to go out of the business and charge the loss up to experiment fund.

"Reconstruction of the system, so far as it relates to commercial lighting, has begun, and evidently it must continue at considerable cost."

MASSACHUSETTS TOWNS NOW WANT TO BUY STREET CAR LINES.

There was introduced in the Massachusetts House on February 6 a petition which will be regarded as a most important one, from the names upon the paper. It asks the Legislature to give cities and towns through which street railways pass the right to take these properties, construct, own and operate street railways, on any part thereof. The petition asks that the management of the roads taken may be vested in such persons as the railroad commission or governor and council may select, or in a special board to be created for the purpose.

The petition is signed by Robert Treat Paine, Thomas Wentworth Higginson, Edward F. Hale, Josiah P. Quincy, Edwin D. Mead, Frank Parsons, W. L. Rutan, K. K. Foster, Harry Lloyd, F. C. Coffin, Mr. Cox, of Melrose, and some others.

It is also said that later petitions will bear the names of Harvey N. Shepard, Levi N. Gould and other prominent men.

MARQUETTE, MICH., PLANT WANTS $35,000 MORE FOR A WEAK DAM.

The unexpected nature of the heavy charges that may come upon a city plant, as well as the part they may play in local politics is indicated by the subjoined from the "Marquette Journal" of January 30.

Electric Light and Power Commission No. 3 has depleted its treasury in making cribwork at the dam with the expectation of keeping the structure from washing out in the spring. It has been working several months on plans for the permanent improvement, and is getting its work in a shape where it will soon be able to report to the council and make a recommendation.

It intends to make this report while the present councilmen are in office and it is sure of its friends rather than to wait till after election, and take a chance on finding more friends among the newly seated aldermen. Perhaps a more potent motive than this is that the board will have its plans ready and will prefer to make a recommendation as soon as it can, so if they meet approval, money will be voted and work can be begun early in the spring.

The board now in office expects to do the work more economically than its predecessor figured it could be done for. Part of this saving comes in the use of the Jacobs dam, which the No. 2 board planned either to tear down or abandon, and by the use of material which has already been purchased, and is now lying on the ground or is in various parts of the work which will have to be rebuilt. The board expects to effect a further saving on the purchase of material buying from first hands.

It is understood that the board wants $35,000, and as its own fund is depleted, and there is no other fund out of which this could come, the council must needs be asked to submit a bond proposition to the city at the coming election. This may furnish an issue for some of the half dozen mayor candidates to stand upon.

HOW POLITICS GOT INTO THE MIDDLEBORO, MASS., MUNICIPAL PLANT.

The committee on manufacturers of the Massachusetts legisture gave a hearing recently on a petition of persons in Middleboro who are dissatisfied with the way the electric light plant in that town is run. It is a municipal plant, and the removal of a former manager, Mr. Mayne, seems to have created a good deal of the trouble. When Mr. Mayne was removed, J. B. Ryder was chosen manager. Mr. Mayne told the committee that Mr. Ryder had never had experience in running the plant, and knew nothing about electricity.

An ex-member of the board of commissioners, Mr. Wood, said the plant was run more in the interest of politics than for the interests of the town. He said two members of the board had elected Mr. Ryder manager, he being a member of the board and voting for himself. He said he was opposed to a member of the board being elected manager anyway.

He favored the passage of the bill offered by Mr. Pratt, of Middleboro, to provide that members of municipal light boards shall not hold office of manager by appointment of such boards. He was opposed to the election of any man who had no qualification for the position.

Mr. Ryder defended himself and said there had been no complaint made as to his conduct of the office. He knew of no abuses. Henry Wilkins, manager of the Marblehead electric light plant, objected to the bill and so did J. B. Litchman, chairman of the Marblehead light board.

Eugene Le Baron of Middleboro favored the bill and said no man should be placed in the position of having to pass upon his own acts as manager, as he must, if a member of the board.

CITY PRIVATE LIGHTING AT TACOMA, WASH.

An attempt was made some time ago, by Tacoma to nearly double the present rates for electric lights, but when the ordinance was brought before the light committee of the council it refused to recommend it. Then other plans were laid, but none of them seemed to give satisfaction, for the reason that all of the proposed rates would permit the opposition company to compete with the city.

Many claim that if the city raises its rates more than 10 per cent., it will lose 90 per cent of its commercial business, while, if it would only run the plant as a plant ought to be run, it could pay all charges for operating as well as interest on its bonds.

HOW NEW YORK CITY GETS ITS STREET LIGHTS AT BARE COST.

In his interesting annual report for 1896—97 referred to elsewhere in this issue, vice-president R. R. Bowker, of the Edison Electric Illuminating Company of New York City, says, with regard to the city street lighting: The lighting of Fifth avenue on the Edison system had given such general satisfaction that last year, at the request of citizens and of the city authorities, this service was extended to a portion of Madison avenue, from Fifty-ninth street to Seventy-second street, which was not lighted by electricity. This year the insistent requests of the residents of Madison avenue for the extension of that system south to Twenty-third street, have resulted in an arrangement with the city authorities under which Madison avenue, from Twenty-third to Seventy-ninth streets, as well as Fifth avenue from its beginning to the same streets, will be lighted by the Edison-Bowker two-arc system, which will also be extended to some of the wider cross streets. The Commissioner of Public Works, who made during the early winter a visit of inspection abroad, reported on his return that "no street lighting in Paris or London excels the Edison lamps on Fifth and Madison avenues for beauty or illumination." This form of lighting is, however, somewhat more costly than other electric lighting throughout the city and, in co-operation with the city authorities, a system of single lamps for street service will be installed in other streets where there are Edison mains, to the extent of about 200 additional posts. The price made to the city is below the actual average cost of current to the company, but the hours of burning are unusually long, giving employment for the station equipment during hours when there is little demand upon it, and this fact, conjoined with recognition of the fact that the city should enjoy the benefit of the best possible rates from a corporation making use of the public streets, has justified a price very much below that necessarily charged for commercial lighting.

THE FIGURES OF THE BROOKLINE, MASS., INVESTIGATION.

EXTENDED reference was made in The Electrical Engineer of Jan. 20 to the official report submitted to the City of Brookline, Mass., by Mr. Nathan Matthews, Jr. In connection with the present discussion in the columns of this paper, we now give the two tables embodied in the report and the conclusions arrived at after the full discussion of all the data:

TABLE OF ANNUAL COST, BROOKLINE, MASS., REPORT.

Estimated by	Capacity of Plant.	No. of Lights Run.	Labor.	Fuel, Materials, Repairs, etc.	Insurance Against Fire and Accidents	Depreciation Fund.	Interest. Account.	Total.	Total Cost per Lamp.
W. Jackson	500	250	$10,236	$8,305.00	$1,200.00	$11,108.26	$6,609.48	$37,458.74	$149.83
"	500	375	12,836	11,857.50	1,285.00	12,855.39	7,308.36	46,142.25	123.04
"	750	500	15,280	15,710.00	1,650.00	17,796.30	10,006.52	60,442.82	120.88
Stone & Webster..	375	250	10,236	9,308.75	606.60	6,782.26	3,567.34	30,500.95	122.00
"	500	375	12,836	13,364.95	792.22	9,365.39	4,869.88	41,228.44	109.94
"	750	500	15,280	17,717.50	1,044.12	12,639.52	6,639.69	53,320.83	106.65

With regard to a list of certain "economical' plants, Mr. Matthews gives the following:

TABLE SHOWING ALLEGED AND REAL ANNUAL COST PER LAMP OF CERTAIN MUNICIPALITIES.

Town or City.	Number of Lights.	Candle Power.	Alleged annual cost.	Real Annual Cost.
Bangor, Me. (a, b)......	150	2,000	$48.00	$79.00
Lewiston, Me (a, b).....	100	2,000	55.00	65.50
Peabody, Mass.	150	1,200	62.00	100.05
Bay City, Mich..........	181	2,000	58.00	76.25
Goshen, Ind. (b)........	240	2,000	77.00	111.54
Bloomington, Ill. (b)....	240	2,000	51.00	93.64
Chicago, Ill	1,100	2,000	96.00	181.83
Elgin, Ill.	98	2,000	43.00	100.73
Aurora, Ill. (b)..........	200	2,000	70.00	87.57
Fairfield, Iowa (b)......	16	2,000	70.00	117.16
Ypsilanti, Mich. (a).....	88	2,000	36.00	77.84

a. These plants are run by water-power.

b. These plants are operated in connection with other works.

"Of the above municipalities only two—Bangor and Chicago—run their lights all night throughout the year. The rest run on schedules—moonlight and other—amounting to from one-half to three-quarters of the standard all-night schedule time."

In his conclusions Mr. Matthews says:

(1) The probable cost of a first-class plant sufficient to supply street lights to the number of 375 with a reserve capacity of 125 more could be built on the overhead system upon suitable land now owned by the town for about $121,000.

(2) Such a plant could be operated at an annual cost, including interest at 4 per cent. on the total investment and a depreciation fund sufficient to renew the entire plant every ten years, for about $41,000, or about $110 per lamp per annum.

HOUSTON, TEX., PROPOSES TO SELL LIGHT.

Alderman G. C. Street, who has been handling the correspondence for the city council on the subject of the city erecting and owning its own electric light plant, has received several letters and propositions from parties in that line. He is introducing a resolution to issue $100,000 of bonds for the erection of such a plant. He also said that from the best information his researches had brought, the city could build a plant for that sum, and in four years the amount saved from the price now being paid for lights by the city would pay for it. His idea was that the city would furnish not only its own lights, but supply them to patrons, and also supply power, which would increase the value of the plant to the city. He also stated that the council would likely push it through as rapidly as practicable.

MUNICIPAL PLANT POLITICS AT GRAND HAVEN, MICH.

A dispatch from Grand Haven, Mich., of February 10, says: The city has been operating its electric light plant under the control of the board of public works, subject to the approval of the council. The board and council have quarreled over the city electrician, who has resigned. Another was elected. The board accuses the council of desiring to put men in charge of the electric light plant who are related to certain aldermen.

The council accuse the board of trying to create liability without reference to the council, and have instructed the city treasurer to pay no bills not approved by the council.

Meantime the spring elections are anticipated and merry times are promised.

A CITY PLANT AS A "CULPABLE LUXURY."

There has been a good deal of discussion lately as to what constitutes "culpable luxury." The little town of Stockton, Mo., appears to have settled that point, to its own satisfaction at least. It is selling its electric light plant and will return to plain and unpretentious petroleum. The town was going to do wonders with the plant and make money enough to do lots of things, but the fond dream is over. The Kansas City "Star" says that the plant is "a luxury that the present hard times will not stand."

ELECTRIC LIGHTING FOR CARACAS.

The municipality of Caracas, the capital of Venezuela, according to the Monthly Bulletin of the Bureau of American Republics, has recently made a contract for the establishment of an electric lighting plant there. The contract requires the installation of 400 arc lights in the streets, squares and public places of the city, and 500 incandescent lamps for the municipal buildings. In addition to the installation referred to above, the national government has ordered 1,000 incandescent lights for the public edifices, and 100 arc lights to be placed in the Paseo de la Independencia, which is the famous drive of the city.

The motive power to be used will be water, taken from the falls of the Macuto River, which are estimated as being capable of producing 6,000 h. p. The water will be concentrated at a height of 2,600 feet above the turbines, it is said, being the highest utilized waterfall in the world, exceeding the famous Comstock mines of Nevada, which has a vertical fall of 2,100 feet.

LOWELL, MASS.—The Lowell Electric Light Company is running 695 arcs and 14,000 incandescents and is furnishing 818 horse-power of motors to 110 customers.

BUFFALO, N. Y.—The Cataract Power and Conduit Company has asked for a six months' extension of its time for being ready to deliver 10,000 horse-power in the city by June.

OF A HIGH ORDER.—The Electrical Engineer, published in New York, is now 16 years old, and celebrated its anniversary, says the "Western Mining World," by issuing what it termed a Crystal number, of 132 pages. This is no doubt the largest single magazine ever published devoted exclusively to electricity. Its contents are of a high order and very instructive to the layman as well as the electrician. The price of the issue is only 10 cents and any one at all interested in electricity should send for one.

THE ENCLOSED ARC LIGHT.—IV.

BY L. B. MARKS, M. M. E.

EFFICIENCY OF THE ENCLOSED ARC.—On a previous occasion I published some curves showing the relative radiant efficiency of the enclosed arc, one of which curves I will reproduce here for you in contrast to the efficiency curve of an average open arc.

Referring to the diagrams, Figs. 7 and 8, the dotted line curves indicate the relative luminous and total radiation of the lamp at various angles below the horizontal is given in the heavy line curve which therefore represents the radiant efficiency of the arc. In the case of the enclosed arc the measurements are given for a clear glass enclosure; in the case of the open arc the readings are given for the naked arc, no globe having been used. The mean hemispherical efficiency of the enclosed arc was found to be 8.4 per cent.; that of the open arc for the same current was 11.7 per cent. It will be noted that the efficiency curve of the enclosed arc differs materially from that of the open arc, the distribution of light in the former being more uniform than that of the latter. In the enclosed arc the change in efficiency from 20 to 60 degrees is inconsiderable, while in the open arc the change is decidedly marked, the curve taking a very sharp turn at about 40 degrees.

The figure which I have given for the efficiency of the naked arc is much higher than that of the average naked arc in service in the United States. From tests which I have made, it is safe to say that as commercially operated the average efficiency of the open lamps falls considerably below 10 per cent. without deducting the loss due to the interposition of a clear or translucent glass globe. When we consider the case of an open in-door lamp with an opal globe such as used extensively in this country and compare the same with that of an enclosed arc lamp as commercially operated, the relative radiant efficiency measurements as given above do not represent the true relative illuminating powers in the two cases. With the open arc for in-door illumination it is necessary to soften the light, in other words, to enlarge the area of the source of illumination. With the common opal globe it is found in practice that from 40 to 60 per cent. or more of the light is necessarily cut out in obtaining the requisite distribution just alluded to. With the enclosed arc, on the other hand, where a thin outer globe is used, this distribution can be obtained with a loss of not more than one-half of that in the case of the open arc, especially when the inner bulb of the enclosed arc is made of a slightly translucent glass.

The conservation of heat in the enclosed arc makes it possible to operate a carbon of given diameter at a relatively higher efficiency than in the open arc. Thus a carbon 11 mm. in diameter operated in the enclosed arc lamp at a current of from 4 to 5 amperes, will give about the same efficiency relatively as a carbon 8 millimetres in diameter operated at the same current in an open lamp. This makes it possible to use a carbon of large diameter more efficiently in the enclosed lamp than in the open lamp. It is found, however, that with with these small currents it is inexpedient for several reasons to use carbons appreciably larger in diameter than the size quoted above.

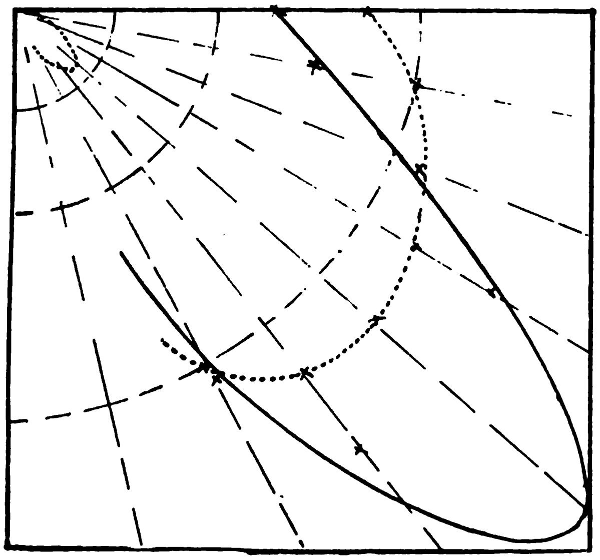


FIG. 7.

First, with the larger carbons the radiation is more rapid and the temperature is decreased; the efficiency being a function of the temperature is therefore also decreased. Secondly, the amount of light cut off by the carbons themselves when the latter are large in diameter becomes considerable; this applies especially to the rays cut off by the flattened tip of the negative carbon.

Thirdly, the coating of the internal surface of the enclosure cuts off light in proportion to the thickness of the deposit. It is well known that all carbons contain a small percentage of impurity consisting chiefly of silica. When the carbons are consumed in the open arc, this silica passes off into the atmosphere. When the carbons are consumed in the enclosed arc, the impurity settles in the form of a thin coating on the internal surface of the enclosure. Although the amount of this deposit is very slight when the carbons are burned only for a short time, the amount of light cut off becomes appreciable when the coating thickens. It has been found in commercial operation in the United States, that after 100 hours' burning the decrease in the illuminating power of the lamp due to formation of this coating is not noticeable by the consumer; after about 150 hours, however, the decrease in illumination becomes objectionable and it is necessary to wipe out the enclosing bulb. Now with a pair of carbons 12.7 mm. (½ inch) in diameter, the life as shown in the test which I have cited is about 200 hours. As a result of this long burning the light efficiency is cut down to an objectionable extent; hence in this case we are using a large carbon at the sacrifice of efficiency from all three standpoints mentioned above.

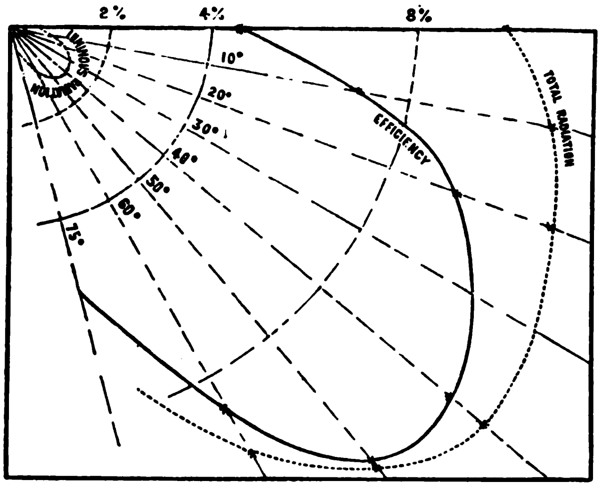


FIG. 8.

LIGHT; ITS DISTRIBUTION AND DIFFUSION AS RELATED TO QUALITY AND EFFICIENCY.—III.

By E. LEAVENWORTH ELLIOTT.

In 1857 M. Degrand took out patents for improvements of Fresnel's invention, and worked out various methods of applying the principle to street lighting. His improvement in the Fresnel lens consisted in pressing the glass in one piece, instead of forming each ring separately—a much cheaper method, but not capable of producing sufficient accuracy for lighthouse purposes. Degrand also appears to be the first to have pointed out the use of glass ribbed with double-reflecting prisms, in place of metal or silvered glass reflectors. His schemes were scientific and ingenious, but were never carried out, possibly on account of their expensiveness at that time. He made no attempt to secure diffusion.

The next step in this line was made by Mr. A. P. Trotter, an English engineer. He took for his problem the uniform illumination of the ground within a circle having a diameter equal to seven times the height of the light-source. To secure this result he used a polygonal lantern, having panes of ribbed glass for the sides, and silvered reflectors for the top. The side panes were ribbed on both sides—the outside horizontal ribs having profiles calculated to distribute the rays by refraction, so as to produce uniform ground illumination, and the interior vertical ribs calculated to produce a certain amount of diffusion by spreading the rays laterally. Here again the expensiveness and complicated construction seem to have prevented its practical use.

A curious idea, theoretically good but practically useless, was brought out by Fredureau in 1891. It is chiefly interesting as being the only recorded attempt to change the quality of the light by means of a globe. His ideas of the results obtainable, however, are strangely erroneous. In describing his invention, he speaks of "the employment of transparent or translucent simple or multiple envelopes—filled with colored or colorless liquid—placed around the source of light. If a source of light be placed within the envelopes filled with a suitable liquid pervious to the rays of light, the light obtained will be diffused, and acquire greater illuminating power, while at the same time becoming more pleasant than if it proceeded from the source of light directly." It is difficult to see how light can be made to "acquire greater illuminating power by being passed through glasses and liquids." He says again: "It should be observed in conclusion that special liquids may be used whereby the light produced will acquire certain peculiar physical and chemical properties, which may prove of great service in many cases; for instance, in the various manipulations connected with photography." In a later specification he seems to have followed this same idea of being able to change the nature of the ethereal vibrations. He proposes to use prismatic rings in such a manner that "The most refrangible rays of the light produced by the voltaic arc (owing to which this light so painfully affects the eyesight) disappear within the said envelope or casing and a whiter light only is allowed to come forth on the outside. The least refrangible rays of incandescent electric lamps diverge generally speaking in the direction of the horizon, so as to allow a whiter light to pass into the cone below. As the result of these effects, the light diffused according to this invention is by far the more pleasant to the eyesight than ordinary electric light, and much more nearly resembles daylight, owing to which fact it will prove particularly suitable for nocturnal photography."

The augmentation of the chemical effect of light by cutting off the "most refrangible," i. e., actinic rays, either by absorption or dispersion, is paradoxical, to say the least. Leaving these claims out of the question, however, his latest globe is of some practical use as a reflector. The outer surface is covered with horizontal prismatic rings, having the upper face of each calculated to keep the rays below the plane of the source. They produce practically no diffusion, and appear luminous in a vertical meridianal band, instead of making the light source appear "equal to the envelope in size," as the inventor claims.

THE KELLY STATIC GROUND DETECTOR.

ONE of the constant vexations of central station operation is the detection and location of grounds. The placing of ground indicators in direct contact with live circuits has the disadvantage of placing a constant strain on the insulation and at the same time entailing a constant waste of current passing through the instrument. To obviate both these difficulties, Mr. John F. Kelly, of the Stanley Electric Mfg. Co., of Pittsfield, Mass., has designed a very simple and unique static ground detector which has proved highly efficient in practice.

This ground detector, shown in perspective in Fig. 1, is essentially a differential static voltmeter made up of four vanes fixed to a base and a movable vane carrying an index or pointer. The movable vane is made of sheet aluminum mounted on a shaft and held centrally, by two jewelled bearings, between the fixed metal vanes. The diagonally opposite fixed vanes are connected in pairs and each pair is statically charged from one pole of some source of electrical supply. The movable vane which is connected to earth is inductively acted upon by each pair of fixed vanes so that the stress produced by each is equal but opposite. The movable vane in consequence takes a position equally between the fixed vanes which position is, theoretically, the same whether the instrument is charged or not, and is the position of "no ground," the pointer pointing to the zero of the scale.

If one pair of fixed vanes and the movable vane are electrically connected, they are charged of like character from one pole of the source, the other fixed vanes being charged of opposite character from the other pole. The action of the similarly charged vanes is to repell the movable vane while the action of the other fixed vanes is to attract it. The two forces acting in the same direction, the movable vane takes the position entirely within the oppositely charged vanes, the pointer pointing to the side of the similarly charged vanes and pointing to the position of "ground" for that side.

The static ground detectors are made in three types: Type A, for use on any two-wire or four-wire circuits of any electromotive forces over 500 volts and under 5,000 volts, and for three-wire three-phase circuits of the same voltages. Type B, is similar to Type A except for electromotive forces of 5,000 volts and higher. Type C, for use only on three-wire two-phase circuits and for electromotive forces over 500 volts and under 3,000 volts.

The general appearance of all instruments is the same, the various types differing only in detail. There is no connection through any of the instruments between the line wires or between either of the wires and earth. It is not necessary to first introduce a temporary ground on the line in order to test for an existing ground, the characteristic of the old forms of ground detectors. This feature is of great importance as it insures greater safety to linemen and lessens the possibility of short circuits in the instrument itself. The instrument consumes no energy and may be left continuously in circuit, indicating grounds as soon as they occur. An instrument for each circuit may, therefore, be used to great advantage.

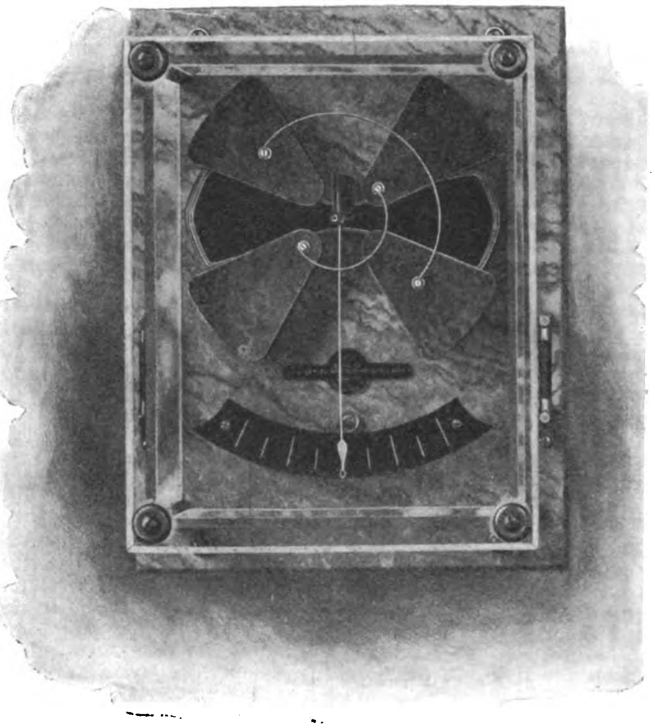


Fig. 1.—The Kelly Static Ground Detector, Stanley Mfg. Co.

In places where severe lightning storms are frequent and where the line is not adequately protected by lightning arresters, it is advisable to disconnect entirely the ground detector or open the "permanent ground wire" during such storms. The first may be done by the commutating switch D, or by the ground plug and cable, A.

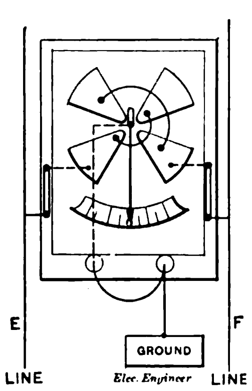


Fig. 2.

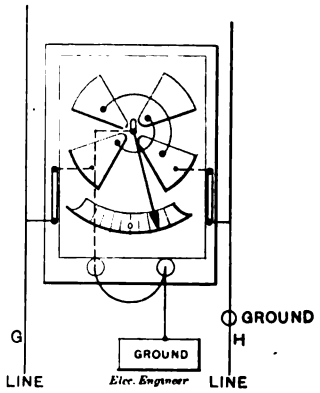


Fig. 3.

Type A is mounted on a separate marble base or directly on the switchboard. It is entirely covered by a case of plate glass, and all parts are perfectly insulated from the operator. The line wires are connected by small terminal plugs through removable fuse blocks, C C, on either front or back of the instruments, to the fixed vanes. By inserting a commutating switch, D, between the line wires and the instrument, it may be transferred safely and quickly from one phase to another or to any one of any number of circuits.

Fig. 2 shows the instrument in circuit with no ground on line, while Fig. 3 shows its position with a ground on the wire at H. Fig. 4 shows the detector in circuit, showing the method of testing when there are grounds on several circuits. Here A shows the ground plug and cable; B the shipping attachment, which holds the pointer in place during transportation, but is taken off when the instrument is set up; C, the fuse; and D, the commutating switch. When testing, the index on the commutating switch indicates the circuit.

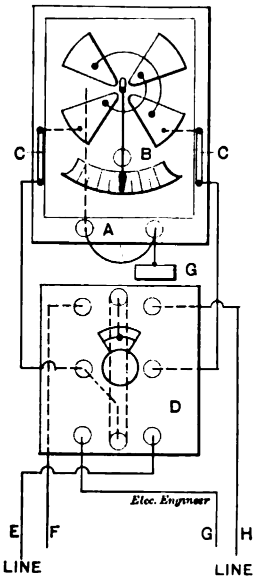


Fig. 4.

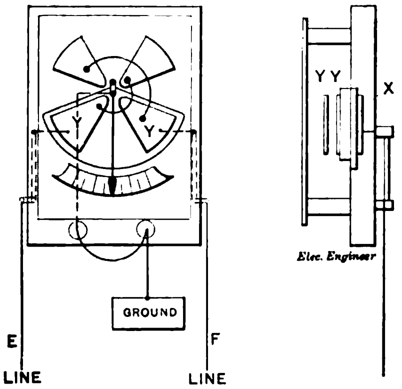


Fig. 5.

Type B, Fig. 5, differs slightly in construction from type A, in that the line wires are connected to a primary set of vanes, X, which are behind the visible fixed vanes, Y Y, and are separated from them by large plaques of hard rubber and mica. The visible fixed vanes are charged inductively from the primary vanes instead of directly from the lines. This type of instrument is mounted on a mahogany base in which are embedded the primary vanes and the mica plaques. This construction secures perfect insulation for very high voltages, while in general appearance and in action the instrument is the same as type A.

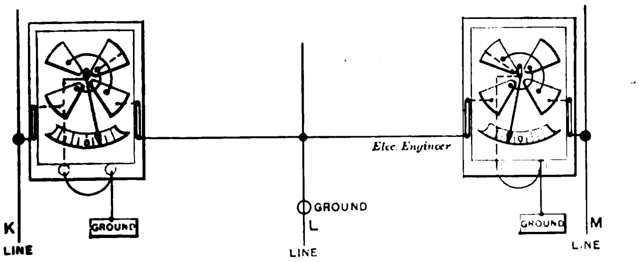


Fig. 6.

Type C, ground detector, Fig. 6, in construction and in appearance is practically the same as type A, differing only in having the vanes connected to the outside wires partially cut away. When the wire, K, is grounded, the pointer is deflected to the left; with a ground on M, the pointer is deflected to the right. With a ground assumed on the middle wire, at L, the pointers are deflected as shown in Fig. 6.

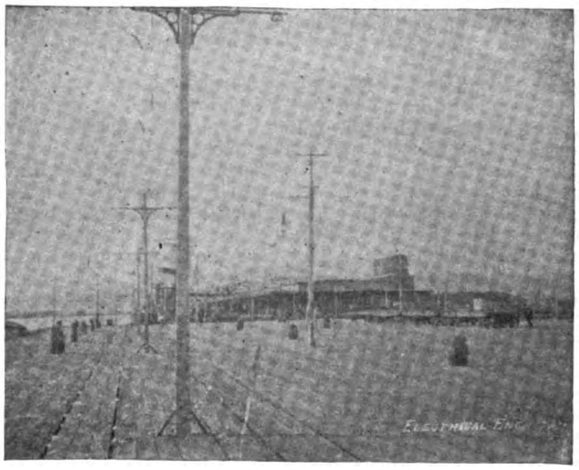
This is claimed to be the only ground detector that will work properly on a three-wire two-phase circuit, others indicating "ground" on the middle wire whether there is one or not on account of the unequal electromotive forces between the wires.

The fuse wire used for all these ground detectors is the well known platinum-silver wire ued in Cardew voltmeters.

ELECTRIC TRANSPORTATION

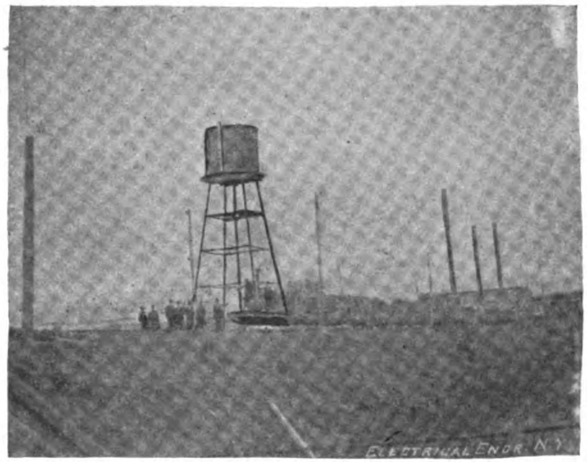
ELECTRIC COTTON HAULER AT PORT CHALMETTE, LA.

THERE has recently gone into operation an interesting electric freight hauling road at Port Chalmette, La., of which we gave several views in the accompanying engravings.



Electric Railway at Port Chalmette, La.

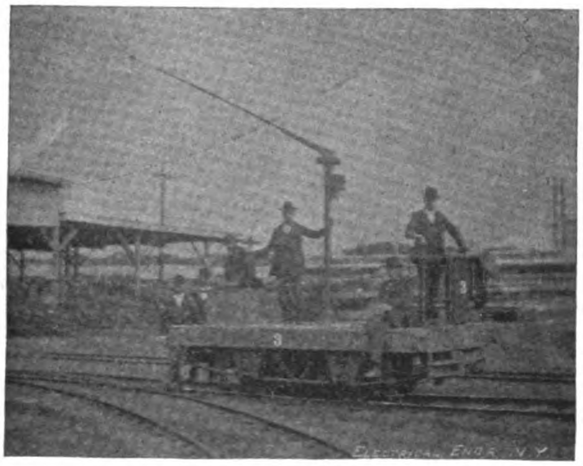
Port Chalmette is the big cotton handling port recently constructed just below New Orleans on the Mississippi. At this point over $3,000,000 has been expended in cotton sheds, warehouses, compresses and wharves. The whole forms a town to itself, lighted by its own electric lighting plant, with arc lights



Electric Railway at Port Chalmette, La.

and 220-volt incandescent lamps. Connecting the sheds, warehouses, compresses and wharves is a system of narrow gauge tracks for handling the cotton.

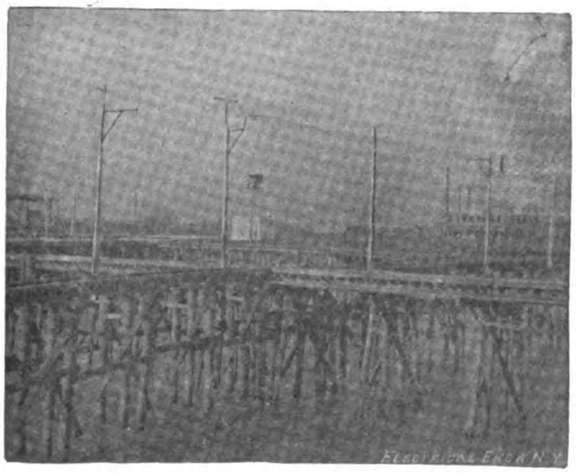
The original promoters adopted compressed air locomotives for the work of hauling the cotton about from point to point. At the beginning of the cotton season last fall, although four air locomotives were in service, they were unable to cope with the handling and moving of the cotton. The managers were skeptical regarding electric traction and the underwriters were afraid that electric motors would increase the fire risk. Something had to be done and done quickly to handle the large consignment of cotton daily received. A temporary trolley line was constructed and an electric truck provided.



Electric Motor for Hauling Cotton, Port Chalmette, La.

An engine and railway generator were hastily secured and inside of ten days the most important part of the hauling work was being successfully handled by the improvised trolley plant. Its working satisfied both the Chalmette managers and the underwriters and the result was a contract was made for four electric haulage locomotives. The apparatus was rapidly installed and by the middle of the cotton season the trolley had supplanted the compressed air locomotives and was taking care of the large and extended haulage system of the entire terminal.

The locomotives are "factory trucks," equipped with two NWP—12 motors, and weighing approximately 15,000 pounds; each is capable of hauling 150 tons on a straight level track.



Electric Railway at Port Chalmette, La.

Current is furnished by a 500-volt railway generator direct coupled to a 300 h. p. Erie City Iron Works engine. The electrical apparatus was furnished by the General Electric Company, through Mr. J. J. Britton, of the New Orleans office.

There are about eight miles of 36-inch gauge track about the cotton sheds, storage warehouses and wharves.

"WEARY."—Mr. C. D. Babcock writes in for The Engineer and says: "I am a trifle weary of my —— covered friend and his chronic lack of news."

TERMS OF THE CHICAGO GENERAL ELECTRIC RAILWAY FRANCHISE.

The conditions of the contract with the General Electric Company are as follows: Compensation: Nothing for first five years; 5 per cent. of gross receipts annually during second five years; 7 per cent. during third period of five years and 10 per cent. during last five years; average of 5½ per cent. per annum for the twenty years.

Fare, 5 cents, for the entire period of twenty years.

Underground system, except on unimproved streets; to abandon overhead within two years on the improvement of any street on which overhead system may have been placed.

Substitution of improved "grooved" rails for the present "girder" rails.

To run no more than two cars to a train.

Transfers on all connecting lines.

TO CONNECT TROLLEY AND ELEVATED LINES IN BROOKLYN.

The contract between the Long Island Electric Railroad and the Kings County Elevated Railroad Company has been confirmed. The companies will build an inclined plane connecting the two roads. The structure will cost about $35,000, and will proceed rapidly. When the incline, which is to be built at the terminus of the elevated railroad at Liberty avenue, is finished, the electric cars will run from the surface up to the level of the elevated structure, and there be attached to the trains and hauled through to the bridge. President Norton of the Long Island Electric Railroad said he thought the running time to the bridge could be reduced, and that the Kings County road would run express trains. The fare between Brooklyn and Jamaica will be 5 cents. To all other points, Mr. Norton says, the fare will be about 50 per cent. of that charged by the steam road. It is said that the line to Far Rockaway will be completed by July 1. The new arrangement adds about thirty miles to the Kings County system.

HEAVY RAILWAY WORK IN KANSAS CITY.

The Metropolitan Street Railway Company, of Kansas City, has awarded the contract for the electrical equipment of the Rosedale line to the Electrical Installation Co., of Chicago. The work of erecting the poles and overhead work will be commenced March 1. The terms of the contract stipulate that the road shall be ready for operation May 1. The construction company will bring its foremen from Chicago, but the laborers will be employed in this city. About 300 men will be given work.

About 350,000 pounds of copper wire will be used in the overhead work. Eight feeder wires will be laid between the Kansas City, Kan., power house and the Rosedale line.

The same company also received the contract from the West Side Railway Company to equip the Wyandotte street line. The wires for this road will be strung on iron posts instead of wooden ones, as are used on the Rosedale line. L. E. Myers, general manager of the Electrical Installation company, is in the city and will superintend the construction work in person.

OBITUARY

M. B. LEONARD.

It is with much regret that we note the death of Mr. Michael B. Leonard, superintendent of the telegraphic and electrical systems of the Chesapeake & Ohio Railroad. The cause of death at the early age of forty-two was a cancerous growth in the throat, upon which he was about to have an operation. He was born in Philadelphia in 1855, and was educated at St. Francis Xavier College, in New York City. It was his intention at one time to enter the Brotherhood. He had a splendid bass voice, and sang in the choir of St. Paul's, New York, as well as at Elmira. He developed a great taste for electricity and mechanics, and in 1872 entered the service of the Franklin Telegraph Company, going to the Western Union in 1873, the New York Central Railroad in

1877, and to the Erie Railroad in 1878, first, as chief clerk in the coal department and then as secretary to the general traffic manager. His next move was to the Chesapeake & Ohio as secretary to the general manager. Here his great executive ability soon displayed itself and in 1881 he was appointed superintendent of telegraphs to that railroad, a place he held down to the time of his death. He was also appointed superintendent of telegraph of the Newport News & Mississippi Valley Company, and of the Marysville & Big Sandy Railroad Company. He thus had complete executive and technical charge of the lines of these roads, comprising 2,500 miles of wire and over 100 commercial offices. He also had charge of the electric lighting and signal plants of the above companies.

Mr. Leonard had considerable success as an inventor. His block signal system was put into use on the C. & O. road, and he also brought out a car brake and an electrical heater. He was a skillful musician and for a number of years was organist at St. Peter's Cathedral, Richmond, the city in which he lived. He was familiar with several languages and had studied law with the idea of doing expert work in patent cases. As to his own electrical profession, it may be truly said that he was one of the most accomplished men in the field of railroad telegraphy, setting a brilliant example by his progressive policy and attitude toward all the new things. He taught electricity also at the Mechanics' Institute in Richmond. He was an influential member of the Association of Railway Telegraph Superintendents, and always one of the most loyal and interested members of the American Institute of Electrical Engineers. He was an early reader of The Electrical Engineer, which was often under obligations to him for suggestions and data; and his frequent purchases of electrical literature also showed his desire to keep abreast of the times. It is hard to part with a man so young, so talented and so amiable in all the relations of life, and the deep sense of loss felt by his relatives is shared by a wide circle of electrical friends and admirers. He leaves a wife and five children. His brother, Mr. John H. Leonard, is railroad editor of the "Mail and Express."

GALILEO FERRARIS.

THE cable announces the death last week of Prof. Galileo Ferraris, the eminent Italian scientist and Senator. The announcement will fill with grief all those whose good fortune it was to know Prof. Ferraris, and his loss is a heavy blow to science, to which he has contributed much valuable work.

Prof. Ferraris was born at Livorno-Marcellese in 1847, and was educated at the Royal Engineering School at Turin, graduating from the latter in 1869. At that time he had already published a paper on "The Telodynamic Transmission of Hirn," which was the first paper on this subject printed in Italy. Soon after this he was appointed assistant professor to Prof. Codazza, professor of technical physics at the Royal Italian Industrial Museum, and in 1879 he was elected professor of the Chair of Technical Physics of the University of Turin.

Prof. Ferraris had in the meantime devoted himself largely to optics, although by no means neglecting electrical work; and among the papers read by him in 1872 was one entitled "The Mathematical Theory of the Propagation of Electricity Through Homogeneous Bodies." His work on geometrical optics, published in 1877, was at once recognized as a standard, and was translated into several foreign languages. In 1881, acting under the stimulus of the Paris Electrical Exhibition, Prof. Ferraris, like many other physicists, found himself attracted more strongly towards electro-physical researches, and he represented the Italian Government at the International Conference on electric measurements, held in 1882. In 1883 he also represented his government at the Electrical Exhibition in Vienna.

The International Italian Exhibition, held in Turin, in 1884, was made memorable by the experiments carried on with the Gaulard & Gibbs transformers, under the guidance of Prof. Ferraris, and which gained this system the prize offered by the government for the best progress in the transmission of energy. Prof. Ferraris' memoir on this subject was a most valuable contribution to electrical literature.

But Prof. Ferraris is perhaps best known to American readers by his independent discovery of the properties of the rotating magnetic field, and their application to alternating motors. It is not necessary for us here to discuss the merits of Prof. Ferraris' claim to priority of discovery in this connection; for, that his work was independent and entirely original no one has yet disputed. The paper in which he first describes his experiments was read before the Royal Academy of Sciences of Turin, March 18, 1888, although his experiments, we are told, were carried out as far back as August and September of 1885. It is interesting to note in this connection that when Prof. Ferraris visited the United States in 1893, as a delegate to the International Electrical Congress, held in Chicago in 1893, he visited Mr. Edison at his laboratory, and in the course of conversation Mr. Edison inquired of Prof. Ferraris how he came to hit upon the idea of the rotating field. In reply Prof. Ferraris said that he was led to this discovery by his study and experiment upon polarized light, another instance of the influence which the study in one department of science may have upon another.

It was in 1886 that Prof. Ferraris organized the Electrotechnical School for Engineers in Turin, the first of its kind opened to the public in Italy. As stated above, Prof. Ferraris also represented the Italian Government at the International Electrical Congress at Chicago in 1893, and many American electrical engineers had the pleasure of making his acquaintance there. Prof. Ferraris had a most pleasing and engaging manner, and his bright and intelligent eye and imposing brow at once stamped him as a man of more than ordinary intelligence and mental endowment.

We may add that the sentiment of American electrical engineers was well expressed in the telegram of condolence sent at once on receipt of the news by the American Institute of Electrical Engineers, to the Italian Society of Electrical Engineers, of which Prof. Ferraris was the president.

MARRIED

BURKE-VEEDER.

The marriage of Mr. J. Burke, Jr., electrical engineer, of the firm of Herrick & Burke, to Miss Anna G. Veeder, daughter of Dr. A. T. Veeder, took place at Pittsburg, Pa., on Feb. 11, at 3 p. m. Hearty congratulations and many handsome presents were received from relatives and friends by the happy pair.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - -	1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - -	916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - - per year.	$3.00
Four or more Copies in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, FEBRUARY 17, 1897. No. 459.

THE AGITATION FOR MUNICIPAL PLANTS.

SOME three years ago The Electrical Engineer, with the co-operation of Mr. Horatio A. Foster, the central station expert, made a collection and digest of all the information then obtainable as to the conditions under which municipal electric light plants in this country were operating. Every plant was written to, and all the data was carefully and impartially analyzed. The net result may be briefly summed up by saying that no real gain to the community was shown by the investment of public funds in commercial enterprises of this character.

The recent meeting of the Northwestern Electrical Association, at which several of the members were urgent and vehement in their protests against the extension of the municipal plant "craze," showed that in many parts of the country the competition of city plants had done serious injury, and is likely to do more, amounting sometimes to the confiscation of private capital that had been expended in good faith under public guarantees. Various remedies for the existing state of affairs were proposed, some sensible and some extreme, but it cannot be said that a definite plan of amelioration was adopted. In the mean time, it has seemed to us that what is really wanted is the intelligent discussion of the subject and that if the public is supplied with the facts it is not likely to go very far wrong, or in its enthusiasm over the new dream forget that such plants sometimes prove a burden and a curse. The position of The Electrical Engineer and of electrical papers generally is often misunderstood, and frequently misrepresented. As the advocates of an extension of electric lighting, they certainly would not stand in the way of anything which while promoting that would obviously benefit also their selfish, personal interests. But, having seen a great new art successfully built up by private enterprise, and witnessing the frequent rank failures of municipal plants for gas or electricity, they believe that both the art and the industry will advance more quickly in private hands than in public, and they are entitled to the expression of their opinions. The editors of this journal, with their fellows on other papers, have been abused like pickpockets for advising against expenditure of money raised by taxation in such enterprises, and have been accused of being allies of trusts and other bad things, but they do not see how their opposition could affect the movement for an instant, unless it were honest and based upon facts.

The present issue of The Electrical Engineer is largely given up to a collection of data bearing on the subject of municipal plants, and presented because it has evidently great interest and value at the present juncture. Perhaps the desire to be impartial will be seen in the space devoted to the special report made by Commissioner A. E. Winchester, of South Norwalk, Conn, a young electrical engineer of high standing and unblemished character, who, not satisfied with making a brilliant success of the plant in his care, has gone to great trouble to collect facts about the 300 other such plants now running. We print his report in full, so that our readers have before them the latest and most favorable word on the subject by one who is himself about as good a municipal commissioner for that work as can be found in all this broad country. In addition to this report, we give a mass of other current data and items, all of recent origin and later in date than the Winchester report, some of it throwing a searchlight beam upon the evils that beset plants of this kind under the conditions that may and do arise.

Mr. Winchester's report is frank and able, and we have no doubt that to those who have made up their minds that a municipal plant is the thing they want, it seems very strong. To us, it betrays a poor case, and does but confirm us in our suspicions as to the general ignorance on the part of municipal plant managers. In most instances, the balance sheet is decidedly unfavorable, and in many there appears to be no knowledge that such a vital factor as depreciation must be taken into account. We do not say that in this respect central station managers are shining examples. On the contrary, many of them sell their light too cheaply, because all the expenses have not been figured in. Still, the loss falls on a few, who have gone into the enterprise willingly, and not upon every member of the community that is already groaning under the burden of modern debt and modern taxation.

Even Mr. Winchester, staunch champion as he is of municipal plants, is slow to approve of them in the large cities, where various misguided people are now clamoring for them. In fact, he does not believe in them there, but, strong in the consciousness of his own acknowledged success and in his conviction that the countryman is sure to be more honest than the citizen, he thinks they are all right for the smaller communities. This may be so where private enterprise has not come forward, but why a small town or medium city should assume a burden and create new officials when it can abstain from doing so, will ever remain a mystery. Mr. Winchester presents a striking little table to show how a city by putting in its own plant may possibly save about $500 a year on a service of 100 arcs, but, as offsetting that, there are the figures, carefully worked out, which led Utica, N. Y., to drop the municipal scheme in order to save money, and there are also the figures submitted by disinterested experts to the citizens of Brookline, Mass., and quoted by us in extenso on Jan. 20, showing that arc lights from the proposed city plant would cost $123 per lamp per annum, or just about the same as those from private plants of the same size throughout the country. We confess that there seems to us to be no getting away from such figures, any more than we can get away from the statistics of bad city gas management in Philadelphia, as summed up by Mr. Bryce in a special section of his "American Commonwealth."

We have said before, and now venture to say again, that the question sums itself up into this: Does it pay? But that implies, after all, a good deal more than the meeting current expenses in which so many plants, whether private or public, fail to give satisfaction. If we look into the social and philosophical aspects of the thing, we find that it must necessarily lead to the creation of more and more officials, of a larger and larger debt, and of a greater and greater burden of management. Nearly all persons to-day who govern city affairs are congested with work and responsibility, yet the process of overloading them goes gayly on. And back of it lies a peril that has never been more sharply outlined than in the recent farewell words of Herbert Spencer: "When from the regulation of the workers of the bureaucracy we turn to the bureaucracy itself, and ask how it is to be regulated, there is no satisfactory answer. Owning in trust for the community all the land, the capital, the means of transit and communication, as well as whatever police and military force has to be maintained, this all-powerful official organization, composed of men characterized on the average by an aggressive egoism * * * must inevitably advantage itself at the cost of the governed. * * * Under such conditions there would be an increasing deduction from the aggregate produce by these new ruling classes, a widening separation of them from the ruled, and a growing assumption of superior rank." If this is what the municipal plant advocates want, it is devoutly to be hoped they will secure it for themselves only. If it is not what they want, why don't they stop before it is too late?

Returning to the specific subject under discussion, we would point out that there are various ways of protecting a city against undue charges. We need only refer to the work of the Massachusetts Commission, which can do, and actually does, much, to keep the companies in the narrow path of legitimate capitalization and fair treatment of their customers. It serves moreover as a barrier for the established companies against undue competition and against the wiping out of their property by the setting up of a municipal plant to do their business under unjust conditions that would ruin them. In Rhode Island, another plan has been adopted, namely that which limits a big company like the Narragansett, in Providence, to the payment of only 8 per cent. annually in dividends, all earnings above that going to the reduction of rates. The dividend allowed is small in proportion to the risks of the enterprise, but the public at least is taken care of.

The American public has been told that there are many municipal plants run successfully in Europe; it is so claimed, anyhow, and one of the reasons given is the superior virtue or morality of the authorities. This may be, though we doubt it, for there are other explanations besides the "unctuous rectitude" about which Mr. Cecil Rhodes has been twitting his English critics. In Europe there are a great many people of moderate means and abundant leisure to look after such plants for nothing save the local honor it confers on them. Here such a class hardly exists in this workaday Republic. Everybody is busy and will be until such a "class" is evolved, to do for all our communities what the town councils have done in old England or the selectmen in New. Even, then, there will be no gain of much account in running such enterprises, and we have still to be convinced that these plants in the old world pay as they are alleged to do. We know they don't in China, the ideal country of governmental and municipal control.

KEEPING TAB ON CITY LIGHTS.

APROPOS of the question of municipal lighting plants, it has been suggested that where such plants are not established, municipalities might keep a check upon lighting companies by taking independent records of the voltage and amperes of the current on the public lighting circuits. An instance of this kind, which has recently come under our notice, is presented by the City of Utica, N. Y. Here the contract between the municipality and the electric lighting company calls for the taking of a continuous record, on recording instruments, of the amperes and pressure maintained in the city lighting circuits, the instruments to be kept under lock and to be accessible only to the proper supervising city authorities. According to the contract, when the readings of the instruments show a discrepancy of more than 10 per cent. from the normal, a deduction is made from the contractor's bill, he being charged for deficiencies at a rate twice as high as the city pays. This system of check has been too short a time in operation to permit of determining its practical value, or as to whether it will prove satisfactory to either party to the contract. As, in addition to the deduction according to meter readings, the electric light contractors in Utica are also liable to deductions for lights out, it would seem to be hardly fair to mulct them twice for the same delinquency, for a light out would show on the record. On the whole we see no particular benefit to be gained by this scheme of recording. In the first place, the limit of variation allowed by the contract is one which no self-respecting lighting company would permit for any length of time on its circuits, since such a reduction of voltage at the arc lamp terminals would reveal itself at once by unsteadiness in the arc, and would be intolerable; or, in the case of incandescent lamps by a tremendous falling off in illuminating power. Besides, the ease with which this method of check can be circumvented is so patent that it seems fair to assume that it cannot have been suggested by any one practically acquainted with central station lighting, where customers' meters sometimes show queer readings. We shall watch the Utica experiment with some interest, but can hardly recommend it as meeting the objects aimed at.

"ONE-SIDED REPORTS."

IN reply to the recent editorial appearing in the American Machinist, in which our contemporary referred to a report on a comparative test between an electric and a compressed air mine pumping plant as being "one-sided," we fell back on the supplementary contribution made by Mr. Searing, the original author, as fully answering, in our estimation, all the criticisms which had been brought against the accuracy of his original contribution appearing in The Electrical Engineer. But it seems that the Machinist is still unsatisfied, and repeats, through some curious perversity, the charge of unfairness against us: "It is this very disposition to exalt and worship electricity," says our contemporary, "and to insist that it is the greatest force known to man, and should always be used in preference to any other, regardless of time, place and circumstances, that has more than anything else weakened the influence of electrical journals among impartial and disinterested engineers."

It is indeed interesting to learn that electrical journals have lost their influence among distinterested engineers for printing unsolicited articles about the application of electricity as a general substitute for other forms of motive power; but it is somewhat remarkable, we think, in view of this loss of influence, that engineers all the world over are slowly but surely applying electricity in situations where heretofore it had never been used, and particularly as a substitute for compressed air. There must surely be something wrong in the make-up of engineers who have ceased to be influenced by electrical journals, and yet will persist in doing the very things which those journals advocate. We are willing to admit the soft impeachment of a disposition to exalt and worship electricity, for we most assuredly think it to be the force, par excellence, to be applied wherever power is needed; but we must emphatically deny that we are blind partisans of the electrical, or any other cause.

Perhaps our contemporary also looks upon the substitution of compressed air locomotives by electric motors at Port Chalmette, La., described in our present issue, as the work of the bitter enemies of compressed air, but the owners of the road were perhaps best able to judge of what they considered adequate for their needs, and they decided that compressed air locomotives did not fill the bill. We believe there are a few things that compressed air may be able to do better than electricity, but they are so few that it is hardly worth while at the present day to enter into an extended study of the two, when considering the choice of methods involving power transmission or application. In the meantime we wish to say again here that we did not lift a finger or a voice, either to induce the Colorado company to supplant compressed air in its mine by electric power or the Port Chalmette people to throw out compressed air locomotives for electric locomotives. They did it all themselves—and then told us about it afterwards. We print the stories; that is our crime!

THE N. Y. EDISON CO'S ANNUAL REPORT.

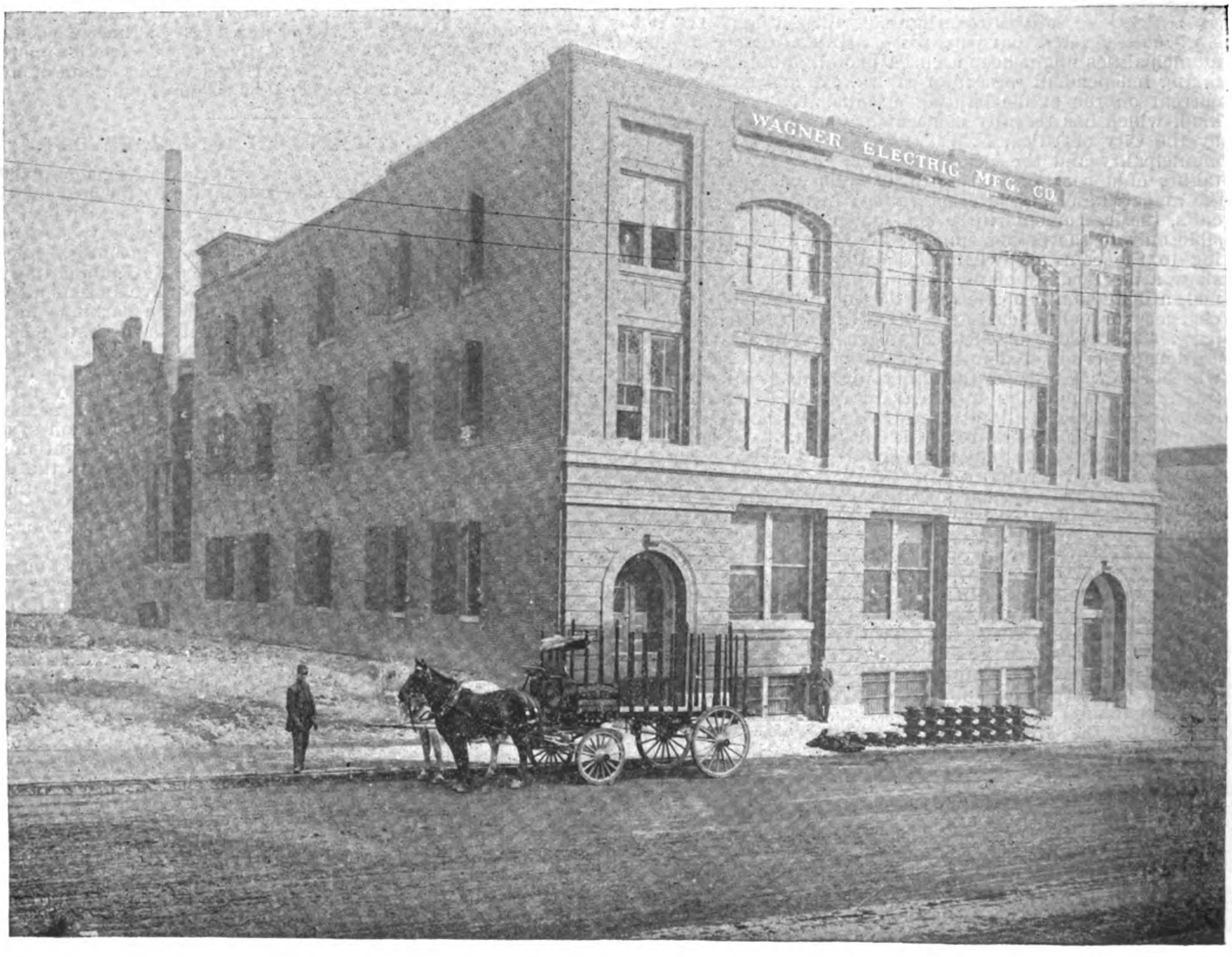
WE hear so much of the financial stringency existing among electric lighting companies at the present time, that it is refreshing to have placed before one a report of a year's operation of an electric lighting company, showing a good profit, and a substantial increase in business. Such is strikingly the case with the Edison Electric Illuminating Co., of New York, of whose annual report we give an extended abstract on another page. The gross station earnings in 1896 were $2,222,737.06, of which the low tension system claims as gross earnings, $1,771,229.83, with net earnings of $814,833.05, to which is added the income from the high tension system, bringing the total income of the company for the year to $960,156.94. These figures show that with nearly 80 per cent. of the income derived from the low tension system, the ratio of operating expenses (including both station and general expenses, but not depreciation charges), to the gross station earnings, is 52 per cent., which we believe is an exceedingly good ratio for this class of station work. There is no doubt but that this is due largely to the heavy motor load which the company is now carrying.

Reducing the entire output of the company's station to a common basis, the total capacity at the present time is 708,458 16 candle-power lamps, a figure which is not equalled, we believe, by any other company in the world. The increase during the past year amounting to 125,000 16 candle-power lamp equivalents, is proof enough of the vitality of the company and, we may say, incidentally, of the stability of electric lighting. In these days when the Welsbach lamp has been creating such unnecessary alarm among the electric lighting fraternity, it will be encouraging news to many to know that during the past year the New York Edison Company increased the number of its incandescent lamps connected by 27 per cent., and its arc lights by 8 per cent. But perhaps the most remarkable showing of all is that of the increase of electric motors connected to the company's circuits during the year—the motors aggregating no less than 15,930 horse-power, an increase of 36 per cent. over the preceding year. Here is a record that must at once strike the progressive station operator strongly with the possibilities of electric power as a profitable field for his endeavors. It is interesting to note that the actual number of motors installed during the year was 1,319 representing no fewer than forty-seven types of manufacture. It will be noted, with surprise perhaps by many that the New York Edison Company has in use among its customers over 8,900 meters, of which a large majority are of the Edison chemical type. In view of the alleged short-comings of this type of meter the proportion of errors to bills rendered, namely, 1-10 of one per cent., must be considered to be remarkably low. It is apparent, however, that the company is trying other types of meters. We commend to the attention of all electrical companies the New York Edison Company's method of providing a benefit dividend for its employés, depending upon the length and nature of their services, as a form of profit sharing. This is a most excellent means of raising the standard of work accomplished by employés, and of instilling into them the practice of looking upon the company's success as their own.

MISCELLANEOUS

THE WAGNER ELECTRIC MFG. CO. ST. LOUIS, MO.—ITS FACTORY AND PRODUCTS.

THE young men who, in the fall of 1890, were putting together a few "hand-made" fan motors in the repair shop of a local electric lighting company, were no doubt energetic and ambitious enough to believe that the fan motor business might eventually grow to generous proportions, but they hardly thought that in the course of a few years they would be at the head of one of the largest manufacturing concerns in this country, devoted exclusively to the manufacture of transformers and kindred specialties.



THE WAGNER ELECTRIC MFG. CO.'S FACTORY, ST. LOUIS, MO.

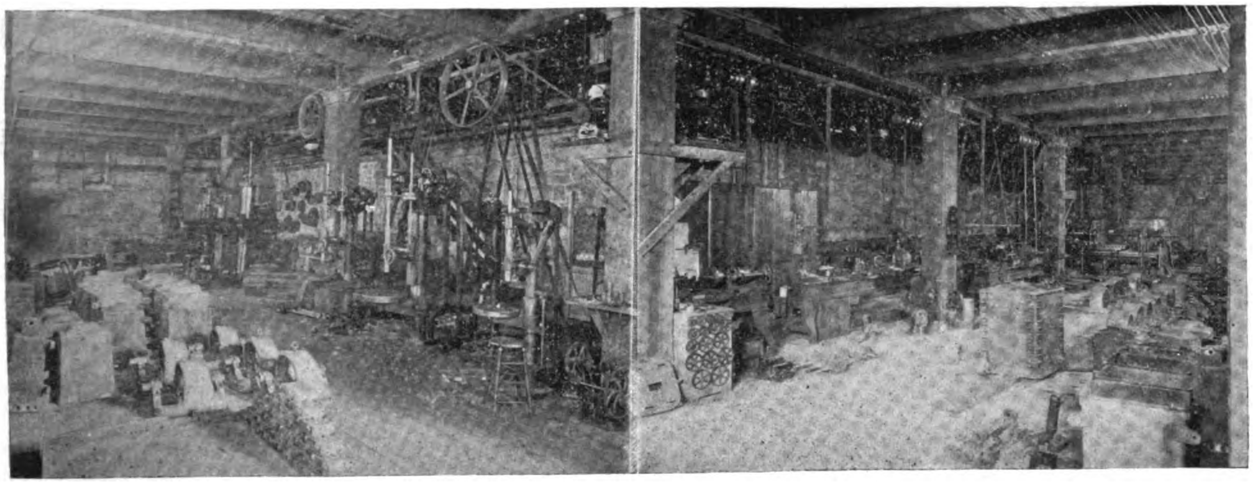
It was in the spring of 1891 that H. A. Wagner, in company with Fred Schwedtman, began the manufacture of alternating current fan motors on a small scale at 1822 Olive street, St. Louis. It was at the time when the single phase alternating current apparatus was considered "the thing" and the fan motors that would operate with such a current found a ready market. The Wagner motor gave great satisfaction, and, although imitated from the start, kept steadily in the lead. In August, 1891, the gentlemen named found it expedient to incorporate the Wagner Electric Manufacturing Company, with a capital stock of $25,000, half of which was paid in the way of machinery, tools, materials, etc. Mr. H. A. Wagner was elected president; M. E. H. Abadie, who had joined forces with Mr. Wagner some time previous, was made secretary, and Mr. S. B. Pike became treasurer.

During the first two seasons the small 1-10 horse-power fan motors were in such demand that the company could hardly turn them out fast enough and as early as 1893 found it necessary to secure the adjoining premises No. 1824 Olive street, thereby doubling their floor space with a corresponding increase in capacity. This gave the company somewhat of a breathing spell, enabling it to give attention to the growing demand for a somewhat larger motor. The 1-10 horse-power was accordingly changed to ⅛ horse-power and several improvements added, which made it the most efficient and reliable motor of that type then on the market.

It was at this time that the company secured some special switchboard work and a few months later built for the Missouri Electric Light and Power Company their large and now well known type of switchboard. The building of this and other boards marked the entrance of the Wagner company into the field of building switches and switchboard devices, especially those adapted for alternating current work, and in which it has steadily progressed, furnishing to-day a complete line of switches and switchboard accessories, acknowledged as of the highest grade and noted for their excellent workmanship, accurate construction, fine finish and ingenious disposition of the several parts.

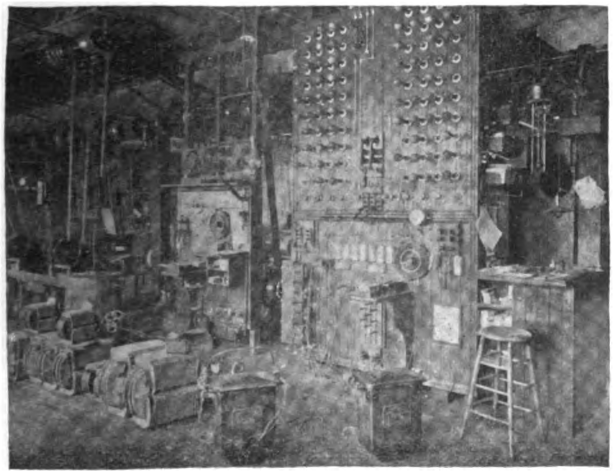
The constant increase in business during the fall of 1892 and spring of 1893 which necessitated the increase in shop room, also showed the advisability of increasing the capital stock in order to keep the business and financial ends in proper balance. Accordingly in June, 1893, the present stockholders arranged to subscribe sufficient funds to increase the capital stock to $100,000, part of the arrangement being that the offices should be held by stockholders only and the management remain in the hands of the original incorporators. At a stockholders' meeting S. M. Dodd was elected president; Jas. W. Bell, vice-president; S. B. Pike, secretary and treasurer, Mr. H. A. Wagner was made general manager, E. H. Abadie, manager of sales department, and Fred Schwedtman, superintendent. These officers have not been changed since. It was only natural that with the constantly growing business the company's quarters on Olive street soon were inadequate to give room for additional tools and workmen, and it was decided to secure a building and ground that would permit of gradually increasing the size of factory for several years to come. Accordingly in August, 1893, the lot 2017-2019 Locust street, extending through to St. Charles street, was acquired.

By this time the repairing, operating and testing of the various transformers sent in by the company's customers had developed to such an extent as to show the desirability of entering the field as manufacturers themselves. One of the stock arguments of the direct current advocates against the use of alternate current apparatus at the time was, that the constant leakage in transformers on a circuit would soon eat up what saving there might be in the first cost of line wire.



Views of the Main Machine Shop.

The Wagner company attacked the problem intelligently and the result was its type A transformer, which at once took a leading place owing to its high efficiency, regulating properties, and other desirable features. Much against its wishes the company was compelled to put on the market its type B transformers, which in make-up were similar to the type A, and while not of the same high grade, were still equal and often superior to most of those built at the time. In the fall of 1894 the company brought out a still later type, designated C, in which were embodied the results of all the latest experiments, resulting in a transformer of an efficiency and with a regulation hitherto unattained. These transformers found a ready sale, as by this time central stations had learned by expensive experience that in a transformer the first cost is not the only consideration. Saving in operating expenses had become the watchword, and the low efficiency apparatus had to go.



A Corner in the Testing Room.

The type C transformer satisfied the central station men, but the Wagner company, believing that still greater improvements could be made, brought out in January, 1896, a still later line, type D, which not only showed still higher efficiency and better regulation, but also contained a most ingenious fusing device. This with the mechanical construction of the coils as well as the arrangement of the magnetic circuit, makes it probably as near an ideal transformer as can be constructed without going so far as to make its manufacture on a commercial scale impracticable.

Many more conservative concerns would perhaps be content to let well enough alone, but the Wagner company, always on the alert for improvements, is now experimenting with and about ready to place on the market a new and distinct line of transformers of a special type for stations desiring the highest obtainable efficiency and who are willing to pay a reasonable price for first-class apparatus of that kind.

THE FACTORY.

Our illustrations show the present location of the company's works, with a few interior views of the several departments. As already stated these premises were secured in August, 1893, but at that time only contained a building 40 x 73 feet, four stories high, fronting on St. Charles street. This answered the purpose for a few years, but in 1896 the new building on Locust street was added, taking up a space of 120 x 73 feet, also four stories high, thus covering the entire ground from Locust to St. Charles street. In planning the new building, provision was made for adding three additional stories when necessary.

A View in the Assembling Room.

The building is constructed and arranged in a most admirable manner, making it thoroughly modern in every respect. All machinery is of course driven by electric motors, supplied with current from the local lighting company's power circuits. The various tools are grouped, generally three or four of a kind, about a short countershaft driven by a separate motor. This arrangement has been found more economical than the practice, advocated by some, of supplying each tool with its motor, in which case the efficiency is no doubt much lower than where the motor has a fair load at all times. The arrangement as practiced in the Wagner factory gives ample flexibility, and as current is available during the entire 24 hours, any one or more departments can be run overtime when required.

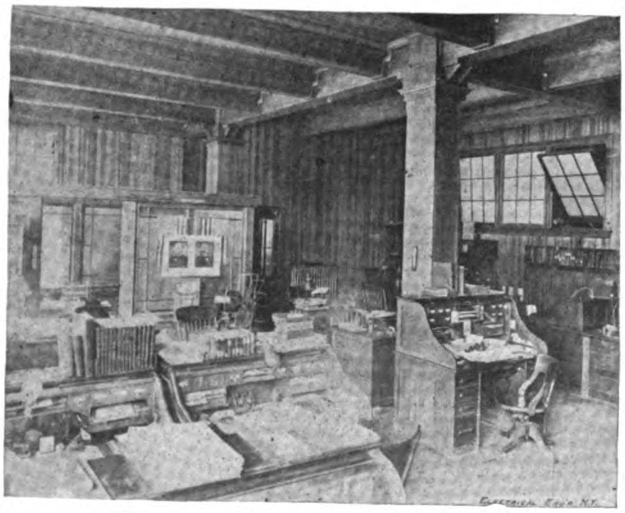
In addition to the necessary power circuits, the factory is supplied with alternating currents of various frequencies and pressure as well as with continuous currents of 220 and 500 volts, so that any desired test can be made on transformers, motors, switches, etc.

A Part of the Shipping Room.

The building is equipped with the latest appliances in the way of heating and ventilating apparatus, intercommunicating telephone system, fire extinguishers, and, in fact, all those details that enter into the equipment of a modern, up-to-date factory.

ALTERNATING CURRENT MOTORS.

With the continued increase in the number of alternating current stations came naturally a demand for efficient motors of the small sizes, suitable for use with such currents. This led the company to continue its experiments in that direction and in the early part of 1895 it had several motors operating in a very satisfactory manner in its shops, driving machinery.

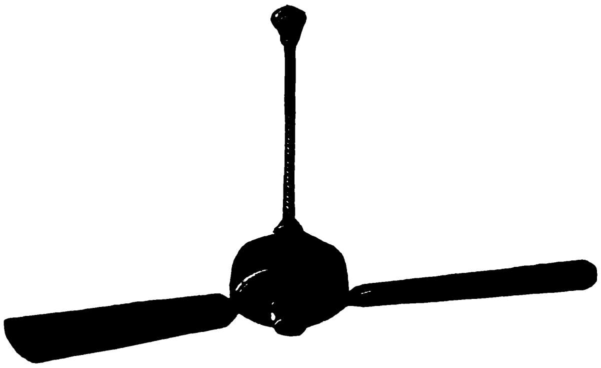


A Corner of the Offices.

On account, however, of the somewhat complicated mechanism of the starting device the company did not deem it advisable to place the motor on the market at that time. These motors have now been so improved and simplified that even an inexperienced operative can handle them without trouble and they are now practically ready to be delivered in sizes of 3, 5 and 10 horse-power. They are of the non-synchronous, single phase type, operate smoothly and are in every respect as reliable and efficient as the direct current type.

ALTERNATE CURRENT CEILING FANS.

Within the last few years the small desk or bracket fan motor seems to have been in great danger of being gradually driven from the field by its more effective successor, the revolving ceiling fan, and in order to supply the demand for this style, the Wagner company last fall began the manufacture of an alternating current ceiling fan and motor which bids fair to outstrip any of its rivals on account of its extreme simplicity. It is of the induction type, and having neither commutator nor brushes, avoids the most vulnerable parts usually found in apparatus of this kind. It runs at the same speed as its prototype of the direct current class and consumes only from 100 to 125 watts, which is certainly as little as can be expected from motors of this kind.

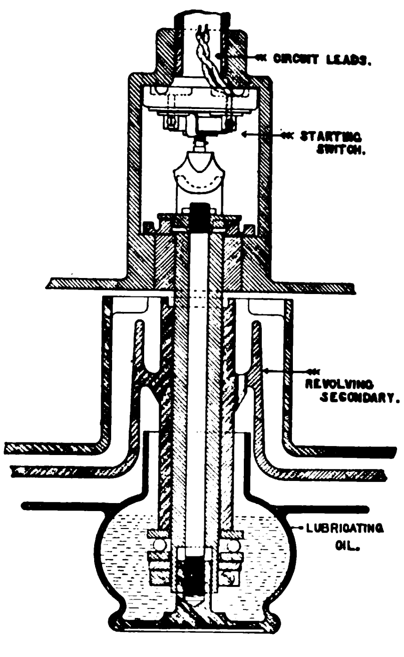


Alternating Ceiling Fan.

The motor has only one journal, and that is ball-bearing and submerged in oil, as shown in the accompanying illustration. The whole apparatus is claimed to require absolutely no attention, except starting and stopping when desired, for at least two years, that being the length of time the oil is assumed to last before becoming too dirty. This fan motor was exhibited at the last convention of the Northwestern Electrical Association, and elicited much favorable comment on the part of those in attendance.

DIRECT CURRENT MOTORS.

In June, 1894, the company placed on the market a line of direct current motors in sizes of from one-fourth to ten horse-power, believing that a demand existed for a first-class motor of the sizes mentioned. These motors were all of the four-pole type, had self-oiling bearings, and, what was then somewhat of a novelty, rigid, non-shiftable brush holders. Like the transformers, the motors were of a higher grade than many then on the market, and even to-day are not surpassed



Section Showing Starting Switch and Method of Lubrication of Ceiling Fan.

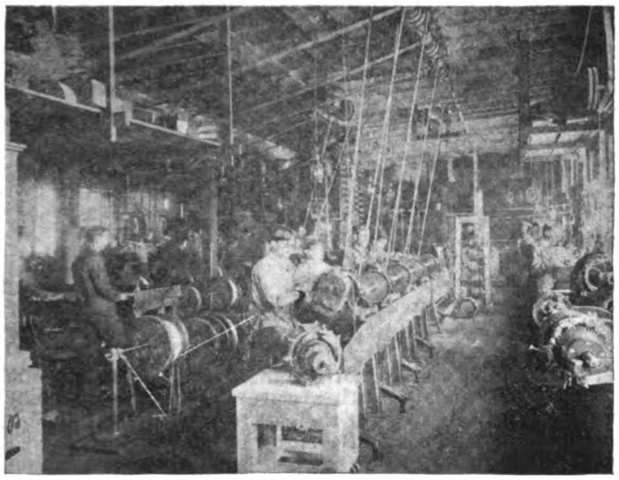
in points of efficiency, regulation and durability. Their fate was similar to that of the high-grade transformers. Power users were not alive to the importance of having a highly efficient motor, and central station people were more or less indifferent, especially when the current for the motor was paid for on a meter basis. The Wagner Company, not caring to meet the competition of the cheaper grades, did not push the sale of these motors to any great extent. The company is contemplating putting them again on the market, having enlarged the line so as to include sizes up to 25 horsepower.

HOW THE WAGNER TRANSFORMER IS MADE.

To follow the making of a Wagner transformer throughout its various details, from the proper determination of its dimensions in the laboratory to the shipping platform, would require more space than is within the scope of this article. A brief mention and a few illustrations, however, of the principal steps during its manufacture cannot fail to be of interest to our readers.

In the winding room the coils are wound on winding machines specially designed and made by the company. A row of these winding lathes is shown in our illustration; each row is driven by a motor, a friction clutch enabling the operator to start and stop his lathe at will. Counters showing the number of wire turns are fitted to each lathe, it being, of course, important to have the exact number of turns on each coil.

While in process of winding the coils are being saturated with a special insulating compound, which soon hardens and makes the coil absolutely impervious to moisture. The compound will not soften under any degree of heat that the coil will be subjected to, and being in itself a high insulator, short circuits or electrical leaks are impossible. As soon as wound, the coils are placed on trucks and run into a baking oven, where the last degree of moisture is driven out. The oven is so arranged that the "green" coils enter at one end and leave, thoroughly dried, at the other. From the oven the coils are delivered to the mounting benches, where they are carefully finished and provided with additional insulation, so as to receive the iron core.



Winding Armature, Field and Transformer Coils.

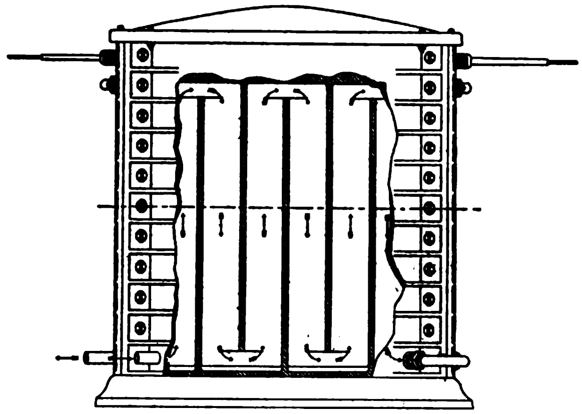
The core is built up of soft iron punchings, made of the thinnest iron obtainable, and carefully annealed before use. In the selection of this iron the company exercises the utmost care, each lot being tested for permeability, hysteresis and magnetic qualities in general. The company has gone into this question of iron losses very thoroughly, and it was found that some kinds of iron which at first showed up favorably in a transformer core would in the course of a few months show an increase in the iron loss of as high as 25 per cent., and in some cases on record the losses gradually increased to nearly 100 per cent. Iron of this kind is, of course, utterly unfit to go into a transformer core.

The transformer, with its coils and core having been assembled, is next sent to the testing board, carefully checked as to winding and tested for insulation and iron loss. If found "O. K." it is returned to the mounting bench and completed, after which it goes once more to the testing board to receive a rigid final test, of which an accurate record is kept for future reference. The transformer is now ready to be cased and boxed for shipment. Owing to this rigid system of inspection and testing it is, of course, improbable that a defective transformer leaves the factory.

These transformers are at present built in sizes of from 250 watts to 100 k. w. for lighting circuits, as well as in similar sizes for power purposes. For two and three-phase work the 100 k. w. size is the one most usually furnished.

HIGH TENSION TRANSFORMER WORK.

Long distance electric transmission at high tension, by means of which otherwise unavailable water powers are being rapidly utilized all over this country, as well as abroad, has opened a new field for the static transformer. Current generated by single, two-phase and three-phase machines at pressures of from 500 to 2,000 volts, to be economically transmitted such distances as twenty and thirty miles, must be raised to 5,000, 10,000 or 20,000 volts, dependent on conditions. Step-up and step-down static transformers for such service equally durable with low tension transformers were promptly put on the market by the Wagner Company. Among the important installations of this kind of apparatus put in by the Wagner Company are the following:

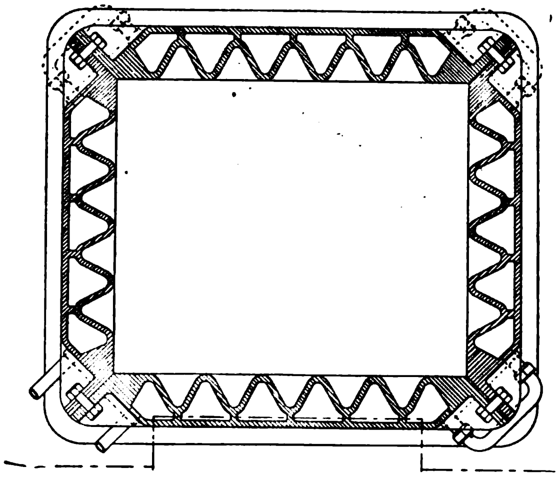


Water-Jacketed High Tension Transformer. Vertical Section of Case.

Riverside, Cal.—Municipal plant, 22-mile, 3-phase transmission, at 10,000 volts, 600 k. w. Colton, Cal.—Municipal plant, 18 miles, 3-phase transmission, at 10,000 volts, 50 k. w. Lachine Rapids Hydraulic and Land Company, of Montreal, 3-phase transmission, at 5,000 volts, 1,000 k. w. Edison Electric Light and Power Company, Brooklyn, N. Y., 200 k. w., 4,000 volts. Missouri Electric Light and Power Company, of St. Louis, 600 k. w., 20 miles, single phase, 5,000 volts. Webster, Mo.—22 miles, 400 k. w., 4,000 volts. A. A. Tibbe, Washington, Mo., 10 miles, 5,000 volts, 60 k. w.

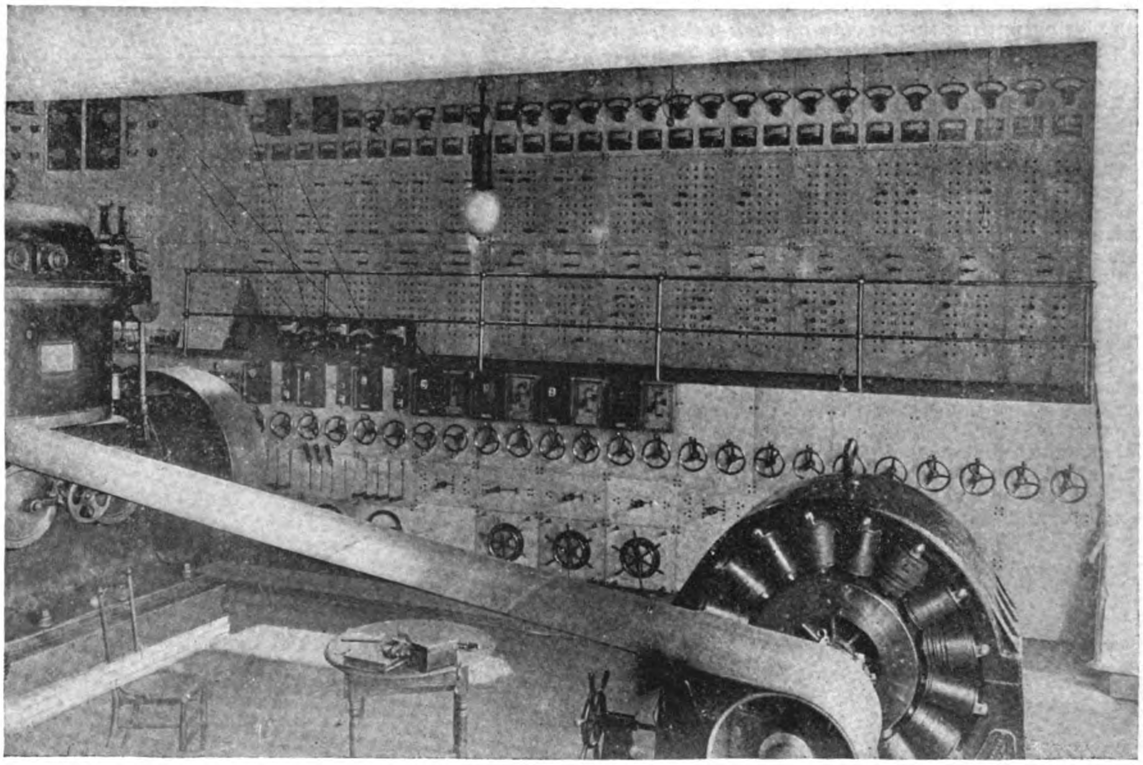
Static transformers for this kind of work are built in four types by the Wagner Company: (1) Self-cooling dry, (2) self-cooling oil filled, (3) air blast dry, (4) water jacketted oil filled.

The first and second forms meet the requirement for isolated substations where no regular attention can be given transformers. The third and fourth types are for use in large installations where station attendants are provided. The system of erection with (3) is to place the transformers over air ducts having blast outlets immediately under each transformer. These ducts converge to one large blower, of capac-



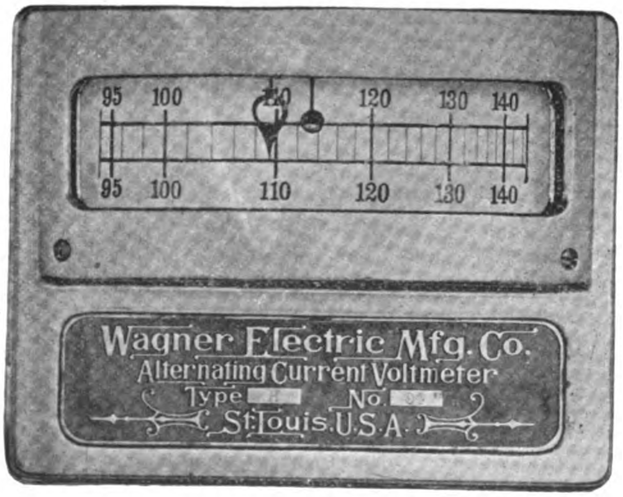
Water-Jacketed High Tension Transformer. Horizontal Section of Case.

ity sufficient to ventilate the entire bank of transformers. The blower is driven by a single-phase, self-starting induction motor, either belted or directly coupled to the blower shaft as conditions warrant.



Wagner Switchboard in Station of Missouri Electric Light Co., St. Louis.

With type (4) a gravity water-head of about 15 feet is provided, each transformer case being coupled to the supply pipe. As shown in the illustration, the water-jacket is so channeled that the water supply passes vertically up and down the transformer case 15 or 20 times before finally making its exit from the discharge pipe. Transformers of this type are so designed as to be self-cooling up to about three-fourths load, and only require the water circulation through the heavy load hours of the day. The volume of water required for proper cooling is about two gallons per 100 k. w. per minute.



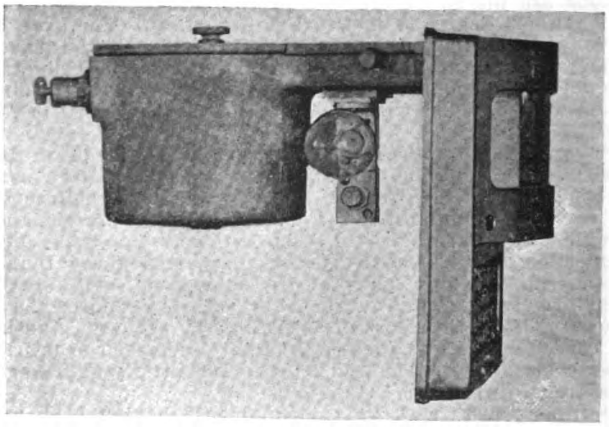
Switchboard Instrument. Front View.

The oil used for ventilating and insulating service in connection with all high-tension transformers is one which is clean, of light weight, and of exceptional insulating quality. Heat, instead of deteriorating it, as is the case with the majority of oils, improves its insulating quality.

In construction, all high tension transformers have the materials so disposed as to allow free circulation of the ventilating medium, at the same time avoiding magnetic leakage and maintaining high efficiency.

In high tension work this company is prepared to build static transformers in such capacities and at such pressures as required by the service, in units up to 500 k. w. for single phase, two-phase or three-phase transmission.

TYPE H. INSTRUMENTS.



Switchboard Instrument. Side View.

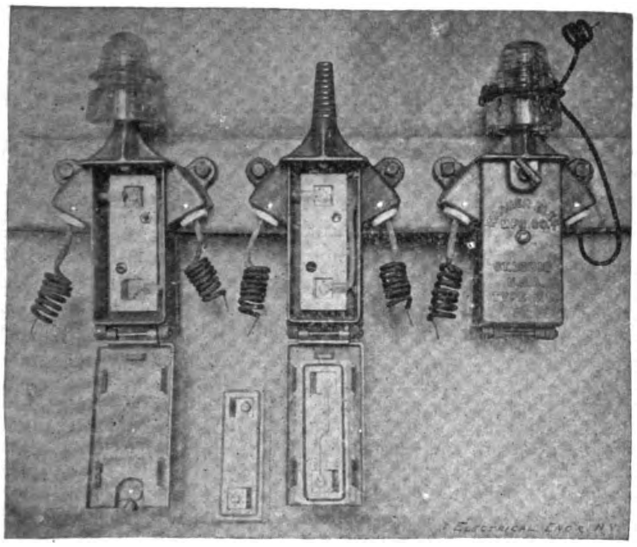
In the design of these instruments, which include ammeters, voltmeters and indicating watt meters, the company's object was primarily to meet the call for a sensitive, accurate and absolutely dead-beat alternating current switchboard instrument. The claim made for them is that they are the only instruments in the market satisfactorily meeting these requirements. They are decidedly novel in design, and so designed that the scale only is seen on the face of the switchboard, the case proper containing the working parts, being behind the board.

The case is filled with a light, highly insulating, transparent oil, completely submerging the working parts. Mounted on a vertical shaft, which carries the armature and pointer, are aluminum vanes, the resistance of the oil to these vanes forming the deadbeat feature. The vertical shaft, moving in jewel bearings, operates without any frictional error, which is unavoidable with horizontal shafts. The resisting element to the deflecting torque consists of a pair of opposing springs of such strength that every deflecting pressure or current causes an absolutely accurate position of the indicator on the scale. The latter is plotted on opal glass, bent to an arc of 7-inch radius, and covers 70 degrees. Two 8 candle-power lamps placed immediately behind the glass serve the double purpose of illuminating the scale and lighting up the rear of the switchboard.

The instruments are practically non-inductive, hence operate interchangeably with any frequency. Although primarily designed for alternating currents, the line complete includes instruments for direct current work, superior accuracy, sensitiveness and attractive mechanical design being the points aimed at.

THE "XL" CUTOUT.

The "XL" cutout embodies features of design especially attractive to the central station man. The case has a pin for the insulator cast upon it, thereby avoiding the extra insulator bracket usually required. The opening of the lid of the case serves to draw the upper half of the block, which carries the fuse, out of circuit, thus avoiding all danger to the lineman in re-fusing. The porcelain parts are interchangeable, the fuse portion sliding out easily on removal of a single screw in the cast iron cover. The cutout will successfully take care of short circuits on any voltage up to and including 5,000, being designed to take care of 30 k. w. in line energy. The insulation against grounds is especially high. The case is absolutely waterproof, and will withstand a ground test of 10,000 volts in any kind of weather.



"X L" Cut-Outs.

THE BUSINESS OF THE COMPANY.

As already indicated in the beginning of this article, the business growth of the Wagner Electric Manufacturing Company has been steady and uniform, showing an increase of about 60 per cent. for each year over the preceding one. Even with the dull times of 1896 the actual gain in sales over those in 1895 amounted to 55 per cent., which would seem to indicate that a superior product is appreciated by the consumer, and that the demand for a better electrical apparatus is increasing yearly.

During 1895 the Wagner Company made several sales of its fan motors and transformers in France and Switzerland, and has since added to its foreign territory Japan, the Philippine Islands and Cuba. Its Canadian and Mexican trade has for several years been quite extensive. The company's entire foreign trade has shown a remarkable increase during the past year, the gain of that year over 1895 amounting to just 600 per cent.

The Wagner Company has several branch offices. In New York they are located at 1103 Havemeyer Building, with offices in charge of Mr. John Mustard, sales agent, with Mr. A. H. Mustard, assistant, in charge, and Mr. King. In Boston their branch office is at No. 620 Atlantic avenue, and is in charge of Mr. G. H. Kimber, sales agent. In Philadelphia, Mr. John Mustard, 1000 Betz Building, looks after the company's interests, as sales agent, assisted by Mr. D. H. Garrett.

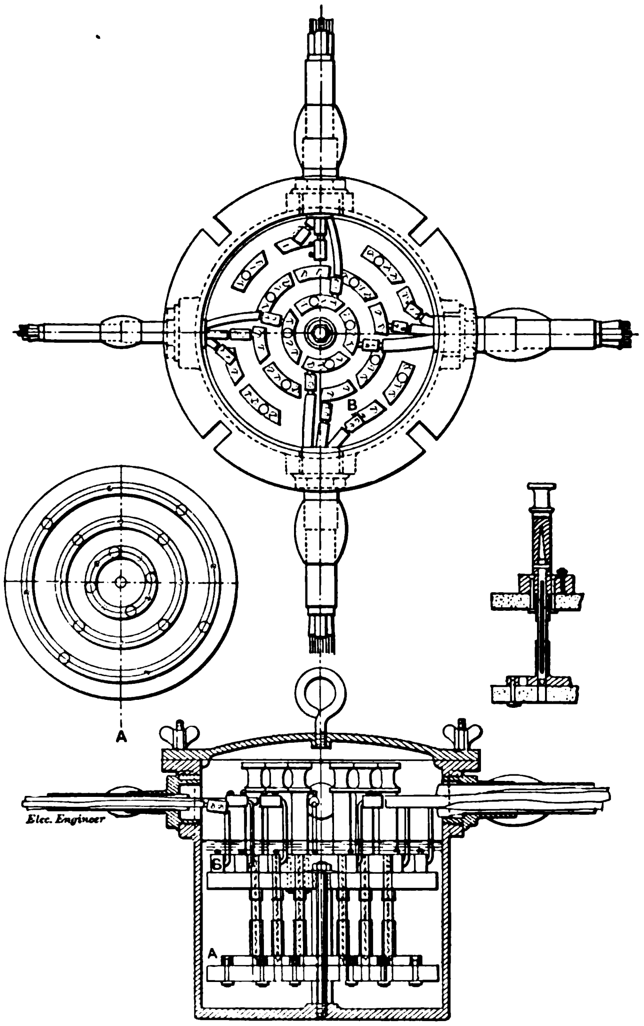
In addition to these branch offices the company has several agents representing it for the sale of its products. These are the Central Electric Company, of Chicago; the Western Electric Company, Chicago and New York; the California Electrical Works, San Francisco, exclusive agents for the Pacific coast, and the People's Electric Company, Madison, Wis., agents for the Northwest.

THE CLOOS JUNCTION BOX FOR HIGH POTENTIAL CIRCUITS.

With the advent of the high tension alternating current underground systems, there has been made apparent the necessity of an improved method of making service connections to the feeders in the manholes.

While the method of perfectly wiped joints gave high insulation it made an insulation test of the feeders proper impossible as all branches fed by a given feeder had to be made part of this test. When the insulation was low on a feeder to locate defective parts necessitated the cutting of a number of joints in order to divide the cable into sections; this caused the whole section fed by that feeder to be in darkness from the time the cable was disconnected until the renewal of the broken joints.

It was very evident that some method was urgently required by which a permanent and high insulated service connection could be made, permitting the cutting out of this service wire without disabling the feeder and at the same time allowing easy access to the ends of the cables for cutting out and testing.



The Cloos High Tension Alternating Current Junction Box.

This has been accomplished, and in a very successful manner, by Mr. Jacob Cloos, electrical engineer of Pabst Heat, Light and Power Plant, of Milwaukee, Wis., by means of a junction box which has been in successful operation for some time on the 2,400 volt underground system at the above plant. This box as shown in the accompanying engravings consists of a cast iron box of cylindrical section. The top of the box is made water tight by means of a lead gasket and holding down screws. The feeder and mains are conducted into the box through brass bushings screwed in with a lead gasket, the lead cover of the cable being joined in the bushing with a wiped joint, making the box absolutely water tight.

Within the box are two marble plates about 4 inches apart. Upon the top plate are mounted brass terminals arranged in concentric rows for two or more wire cables connected by special terminals and fuses to the various cables. Upon the lower plate are two or more continuous brass rings, directly under the brass terminals on the upper plate. The lower rings are made alive by pushing spring plugs through holes in the terminals connected to the feeder into corresponding holes of the lower plate. Any cable leading out is connected to the feeder by similar plugs leading from the rings to the cable terminals above. The boxes are filled with oil, thus forming a water proof joint of high insulation and one easily accessible.

These boxes have been operated when entirely submerged under water and no difficulty has been experienced whatever. They have demonstrated their great value on several occasions by enabling repairs to be made and faults to be located on sections, without interfering in any manner with the rest of the system connected to feeders.

The above described junction box was originally designed for underground work only. Since then the inventor has designed another box on the same principle for overhead construction covering all the essential points and features of the box described above.

EDUCATIONAL

THE STEVENS INSTITUTE OF TECHNOLOGY'S 25th ANNIVERSARY.

As already announced in these columns, the Stevens Institute of Technology will celebrate its 25th anniversary on February 18th and 19th. Preparations are now being actively pushed to make the event a memorable one in the annals of the Institute. The banquet to be held at the Hotel Waldorf, New York, will be attended by several hundred graduates and undergraduates, as well as by many representative men in the engineering and mechanic arts, who have been invited to be present.

The exhibition of the work of the Institute's graduates promises to be one of the most attractive features of the celebration. The applications for space will tax severely the capacity and facilities of the Institute, as many of the exhibits will be shown in actual operation. The exhibits range from single devices to a complete electric light plant operated by gas engine. The latter is the invention of Mr. F. P. Nash, a graduate of the Institute, who bears the distinction of being among the five most prolific inventors in the United States, there being over 200 patents issued to him, on various types and details of gas engines, water meters, etc. The exhibition of photographs, working drawings of apparatus designed, and works carried out, by graduates, will also be of more than usual interest and value.

The present occasion seems a fit one to call attention to the needs of the Stevens Institute of Technology, whose work has year by year outrun its facilities. The founder of the Institute, Edwin A. Stevens, Esq., originally bequeathed a plot of ground and $150,000 for the erection of a building "suitable for an institution of learning," together with $500,000 as an endowment fund. From this amount the U. S. Government in 1870 took about $45,000 as a collateral inheritance tax. As the courses of the Institute were broadened, increased funds were required for equipment, but as these were not available from the income of the endowment fund, the worthy President of the Institute, Dr. Henry Morton, has in the past generously provided the increased facilities placed at the disposal of students, out of his private funds, and we learn that in connection with the coming anniversary he has already transferred to the Trustees of the Institute 1,000 shares of the stock of the Texas Pacific R. R., to be held by them until, by reason of its increased value and other donations for the same object, a fund will be made up adequate to the erection and maintenance of a much needed new building, for which a considerable amount has been already raised by the Alumni Association.

This stock is to-day worth $10,000, but, representing as it does a property of great intrinsic value, may be reasonably expected to appreciate largely within a moderate time. This idea of presenting to the Institute something of growing value, which may be likely to advance so as to meet the enlarging demands of the future is, we think, worthy of imitation.

CHICAGO SCHOOL OF ELECTRICITY.

At the regular fortnightly meeting which was held at the rooms of the Chicago School of Electricity on Thursday evening, February 4, Mr. James Wolff, of the New York Insulated Wire Company, gave a very interesting talk on the subject of the manufacture of insulated wire. Mr. Wolff proved thoroughly conversant with the various processes which copper wire has to go through in the course of its manufacture. The audience, which was large, paid marked attention to the discourse, and on its conclusion Mr. Wolff received its warm thanks for his instructive lecture.

SOCIETY & CLUB NOTES

AN IMPORTANT FORTHCOMING EXHIBITION IN NEW SOUTH WALES.—A CHANCE FOR MORE EXPORT TRADE.

On June 26 a very important exhibition is to be opened in the Exhibition Building, Prince Alfred Park, Sydney, N. S. W. The exhibition will remain open during the months of July and August. It is intended to embrace engineering in all of its branches, and the exhibits will consist of raw materials, manufactured articles, machinery and models (in motion and otherwise), drawings and photographs of all kinds relating to scientific, mechanical and educational works, in classified sections. There will be no charge made for space allotted, but the Executive Committee reserves the right to limit the space of each exhibitor. The object of the exhibition is solely the advancement of engineering science and the promotion of a general and practical education therein. It will be non-competitive.

It is scarcely necessary to point out the advantages which will accrue to exhibitors in bringing their manufactures in such a prominent manner before the general public.

The exhibition will be under the patronage of the Governor, Viscount Hampden.

Among the various groups we notice Group IV. Prime Movers, comprising steam engines, gas, electric, hydraulic, hot air, etc., water wheels, turbines, windmills, etc., steam generators, accessories of engines or boilers.

Group V. comprises machine tools, hardware, edge tools, cooking appliances. Group VI. comprises railway, tramway and vehicular appliances, and embraces rails, switches, signaling apparatus, locomotives, goods wagons, carriages, etc., tramway cars, rails, permanent way, brakes, couplings, ticket checking apparatus, bicycles, tricycles and auto-cars.

Electricity, Group IX., occupies an important place and embraces generators, conductors, testing and measuring apparatus, telegraph and telephone apparatus, electric lighting apparatus, electro-metallurgy and electro-chemistry, transmission, distribution and utilization of power, lightning conductors, electro-thermic apparatus, and electro-medical apparatus.

There are important groups also covering hydraulic machines, refrigeration, chilling and dairying appliances, educational appliances, drawings and photographs.

The exhibition will be very comprehensive, and as those held in 1883 and 1886 proved exceedingly successful, it is expected that this exhibition will be a greater success than the others. The Executive Committee has appointed Mr. Edward Noyes, of Sydney, its representative in Europe and America for the purpose of obtaining exhibits. All communications on the part of intending exhibitors may be addressed to him, care the Standard Air-Brake Company, 100 Broadway, New York, and they will receive immediate attention.

This opportunity gives American manufacturers of electrical and engineering apparatus an excellent means of displaying their wares in Australia as the exhibition will be very largely attended. It opens a favorable field for leading the way to sales in that enterprising country.

LIGHTING AT THE CYCLE SHOW.

The cycle show, held in New York City last week, proved to be in reality two shows, there having been, in addition to the display of bicycles, a display of electric lighting effects. Many exhibitors spent more money for signs than for rent and other incidental expenses.

In addition to the regular house lighting of 5,000 16 candle-power lamps, a special service was taken from the United Electric Light and Power Company for the sign lighting and extra illumination in the booths. This extra lighting amounted to more than 16,000 lamps evenly distributed over the three floors. All the work on the extra lighting was done under the direction of Marcus Nathan, and the consulting engineer of the board, Frank Patterson.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION will hold its annual convention at Niagara Falls, N. Y., during the last week in May or early in June.

REPORTS OF COMPANIES

ANNUAL REPORT OF THE NEW YORK EDISON CO.—INTERESTING FIGURES.

THE annual report of the Edison Electric Illuminating Company, of New York, has just been issued and shows a remarkably healthy growth in the business of the company during the past year.

We give below an extended abstract from the report of the first vice-president, Mr. R. R. Bowker:

The year 1896 has continued the good record of this company for successful and profitable results. The increase in installation has been unusual, reaching 125,000 16 candle-power equivalent, or 28 per cent., largely in power business, this increment alone exceeding the total installation of any other electric supply company in this city. the gross station returns have increased 14⅜ per cent., while the general and operating expenses have increased but 7½ per cent.

The following table shows the net increase in the several classes of installation and in earnings in the past year, reckoning a standard arc lamp as the equivalent of ten 16 candle-power incandescent lamps and a horse-power in motors as the equivalent of fifteen 16 candle-power incandescent lamps:

	1896. Dec. 31.	1895. (Jan. 1, 1896.)	Increase in 1 year.	P. C. Inc.
No. customers ...	6,562	5,705	857	15
No. inc. lamps...	279,405	218,877	60,528	27
No. arc lights....	3,225	2,964	261	8
No. motors, h. p...	15,930	11,640	4,290	36
Totl equiv. 16 c. p..	560,342	434,834	125,508	28
Gr's sta'n ret'ns†.	$1,771,229.83	$1,544,822.78	$226,407.05	14⅜
Gn. & op. exp's*.	836,396.77	759,472.71	56,924.06	7½
Net sta'n returns†	934,833.02	785,350.07	149,482.99	19
Prop. exp's* to grs†	47%	50%		

These figures include only Edison central station direct service.

The following table gives the figures inclusive both of Edison central station service and of isolated plant installations supplied from the Edison stations during minimum hours or for emergencies:

	Central Station Service.	Isolated Plant Service.	Total Service.
Customers	6,562	72	6,634
Meters	8,441	91	8,582
Incandescent lamps	279,405	64,705	344,110
Inc. lamps, 16 c. p. equiv.	286,532	68,447	354,979
Arc lamps, number	3,225	889	4,114
Arc lamps, 8 ampere equiv.....	3,486	889	4,375
Motors, h. p.	15,930	1,142	17,072
Total equivalent	560,342	94,467	654,809

These figures do not include those of the high-tension companies operated under the supervision of this company and constituting practically the high-tension division of this company. These companies had on their station service December 31, 1896, 29,964 incandescent and 2,334 arc lights, and 23 horse-power in motors, or an equivalent of 53,649, which, added to the Edison station service, gives a total of 613,991, or, with isolated plant service, 708,458 16 candle-power equivalent.

Bowling Green Storage Battery Annex.—The generating plant in that portion of the Produce Exchange Building rented from the Produce Exchange as an annex station, was entirely removed in the month of April, and in its place provision was made for a storage battery Annex in the new Bowling Green Building, so near as to permit the utilization, by running feeders across Broadway, of the existing distributing center adjoining the Produce Exchange. By arrangement with the proprietors of the Bowling Green Building, space was obtained in the sub-basement of that building for the installation of a storage battery, supplied by the Electric Storage Battery Company, of Philadelphia, of a capacity of 8,000 ampere hours at a ten-hour discharge rate or 4,000 amperes at 125 volts for one hour. By careful handling of the charging of the battery, it has been practicable to keep the large units at the Duane Street Station operating at practically full load and with most economical results, during the hours while these are in service.

An Annex Station, installed on premises temporary leased at 72d street and 5th avenue, is supplied by the Manhattan Company from its main station at the foot of 80th street, with high tension two-phase alternating current, operating a 240 k. w. two-phase motor at 2,000 volts. This drives two 100 k. w. 135 volt Edison direct current dynamos, furnishing low tension current which reinforces the supply in the upper district, pending the further development of the 53d Street Station system.

"Operating Results.—The highest load of the entire system taken together was on December 15, a maximum of 79,360 amperes. The best daily average of the system was on December 22, 28,926 amperes..

The total current generated in the year was in the downtown district, 68,738,565 ampere hours, and in the uptown district 84,581,417 ampere hours; in both districts a total of 153,319.982 ampere hours.

The modern equipment of 12th Street Station, including the storage battery, the turbo-generator and the water cooling tower, has shown most interesting and on the whole satisfactory results, although there have been some drawbacks in the handling of all these new classes of appliances, as is usually the case in pioneer work. By help of the storage battery at 12th Street, the generating plant of the entire system, with the exception of that of the 26th Street Station, was shut down on several occasions over night or over Sundays, for the purpose of testing the practicability of running the entire system from one generating plant during the hours of minimum load. The results show that this is quite practicable, and with the aid of the new storage battery in the Bowling Green Annex, it is probable that considerable improvements in economy will be developed in this way during the coming year.

Underground Installation.—The mileage of the underground street system December 31, 1895, was, on the 3-wire system, 68.76 miles of feeders and 133.92 miles of mains, a total of 202.68 miles of the 3-wire system; and on the 2-wire system, 0.24 mile of mains. The total mileage December 31, 1895, including 1.41 miles of cable feeders contiguous to the stations, was 202.92 miles of mains and feeders. The system also included December 31, 1895, 1,160 junction boxes at intersections.

The net increase of the system, in both districts, is 6.41 miles, bringing the grand total December 31, 1896, to 209.33 miles. The increase in junction boxes has been 48, making a total of 1,208. The number of service connections added during the year was (net) 317 in the downtown district, and 402 in the uptown district; in both 719.

Inspection Department.—The Inspection Department has been most successful in its work of the year, combining as hitherto the functions of the general agency and of general inspection, increasing the business of the company and at the same time improving the standard of insulation and of installation generally. During the year 230 contractors have reported installations, involving 2,840 reports. Of these 13 have reported installations reaching over 1,000.

Of electric motors, in which the exceptional development of 1895 has continued throughout 1896, 47 types have been installed on the system, numbering 1,319 motors, averaging 3.47 h. p. each and aggregating 4,290 h. p. The use of electric elevators continues to increase.

Meter Bureau.—The Meter Bureau, under the general charge of the Controller, has been very efficient during the year; it had under its care on December 31, 1896, 8,532 meters in customers' premises, of which the great number were Edison chemical meters. The most careful attention has been given to complaints from customers, as to amount of bills, etc., of which 1,359 were received during the year. In connection with these complaints, 86 errors were found, of which 63 were clerical and 23 technical, 14 of these last because of the freezing of meter bottles during extremely cold weather. The proportion of errors to bills rendered was but 1 in 1,107, or less than 1-10 of 1 per cent. The policy of offering to submit any disputed case to arbiters has been continued with satisfactory results.

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* Exclusive of depreciation charges. † Not including outside earning.

Relations with Employés.—During the year past, the benefit-dividend paid to employés, has been placed on a more definite basis, so that the employés more directly reap the advantage of the bettered economies and increased revenues which they help to bring about. After deducting from the gross earnings a sum covering operating and general expenses, depreciation charges, and a minimum return on capital, a percentage on the balance equal to the rate of dividend paid to stockholders has been appropriated for the employés benefit fund. From this, there has been paid, in the week preceding Christmas, to all employés in continuous good standing in the service of the company, 4 per cent. on the annual salary or wages to those in the employ of the company for 10 years, 3 per cent. to those of 5 years' service, 2 per cent. to those of 3 years' service and 1 per cent. to those of one year's service. There are many evidences that this form of profit-sharing is thoroughly appreciated by the employés and it is believed that the effect is to obtain the most hearty co-operation of all in bettering the efficiency of the company's service.

Electrical Developments.—An electrical kitchen is now in practical operation at the company's building and can be seen on specified days in the week, on application by letter. The development of apparatus for this purpose is in a more promising state than ever before and its promoters are working in hearty co-operation with this company.

The development of the enclosed arc light, which requires trimming only once a week instead of once a day, is also proving a considerable advantage to this company and it furnishes a method of lighting large interior spaces which is most economical as well as most effective.

The net earnings of the company for the year were $960,156.94, including $126,582 earned by the high tension system (Manhattan Electric Light Co.) The company paid $322,100 interest on its bonds, and $476,220 in dividends (6 per cent.) on its stock of $7,938,000 issued. The report also treats of the city lighting done by the company, reference to which is made elsewhere in this issue. Reference is also made to the promotion of Mr. John W. Lieb, Jr., to the general managership of the company in recognition of his past services. Fitting reference is also made to the loss sustained by the death of Mr. Harry J. Smith, the late general operating superintendent of the company, in memory of whom a memorial is being prepared by the staff, to which the company is also contributing.

THE STOCK MARKET

GENERAL QUIETNESS.

THE condition of the industrial and stock markets during the past week has been dull, but curiously uneven. There has been a break, for example, in price of rails, but leather has gone up. The railway share market and bonds have been firm, but industrials, in spite of steadily improving trade, have weakened a bit under pressure of the bears. That the general state of affairs is better, outside the unsettled politics of hell's kitchen down in southeastern Europe, is shown by the list of some thirty signs of incontestable improvement enumerated by a financial authority.

For a great property, American Bell Telephone is always singularly inactive, but it was seldom more so than last week when only 248 shares were sold, making an advance of half a point up to 217½. From Boston, however, come reports of a movement contemplated by a group of local holders of General Electric preferred stock to take the matter of their unpaid dividends into court. They may set up the claim, on the recommendation of New York attorneys, that the pending dividend default gives them a lien on current earnings from the date on which they demand and fail to receive payment. It may also be set up that official representations upon which the preferred stock was sold made a contract additional to the stated terms in the issued certificates. During the week, in New York, 10,231 shares of General Electric were sold, declining from 35¾ to 34⅜.

In telegraph stocks there was little activity and the same is generally true of local lighting and street railway securities all over the country. The weather and the holidays account perhaps for much of the apathy. Of Western Union only 5,528 shares were sold, declining slightly to 82⅜.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEBRUARY 9, 1897.

Batteries, Primary:—

GALVANIC BATTERY. H. J. Brewer, New York, 576,720. Filed May 18, 1894.

Comprises a covered cell, a central carbon surrounded by loose carbon contained in a pervious sack, and a zinc element.

BATTERY. F. B. Badt, Chicago, Ill., 576,936. Filed Sept. 7, 1894.

The jar is provided with a circular channel at the upper edge, and a circular projection upon the cover is adapted to rest in the channel, a liquid insulating material in the channel, permitting the escape of gas.

Connectors, Conduits and Insulators:—

OUTLET BOX. J. J. J. DeRycke, New York, 576,810. Filed May 2, 1896.

A thin cast-iron box divided along the midthickness and having a series of discs arranged on the side walls and bottom capable of being broken away by light blows of a hammer, leaving a clean circular opening where required to receive the open end of the conduit.

Electro-Metallurgy:—

APPARATUS FOR ELECTRICALLY HEATING METAL. G. D. Burton, Boston, Mass., 576,545. Filed March 30, 1895.

Apparatus for heating metal to a forging, welding or fusing heat by means of an electric arc sprung between the metal and an electrolytic bath.

Lamps and Appertenances:—

ELECTRIC ARC LAMP. H. Baurlin, Aarburg, Switzerland, 576,802. Filed May 11, 1896.

Feed mechanism for shunt regulated arc lamps.

Miscellaneous:—

TROLLEY SYSTEM. W. F. Caffrey, Reno, Nev., 576,721. Filed April 2, 1896.

Adapted for horseless carriages.

ELECTRIC HEATING APPARATUS. A. Robertson, Taunton, Mass., 576,766. Filed April 5, 1895.

Comprises a casing perforated at its bottom and along its upper front portion; a plurality of heating bars each made up of a wide thin bar of metal, an insulating covering and a heating coil.

Railways and Appliances:—

ELECTRIC LOCOMOTIVE AND RAILWAY SYSTEM THEREFOR. M. Schalscha, Hoboken, N. J., 576,622. Filed Feb. 20. 1896.

Automatically controlled car adapted for conveying material such as coal from a vessel to place of storage.

STATION INDICATOR. J. D. Keen and J. J. Roberts, Louisville, Ky., 576,854. Filed Sept. 24, 1896.

By closing the circuit the motor is released and moves the ribbon to bring into view the name of the next station.

ELECTRIC LIGHTING FOR VEHICLES. J. A. Ageron, Paris France, 576,933. Filed Aug. 2, 1895.

A generator adapted to be operated by the rotation of the wheels.

Regulation:—

ELECTRICAL REGULATING DEVICE. J. F. Kelly, Pittsfield. Mass., 576,732. Filed July 24, 1893.

Comprises an alternating current generator used as a source of electrical supply, one or more feeders for conveying the current from the same, and a regulator for each feeder, consisting of an induction motor connected with the feeder and driven at a speed above that of synchronism.

Switches, Cut-Outs, Etc.

ELECTRIC SWITCH. M. Schalscha, Hoboken, N. J., 576,621. Filed Feb. 20, 1896.

Automatic motor switch.

VENTILATED FUSE PLUG FOR ELECTRIC CIRCUITS. H. C. Wirt, Schenectady, N. Y., 576,710. Filed Nov. 20, 1896.

Details of construction.

Telephones:—

TELEPHONE TRANSMITTER. M. E. and E. C. Clark, Minneapolis, Minn., 576,551. Filed Sept. 23, 1895.

Comprises a diaphragm of insulating material, with a multiple contact device secured directly upon it, and provided with a large number of contact points, a disc to engage the contact points and a binding piece of material similar to that of which the diaphragm is formed, and whereby the disc is secured upon the diaphragm and multiple contact device.

TELEPHONE SYSTEM. A. S. Hibbard, Chicago, Ill., 576,577. Filed May 4, 1896.

Coin controlled telephone system.

TELEPHONE APPARATUS. C. E. Buell, North Plainfield, N. J., 576,804. Filed April 24, 1895.

A subscriber's station apparatus that comprises a telephone apparatus in a derived branch, a calling instrument in the main line, a local circuit that includes the primary of an induction apparatus, and connections from the derived branch local circuit to the armature of the calling instrument.

TELEPHONE TRANSMITTER. J. F. Gilliland, Adrian, Mich., 576,813. Filed Dec. 21, 1895.

Comprises saucer-shaped electrodes provided with a groove about the facing edges, a resilient non-conducting ring located in the grooves, granular conducting material confined between the electrodes, and opposite axial bearings for supporting the united electrodes.

LEGAL NOTES

STATE TAXES OF TELEGRAPH COMPANIES SUSTAINED.

The United States Supreme Court has sustained the Indiana law taxing telegraph companies, which was brought up for review by appeal from the judgment of the Indiana State Supreme Court. From this decision Justices Harlan and White dissented. One reason for their dissent was stated by Justice Harlan. The law of Indiana taxing railroad companies provides a penalty of 16 per cent. for delinquency; in the case of telegraph companies the penalty for delinquency is increased to 50 per cent. This, Justice Harlan said, was a denial of equal protection of the law guaranteed by the Federal Constitution.

SWITCH PATENT CASE DECIDED IN FAVOR OF THE WESTERN TEL. CONS. CO.

Judge Showalter, in the United States Circuit Court, at Chicago, has handed down a decision in the case of the Western Electric Company, representing the Bell Telephone Company, against the Western Telephone Construction Company, finding in favor of the defendants. Suit was brought against the Western Telephone Construction Company for an alleged infringement on the Western telephone switch, a device doing away with the call bell. Judge Showalter held that the switch was no novelty, the same idea being embodied in the prior Watson and Roosevelt patents. The details of the case have already appeared in these columns.

LETTERS TO THE EDITOR

TO PREVENT TAMPERING WITH METERS.

We have found places where the electric light meters have been tampered with and in other places current has been stolen and connections made with feed wires without the knowledge of the Light Department. In order to successfully prosecute such cases we propose to have an act passed in the State Legislature which will give the courts power to punish the theft or undue interference with meters and electric light wires.

BOARD OF PUBLIC WORKS.
By David Rydstrom.

Tacoma, Wash., Feb. 2, 1897.

PERSONAL

CAPT. SAMUEL TROTT, of the cable steamer "Minia," was a visitor in New York last week, where his many friends were glad to see him in restored health and to congratulate him on his recent saving of lives at sea.

MR. JOHN CAMPBELL, who was until recently the local superintendent and manager of the Postal Telegraph Company at Pittsburg, has accepted the position of manager of the Pittsburg district of the independent Home Telephone Company which proposes to carry on a vigorous opposition. Mr. Campbell is a man of marked energy and ability.

MR. ALBERT VICKERS has been made general manager of the Buffalo, North Main street and Tonawanda Electric Railroad. He announces a number of improvements to be constructed in the spring.

MR. F. H. MICHALES has been appointed city electrician of Peoria, Ill. He is an experienced man and graduates from the telegraph service.

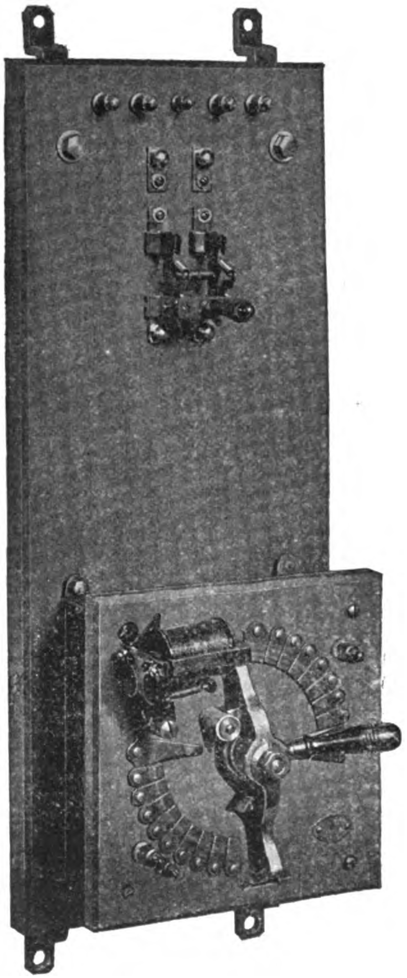
MR. WILLARD E. CASE is to lecture before the New York Electrical Society at Columbia College, on Feb. 24, his subject being "Electricity from Carbon Without Heat." Mr. Case has long been an experimenter in this field, and has a great deal of interesting and valuable data, which will be appreciated by electrical engineers and students in all lines. Mr. Case has made for the occasion a variety of apparatus to illustrate types and principles.

MR. WM. TAYLOR, the well-known electrical manufacturers' agent at 203 Broadway, has won the prize of a trip around the world given by the "Evening Telegram," for the nearest guess to Mr. McKinley's plurality in the popular vote. He made nineteen coupon guesses and one of them was 597,397, or within 8 of the actual 597,389. The next 49 nearest guessers will be given a free trip to Washington for the inauguration exercises.

TRADE NOTES & NOVELTIES

NEW G. E. PANEL BOARD.

THE importance of economy in the space occupied by operating appliances and the necessity of making as few wiring connections as possible in small direct current motor installations, has assumed the shape of a brisk demand, which the General Electric Company meets by a series of small switchboard panels designed for motors of the usual voltages and capacities ranging from ½ horse-power up to 16 horse-power. The equipment of each panel consists of a main switch, fuse-holder and motor starting rheostat with automatic release switch, the connections themselves being embodied in the panel. For motors up to 300 volts, open fuses are used, while for voltages higher than 300 volts, magnetic fuse holders are mounted on the panels.



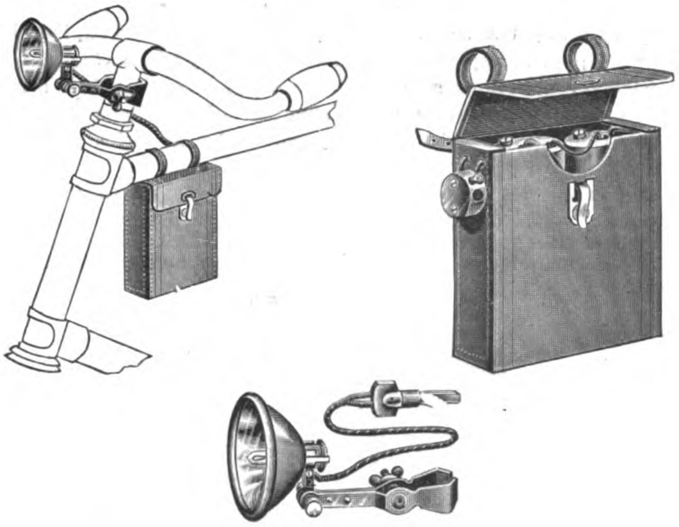
New G. E. Panel Board.

The only connections necessary when installing the motor are those from the motor and mains to the five binding posts at the top of the panel. The panels are of plain slate, enameled slate or blue marble, the enameled slate being considered superior on account of its wearing qualities and finished appearance. Each panel is self contained and is provided with iron supports for adjustment to the wall or to a post adjacent to the motor.

THE "LUMINO" ELECTRIC BICYCLE LIGHT.

THE Cycle Exhibition just concluded in New York, exemplified the wide application of electricity in this as in almost every other field of daily work and diversion. Bicycle riders have from the beginning been longing for a light which will relieve them from the annoyances of the oil lamp, and also afford a more powerful and reliable illumination. To meet their wants, the Leecol Storage Battery Company, of 76-82 Jackson Boulevard, Chicago, Ill., have got up a neat little storage battery and electric lamp outfit, which they have named the "Lumino," and which attracted much attention at the Show. The outfit consists of a two-cell storage battery enclosed in a leather case, hung from the top bar of the diamond frame, or from the handle bar of the drop frame machine, as shown in Figs. 1 and 2.

The lamp is enclosed in a small, heavily silver plated reflector, Fig. 3, which is mounted on a swivel support, and connected with the battery by short flexible cords.



Figs. 1, 2 and 3.—The Lumino-Electric Bicycle Lamp.

The miniature incandescent lamp is mounted on a cartridge shaped base, so that it can be pushed into the back of the reflector.

The battery has capacity sufficient to afford a light for eight hours, but larger batteries can be arranged for longer lighting when desired. The batteries are accompanied by a resistance in the shape of an incandescent lamp, by means of which they can be charged directly from an incandescent light circuit.

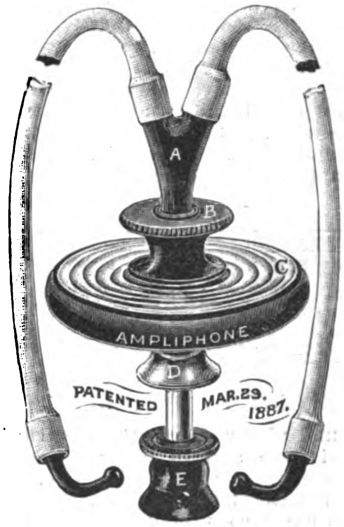
The whole outfit is gotten up in a workmanlike manner and ought to take well among the wheeling fraternity. The storage battery is of extremely simple form, and appears to have remarkable powers of endurance and stability.

P. & B. INSULATING COMPOUNDS.

Mr. Frank S. De Ronde, the general sales agent of the Standard Paint Company, 81—83 John street, New York City, says: "The demand for our well known P. & B. insulating compound is constantly increasing. There are some manufacturers who are pushing their goods to the front as the "best" with nothing to prove their bold assertions but their own claims. It takes but a short time to demonstrate the worthlessness of these inferior materials. In the many years that P. & B. has been before the electrical public it has proven itself to be all and more than the manufacturers claim for it. In special places where an insulating and preservative compound is needed, people cannot take the chances of using an inferior material when they can get P. & B. at a reasonable price. Our goods are handled by dealers everywhere. If for any reason electricians cannot get P. & B. from their dealer, we invite correspondence direct. We are willing to send good sized samples of our insulating compound, preservative paints, armature varnish, and insulating tape to any electrician who will ask for them. We will not send little samples by mail, but good sized samples by express prepaid, sufficient for practical trial. Even our preservative paint, which is sold at a price competing with the cheap, inferior, so-called insulating paints, will give much better satisfaction than any of these in the market. Years of use prove more than a few hours or a few days' trial. Our references are electricians and electrical manufacturers the world over."

THE AMPLIPHONE.

THIS instrument, which is now attracting wide attention among the medical profession on account of its peculiar adaptability to their uses in the magnifying of sounds pertaining to diseased organs, etc., is the invention of A. A. Knudson, well known as an inventor in electrical and acoustic apparatus. Although this invention was patented ten years ago, and first intended for use in telegraphy, by providing a method by which only the operator could take a message from a relay adjusted low, it has not as yet come into use for that purpose, although successfully tried on the lines of one of the large companies. The instrument itself as now designed is very simple in construction. By referring to the cut a good idea of its construction and appearance may be obtained. It will be seen that the magnified sound of the ampliphone is conducted to the ears of the person using it, through rubber tubes which terminate in hard rubber ear bulbs similar to those of the phonograph. These rubber tubes branch out from the Y-piece of the instrument, A, which is inserted in the socket which connects with the air chamber of the instrument. B is the hard rubber knob which is screwed to a stud which projects through the diaphragm, C, and serves as a handle to manipulate the instrument. C is the upper diaphragm, the lower one not being shown, but is an exact counterpart; both of these diaphragms are pressed out of very thin aluminum, the exact thickness being 12/1000 of an inch, and are shaped with circular corrugations. These diaphragms are slipped over the edges of a brass rim having grooves into which the edges of the diaphragms are depressed and are thereby firmly secured. A polished rubber ring is then driven over the whole which completes its finished appearance. D is a metal bell-shaped terminal, which is placed against the object or person whence the sound emanates. E is a hard rubber bell screwed to the end of the small metal tube, which is also screwed when in use into the metal bell, D, attached to the instrument.



Knudson Ampliphone.

All of the metal parts, including diaphragms, are nickel-plated, and highly polished, making a handsome and attractive looking instrument. The whole appliance weighs but two and a half ounces and can easily be carried in the pocket. A morocco case lined with satin is furnished in which it is kept together with the tubes when not in use. Mr. Knudson informs us that he expects to make other applications of this invention either in its present or modified form, and we shall look with interest for new developments in other fields where it may prove as useful and successful as it is now in the medical.

The sole manufacturers of this appliance are Fred. Haslam & Company, 83 Pulaski street, Brooklyn, N. Y.

HELIOS.

THE new edition of the Heine Safety Boiler Company's catalogue "Helios" is, if anything, even more useful than its predecessors. There is scarcely a problem in the generation or utilization of steam that is not treated of and reduced to data in "Helios," and as a result the volume is of the greatest possible value to every steam user. We find among its pages valuable tables on the properties of steam, the heating value of the principal American coals, analyses of water for boilers, chimney construction, condensation in pipes,—in fact everything that the owner or operator of a boiler ought to know.

Not the least interesting part of the work is the series of views of buildings in which the Heine safety boilers have been installed. They embrace the whole country and form a striking testimonial of the merits of the company's product.

THE NEW YORK TELEGRAPH AND TELEPHONE CONSTRUCTION CO.

Mr. Paul Minnis, chief engineer of the New York Telegraph and Telephone Construction Company, and New York representative of the Best Telephone Manufacturing Company, of Baltimore, left on the 4th inst. for a Southern business trip of about two months. Mr. Minnis is interested in the Southern Home Telephone Company, a parent organization lately organized to operate in the States of North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas and Tennessee. This company is being promoted under the auspices of the Southern Telephone Security Syndicate, a promoting and brokerage company organized for the purpose, and it is in the capacity of trustee of this latter organization that Mr. Minnis goes South.

While in the South he will decide upon the location of a telephone factory to handle the overflow from the Best Telephone Manufacturing Company, of Baltimore, that company having found the demands upon it by its affiliated companies so far in excess of its possible present output, that it is forced to establish subsidiary factories in order to take care of its increasing business. Inducements have been offered by three available Southern cities, but Mr. Minnis states that it will probably be two or three weeks before the preference is given to any one of them.

ADVERTISERS' HINTS

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., publish a list of recent sales of dynamos, motors and engines. It is a good one and sets forth quite clearly the growing popularity of their apparatus.

THE GENERAL ELECTRIC COMPANY state that there are now over 300,000 of their arc lamps in service.

THE NATIONAL TUBE WORKS COMPANY claim to be the largest makers of all sizes and kinds of special wrought mild steel and best wrought iron tubular goods in the world, controlling the manufacture of wrought tubular goods made of a high class of mild steel from the ore to the finished product.

THE C & C ELECTRIC COMPANY include everything in their manufacture of electric machinery for the complete equipment of central stations and isolated plants.

THE AMERICAN ELECTRIC METER COMPANY, Philadelphia, have removed their offices from the Betz Building to Ninth street and Montgomery avenue.

THE CROCKER-WHEELER ELECTRIC COMPANY draw special attention to the design and finish of their belted and direct connected dynamos and motors.

THE SHELBY ELECTRIC COMPANY, Shelby, O., claim their incandescent lamps are 20 per cent. more economical and 30 per cent. longer lived than any other.

CHAS. WIRT, Philadelphia, offers a very convincing testimonial regarding the merits of his dynamo brushes under constant service.

McLEOD, WARD & CO., 27 Thames street, New York, say that none of the imitators have been able to equal them in their desk light—the "Kinsman."

THE AMERICAN STEEL ROOFING COMPANY claim to have a roofing which is all that is needed: fireproof, durable, neat and economical.

CAHALL SALES DEPARTMENT advertise a list of companies using their boilers.

TRIUMPH ELECTRIC COMPANY, Cincinnati, O., make a specialty of direct current municipal lighting plants.

DONLEY & BUNCE, Monadnock Building(Chicago, are exclusive agents for the Cloos junction box.

ABENDROTH & ROOT MANUFACTURING COMPANY, New York, point out many advantages their boilers possess.

BIBBER-WHITE COMPANY, 49 Federal street, Boston, Mass., are selling the "Boston" transformer.

THE WESTERN ELECTRIC COMPANY have issued a very complete price list on Boudreaux dynamo brushes, Perfection dynamo brushes, Wirt dynamo brushes and carbon brushes. All central station men should have one of these price lists on file.

NEW YORK NOTES.

SPRAGUE ELEVATORS.—A large 20-story building is being put up for R. G. Dun, of the Dun Commercial Agency, at Broadway and Reade street, and a contract has been awarded to the Sprague Electric Elevator Company for six multiple sheave electric passenger elevators, and one freight machine. These elevators are to have an average speed of 450 feet a minute, and will be installed with all the most modern and approved appliances. The Sprague Company continues to capture a great deal of the best work not only in New York, but all over the country.

KENT'S LUBRICATING COMPOUND.—This compound is constantly increasing in popularity. Owing to its peculiar composition it adheres to the bearing surface, where it is needed, instead of flowing away from it. Every particle of it is a lubricant, but the mixture is so happily chosen that they blend perfectly and form a homogenous and stable compound. Among the hundreds of users of Kent's compound we may mention the following recent ones: The New York Herald, Consolidated Gas Company, Jackson Architectural Iron Works, L. H. Mace & Co., Travers Brothers, Bronx Company, F. E. James, branch of National Wall Paper Company; J. L. Mott Iron Works, Methodist Book Concern, Quintard Iron Works, J. E. Linde Paper Company, Potter Printing Press Company, Baumgarten & Co., Messrs. William M. Crane & Co., Columbia Typewriter Company, Messrs. Joseph Wild & Co., the P. Lorillard Company, Principio Forge Company, Siegel-Cooper Company, N. Y. Quinine Chemical Works, Messrs. Otis Brothers, Johnston Building, Man. Company and Merchants' National Bank Building, Messrs. James Pyle & Son, Metropolitan Street Railway Company, National Saw Company, De La Vergne Refrigerating Machine Company, Interior Conduit and Insulation Company, Louis Bossert, Ferguson Brothers, Edwards & Co., Judge Building, George Fox's Sons, Central Cooperage Company, Hudson Steam Laundry, Harper Brothers, Standard Bleachery, Robert Gair, N. Y. Biscuit Company, Walden Knife Company, Tyler Tube and Pipe Company, Urban & Co., Messrs. R. H. Wolff & Co., Presbyterian Building, American Surety Building, Mr. John T. Williams (builder), the Union Pearl Works, Messrs. Curtis & Blaisdell, Messrs. Joshua Oldham & Sons. The Kent's lubricating compound is sold by the New York and New Jersey Lubricant Company, 30 Cortlandt street, New York.

KINSMAN AND KNUDSON is the name of the new firm just established by F. E. Kinsman and A. A. Knudson, both of whom are widely known as engineers and inventors. They have opened offices in the Manhattan Life Building, 66 Broadway, as consulting and supervising electrical engineers, and will make expert examination of new inventions and new enterprises.

MR. H. H. HUMPHREY, of the firm of Bryan & Humprey, consulting mechanical and electrical engineers, St. Louis, is a visitor East, and was in New York City last week.

HENRY R. WORTHINGTON has just been awarded a contract by the City of Chicago, covering six vertical triple expansion direct-acting high duty pumping engines, each of twenty million gallons daily capacity. This contract amounts to $437,600, and is the largest contract for water works pumping machinery ever placed in this country. The above six engines each have a daily pumping capacity of twenty million gallons against a head of 150 feet, and will be supplied with steam at a pressure of 140 lbs. to the square inch. The engines will each be of 530 horse-power. This company is also building three vertical triple expansion direct-acting high duty pumping engines for the city of Brooklyn, N. Y., under a contract amounting to $385,000. These engines each have a daily capacity of twenty million gallons to be delivered against a head of 168 feet, and the steam will be supplied at a pressure of 135 lbs. to the square inch, each engine being of 600 horse-power.

POLES BY THE THOUSAND.—The largest order ever placed for manufactured tapering yellow pine poles, numbering 3,000, ranging in length from 25 to 35 feet, has just been awarded to S. C. Strock, of 50 Broadway, New York, by the American Telephone and Telegraph Company, for use on its lines. Mr. Strock is a man well known to the electrical field on account of his former connection with the Thomson-Houston and General Electric Companies.

MR. W. POMEROY, of the Bossert Electrical Construction Company, Utica, N. Y., delivered a lecture there last week before the Railroad Y. M. C. A., on "Electricity: Its Past, Present and Future."

MR. CHAS. B. MARTIN has been appointed electrical engineer of the Brooklyn Bridge at a salary of $2,500.

THE IRON CLAD RHEOSTAT COMPANY, of Westfield, N. J., have just issued a new broadsheet price list of their new theatre dimmers. They cover the ground thoroughly in a great variety of styles. There are over 2,500 of these dimmers in daily use, varying from 1 to 1,440 lights capacity. Many of these have the company's special interlocking device. The Iron Clad Company make a specialty of theatre dimmers and have a long list of patrons, attesting the superior character of their product. Cuts, sizes, prices, etc., are carefully given in the sheet, which the company will be glad to forward to any address. It will also be glad to furnish data or respond to inquiries in regard to new work in this line.

F. P. JONES, of 126 Franklin street, Buffalo, informs us that he has sold out his interest in the F. P. Jones & Co., a corporation which, together with its predecessor of similar name, has been doing business in the city for ten years past. He has opened up in the same line, and wants to receive manufacturers' prices, catalogues, etc.

WESTERN NOTES

THE ELECTRIC APPLIANCE COMPANY are at present distributing two very neat circulars of some of their specialties and staple goods, one circular being devoted to porcelain tubes and insulators, and the other to sparkless and Boudreaux dynamo brushes. In connection with the circulars, the Electric Appliance Company are quoting a revised discount on these goods, low enough to warrant the assurance that considerable business will result. They will be pleased to send circulars and quote discounts where they have not already been received.

CENTRAL ELECTRIC COMPANY announce that they are having quite a demand for their new type of station switchboards. These are finished in various designs, and are shipped assembled ready for erection if desired.

THE METROPOLITAN ELECTRIC COMPANY of Chicago, have been given the Western Agency for the Ham Sand Box. This is a new sand box for distributing sand and gravel on the rails, while the cars are in motion. It is used on railroad trains as well as street cars, and the box is making a good deal of stir in the railroad world. The great trouble with sand boxes is that they operate with a valve, and this valve gets clogged up with the sand and the gravel passing through it. This new sand box, however, gets away with this difficulty entirely by omitting the valve, and substituting a simple device for equally distributing the material to be used on the tracks, whether it be sand, gravel or salt. The company are putting them out on trial, not to be paid for unless satisfactory, and are making a very low price on this sand box.

NEW ENGLAND NOTES

FRENCH COFFEE POTS.—This week the American Electric Heating Corporation, of Boston, announce the addition of a French coffee pot to their line of domestic utensils. In the past, such articles have been made with the electric heater permanently attached to the device, thereby rendering it nécessary to have a number of complete outfits to do a limited amount of work. The coffee pot above referred to is made to fit a 4½-inch disc heater and is of ample size for the wants of four people. It is made of block tin and so designed that all of the heat generated in the stove is used. Two of the $4 stoves, with a stew pan and coffee pot, will enable a family to cook a breakfast of coffee, toast and eggs in the time required to build a fire and get the ordinary stove ready.

PHILADELPHIA NOTES

WIRT DYNAMO BRUSHES.—Mr. Chas. Wirt, 1028 Filbert street, Philadelphia, has received the following letter from John Weyker, chief engineer, Kinsley's Restaurant, Chicago: "The Wirt dynamo brushes which you furnished for our Edison dynamo four years ago, have been in use seven days a week and about fifteen hours per day ever since. The brushes are still good for some time to come and the wear on the commutator is imperceptible."

SOUTHERN NOTES.

BALL ENGINES.—The Wilmington Gas Light Company, Wilmington, N. C., is installing a 350 horse power horizontal cross compound engine built for them by the Ball Engine Company, Erie, Pa. A 60-horse-power engine direct connected to 25 horse-power General Electric dynamo, has been recently placed in the Church Home and Infirmary of Baltimore, Md., by Crook, Horner & Co., representing the Ball Engine Company.

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The Electrical Engineer.

Vol. XXIII. FEBRUARY 24, 1897. No. 460.

MISCELLANEOUS

DETAILS OF CARBORUNDUM FURNACE AND ITS OPERATION.

While a good deal has been written about the manufacture of carborundum, very little has been said, so far, about the electrical part of the work. The following details of the operation of a carborundum furnace may, therefore, be of interest to electrical engineers.

Although from a general description of the manufacture of carborundum it may seem a comparatively simple process, yet this is really not the case, for it is only by long experience and an immense number of experiments that the present high efficiency of the process has been attained. At the old works of the Carborundum Company, in Monongahela, Pa., 134 horsepower was employed, and it was by the most careful study of the results obtained there, that it was possible to at once operate in an efficient manner the Niagara Falls furnaces, using, as they do, nearly eight times as much power.

Obviously one of the most important considerations is the construction of the furnaces, so it will not be out of place to consider that subject briefly. The furnaces are built of brick in the form of an oblong box, Fig. 1, having the following dimensions: Length, 16 feet; width, 6 feet; depth, 5 feet. An iron frame about 2 feet square, is built into either end of the furnace, and encloses 60 carbon rods 30 inches long and 3 inches in diameter. From a hole bored in the centre of the end of each carbon a piece of ⅝-inch copper wire projects and passes tightly through a corresponding hole in a stout bronze plate bolted to the frame and having four projections to which are bolted the cables conveying the current to the furnace.

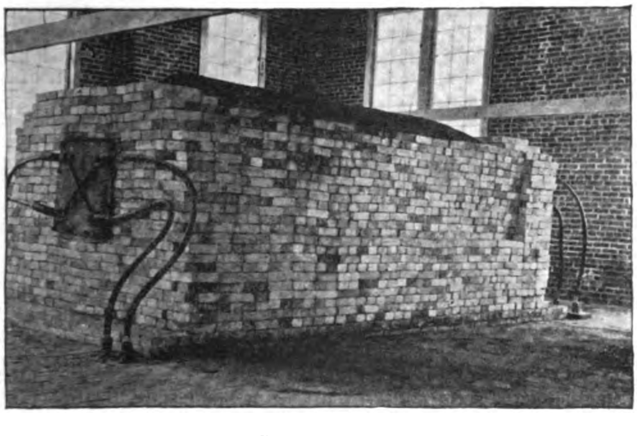

Fig. 1.—A Carborundum Furnace.

Unlike the ends of the furnace the sides are merely temporary structures that are taken down after every run. When the sides of the furnace have been built up, pieces of sheet iron are placed in such a way as to prevent the mixture or charge for the furnace from coming in contact with the inner ends of the carbon rods.

The mixture, consisting of sand, coke, sawdust and salt, is now thrown into the furnace until it is rather more than half full, and in this a semicircular trench, extending from one piece of sheet iron to the other, and having a diameter of 21 inches, is formed. Into this trench is introduced the "core" which consists of grains of coke that have passed through a screen with four meshes to the inch. The weight of the core is adjusted so that when finished it forms a cylinder of coke grains 21 inches in diameter. The connection between the core and the terminals of the furnace is made by packing finely ground coke in the spaces between the pieces of sheet iron and the ends of the carbons, and then withdrawing the former. This having been done, more mixture is thrown on the furnace and heaped up to a height of about eight feet, after which the furnace is ready for operation.

The current as supplied from the power house is at 2,180 volts and is transformed at the carborundum works to one of 166 volts. In operating a furnace it is necessary to have some means of varying the e. m. f. between the terminals, for at starting, the resistance of the core is comparatively high, but is greatly reduced when the furnace becomes hot. In the Monongahela works the e. m. f. was varied by altering the field current of the dynamo, further variation being obtained by throwing the transformers, which were arranged in two batteries, into series or parallel as the case might be.

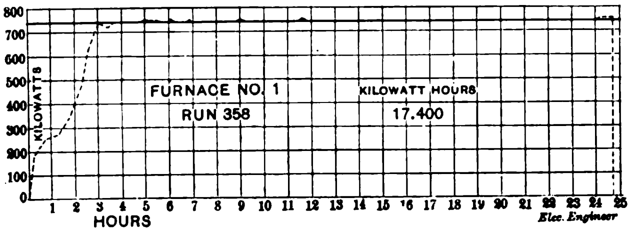

Fig. 2.

The result of his long experience with this arrangement demonstrated to Mr. Acheson the importance of having some really accurate method of regulation, a method that would be continuous. Accordingly when the plans for the Niagara Falls works were under consideration there was much discussion on this subject. Some of the engineers were in favor of constructing the transformer in such a way that, by means of switches, coils of the primary could be thrown in or out, thus varying the voltage of the secondary circuit, for they considered that Mr. Acheson's idea of using some kind of induction regulator was impracticable. Professor Forbes, however, was in favor of the induction regulator and the plans for an instrument of this sort, submitted by the General Electric Company, were finally decided on. By means of the induction regulator the e. m. f. between the terminals of the furnace can be varied between a maximum of about 230 and a minimum of 80 volts. The remarkable success attending the use of this instrument is shown by the power curves of the furnaces.

When the furnace is ready for operation, the cables are bolted to the terminal plates, the primary circuit closed in the transformer room by means of a water rheostat, and the regulator "run up" so as to raise the voltage. There are two kinds of core used in the furnaces, known as "new" and "old" core, respectively. The former consists of coke, as it comes directly from the screens, while the latter has already been used in a furnace. It is customary to give an e. m. f. of 175 volts to the current supplied to a furnace containing new core; but with old core a current of 140 volts is used. The reason for this is that the core which has already been used in a furnace has been heated to such a high temperature that all impurities have been driven off and nothing but pure carbon, having a much lower resistance than coke, is left.

While the furnace is running, readings of the voltmeter and ammeter on the secondary circuit are taken every fifteen minutes, and from these the kilowatts are calculated and the power curve is plotted. Two typical examples of these power curves are shown in Figs. 2 and 3. Run 358 shows the curve of a "new" core furnace, while Run 387 is an "old" core.

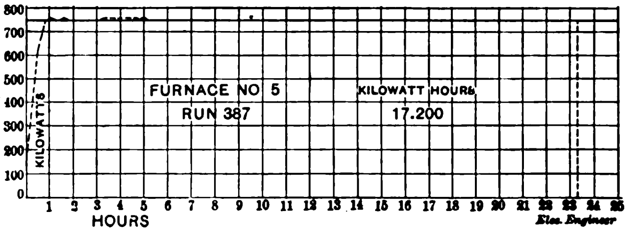

Fig. 3.

It will be observed that the former takes three hours to come up to the full load of 746 kilowatts indicated by the horizontal line, while the latter reaches the full load in forty-five minutes. By comparing Run 358 with Run 702, a Monongahela "new" core furnace, Fig. 4, it will be seen how much better the regulating scheme in Niagara Falls is, and there can be no doubt that the high efficiency of the Niagara Falls furnaces is largely due to this.

The portion of the conductance curve of Run 429, Fig. 5, shows the remarkable effect that a comparatively brief stoppage of the current has on the resistance of the core. When the furnace had been running for 19.3 hours, it was necessary to break the circuit in the transformer room and remain shut down for 42 minutes. On starting up again the resistance of the core had increased so much that it was necessary to raise the voltage in order to bring the load up to 746 kilowatts, and even then it was nearly two hours and a half before the resistance of the core was reduced to its value at the time of shutting down.

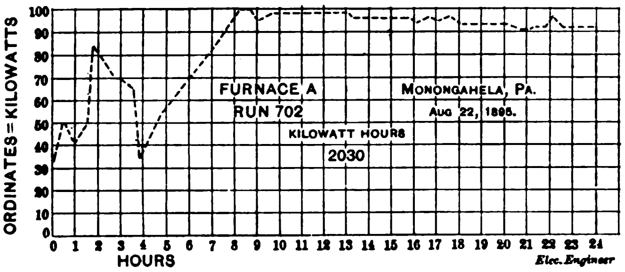

FIG. 4.

In the case of Run 398, Fig. 6, a core altogether too small in diameter was used. The result of this is to produce a very high temperature in the core and consequently a very rapid formation and decomposition of carborundum accompanied by the formation of large quantities of carbon monoxide and other gases. The result is that the gases cannot escape with sufficient rapidity through the mixture and hence form vents through which they rush out with considerable violence forming miniature volcanoes. These phenomena are usually attended with considerable disturbances of the whole upper portion of the furnace, which cause displacements of the core and consequently very rapid changes in its resistance. This is illustrated very clearly by the parts of the conductance curve of Run 398 shown here. When the gases begin to escape through vent holes in this manner, it is usually necessary to shut down the furnace, and cut out the vent hole.

It is not the purpose of this article to enter into all the minute details of the operation of carborundum furnaces; but rather to show the main points of interest in the application of electrical engineering to this new branch of electro-metallurgical work. The electric lighting engineer appreciates the extreme importance of very small variations of current in the efficiency of his lights when they have reached a point near their full candle-power, and that to have his lamp efficient they must be adjusted with the greatest accuracy to the conditions under which they will be used. The operation of a carborundum furnace presents an exactly parallel case, and it is for this reason that the behavior of every furnace is studied with such care by means of curves, examples of which are shown above.

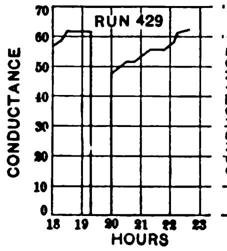

FIG. 5.

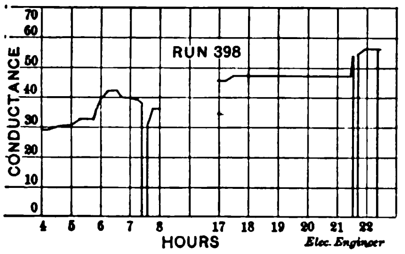

FIG. 6.

PLAYING WITH HORRORS.—One of the "new journalists" tried recently to get up a little scheme for putting Maria Barberi, who was acquitted for killing her brutal lover, into the electrical execution chair and giving her a little dose of current, to see the effect and describe it.

GASEOUS FUEL AS A MEANS OF CHEAPENING ELECTRICITY.[1]

BY NELSON W. PERRY, E. M.

THERE is certainly something wrong in the existing state of affairs, which the electrical engineer must correct. The most significant feature of the situation is that notwithstanding the fact that gas is distributed over very much greater distances than low tension currents are, the consumer can buy it so cheaply that he can produce electric light more cheaply by burning it in a gas engine even after incurring the losses in conversion in the engine and dynamo, than he can buy it from the electric company. If this be true in large cities like Chicago, New York, Philadelphia, Brooklyn and Boston, and it cannot be gainsaid, what must be the condition of light and power plants in smaller and less favorably situated cities.

Many managers now find themselves confronted with the question, Is it possible for me to increase my radius, or must I decide between foregoing the increased business just beyond my reach or, taking the bull by the horns, build another station?

Unquestionably the gas engineer has the advantage of the electrical engineer in his method of distribution, but he has this advantage solely through the apathy of the electrical engineer and not through any inherent right. The facts are indeed the other way, for the pressure at which the gas engineer may distribute his gas is limited to that at which gas can be burned at its most efficient rate. No such limitation is placed upon the engineer who distributes gas for fuel purposes. Compressed air is being daily delivered through 20 miles of pipes with a pressure at the point of delivery of approximately 100 lbs. to the square inch and a leakage loss not to exceed 10 per cent., and gas for fuel purposes can be delivered through the same pipes at the same pressure and leakage, whereas for illuminating purposes the final pressure is limited to a fraction of a pound in pressure to the square inch, but even under these conditions the Consolidated Gas Light Company of New York is distributing gas from the Harlem River clear down to the Battery—a distance of 13 miles, and the Gas Light and Coke Company of London is delivering gas over 70 miles of territory through 2,000 miles of mains to a distance of 17 miles from its stations. On the same investment in pipes, therefore, a far greater gas delivery can be made for power purposes than can be made for lighting purposes and the electrical engineer who will deliver his energies to his centers of distribution in the gaseous form will have an enormous advantage over the gas company by reason of his ability to distribute his gas at greater pressure.

But he must be careful not to throw away the advantage thus gained by distributing his electrical energy over too extended areas. Mr. Perry was convinced that the tendency to increase the radius of distribution is in the wrong direction and that the solution of the electrical engineers is in the contrary direction, viz., in increasing the number of centers and decreasing the radii.

Mr. Perry then gave a table showing volume of gas which can be delivered at various pressures through various lengths of pipe.

The extreme cheapness of transmission of gas distribution enables the gas manufacturer to locate his generating plant where real estate, coal and water are cheap, and thus we find all of the gas plants in New York City located on the water front, whereas the principal electric light plants are placed on the most expensive land at such a distance from the water front that the hauling of coal and the disposal of the ashes costs one of the most favorably located of these plants 54 cents per ton on an aggregate of some 50,000 tons of coal per annum. Water for condensing or other purposes costs the largest consumers in New York 10 cents per 100 cubic feet, rendering it in most cases more economical to operate engines non-condensing than to run them condensing.

These facts and the further fact that the gas manufacturer utilizes the majority of his generating plant continuously and at its maximum efficiency, explain why on an investment of less than one-third he can accomplish essentially the same results more cheaply than can the electrical engineer.

The gas engineer by reason of the facility of storage of his product has practically no standby losses and his total investment is constantly worked to nearly its maximum capacity. About the only part of the plant not so continuously employed is his distributing mains, for these are not employed to their fullest capacity except for an hour or two each day. He has avoided these inefficiencies over a portion of his system, however, by establishing distributing gas-holders at con venient centers so that the mains connecting these distributing tanks and the generating plant are continually employed, and only those radiating from these centers fall short of their full earning capacity.

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[1] Abstract of a paper read before the Northwest Elec. Assoc.

Mr. Perry's suggestion for rectifying the existing conditions was to locate a gas generating plant with regard to economy of land, fuel, etc., and install at this point a large gas-holder so that every dollar of investment at that point would have a maximum earning capacity. Taking advantage of the greater economy of gas over electrical transmission, transmit this gas to local centers of distribution. At these points smaller gas-holders should be erected so as to enable the gas mains to be used to their maximum capacity. Gas engines would take the place of steam boilers and engines, less space would be required and standby losses entirely avoided. If the load line were such as to warrant the introduction of storage batteries, these would supplant the local gas storage and the real estate at this point, and dynamos, engines and labor would all be employed continuously to their best advantage. In fact every dollar of investment from the gas generating plant to the electrical plant at the local distributing center, including the gas mains, would be employed to its best advantage leaving only the distributing mains to be employed under a low load factor.

SAFETY DEVICES FOR ELECTRICAL CIRCUITS.[1]

BY PROF. W. M. STINE.

THE author gave the results of an extended series of tests on fuse wires which he summed up as follows: 1. Covered fuses are more sensitive and have a lower carrying capacity than exposed ones. 2. Fuse wire should be rated for its varying capacity for the lengths ordinarily employed. 3. Fuse blocks should be made with greater distances between the terminals. 4. Fuses should be removed from time to time, as they become coated or fouled. 4. The time element should be considered when protecting parts liable to burn out. 6. Fuses up to 5 amperes should be at least 1½ inches in length, one-half inch to be added to the length for each increment of 5 amperes. 7. Except for smaller sizes, flat fuses are more reliable than round wires. 8. Round fuse wire should not be employed in excess of 30 amperes capacity. For higher currents flat ribbon exceeding four inches in length should be employed. Prof. Stine also pointed out the duty of the manufacturer. The ordinary method of marking fuse wire is entirely inadequate. Each spool of wire should be accompanied by a curve or table clearly setting forth the carrying capacity for varying lengths. Better still, the use of wire should be discontinued, and fuses sold already mounted to copper terminals, plainly marked with their normal rating, which should be at least 80 or 90 per cent of their fusing currents.

Prof. Stine objected to screw fuse plugs, not only because the length of wire is too short, but because poor workmanship and liberal use of solder raises their fusing points to a dangerous degree. As a rule, their actual fusing points are double their marked ratings.

In treating of mechanical cut-outs Prof. Stine premised that these apparatus involve points which admit of extended experiment and discussion—questions which relate mainly to the form of the actuating apparatus, but which, for our present purposes, need not be entered into. A comparison with the thermal cut-out is at once suggested. The fuse wire is an indirect device. The electrical effect must be transformed into heat energy and the distribution of heat in a metal is always slow. In a mechanical cut-out whose vital member is an electromagnet, an excessive current acts immediately to open the circuit. There is here no transformation of energy and tardy distribution, as direct advantage is taken of the energy of the magnetic field which always accompanies an electrical current.

There is but one principal factor influencing the reliability of the magnetic cut-out—the sticking of the mechanical parts. In those tested, this was found to be so small it was negligible. What would occur should the cut-out not be opened for months, and the parts become corroded, one cannot say.

In the choice of mechanical cut-outs simplicity is of great importance. The electromagnet should contain but little iron, and the mechanism for opening the circuits should be powerful enough to insure prompt and regular action.

In view of the foregoing facts the question arises, when to employ a fuse wire, and in what cases should the circuit-breakers be used. This is a question to be decided by individual judgment, enlightened by a proper knowledge of the properties of both. It is advisable to keep fuse wires off switchboards entirely—they do not afford the requisite protection, and, besides, foul the board.

For protecting motors, except in the smallest sizes, fuses are not reliable, and circuit breakers should invariably be used. The same plan is to be recommended for protecting transformers, though at present it seems rather impracticable. But in this same connection it is to be remembered that electromagnetic cut-outs act as efficient choking coils and lightning protectors. For such places as distribution closets and tap circuits the fuse leaves little to be desired, and it would be well were it confined to such uses exclusively.

Another matter which demands fuller treatment than can be here given to it is the protection of large electromagnets against high electromotive forces of self-induction. Transformers and the fields and armatures of dynamos and motors are here referred to. The subject has been treated at length in a recent article by the writer. (The Electrical Engineer, Nov. 25, 1896, p. 532.) Only a few brief suggestions can here be offered. Due provision should be made for absorbing circuits across the terminals of all electromagnets. The simplest form which this protection can assume is a circuit of one or more incandescent lamps placed across their terminals. If the exciting currents in such magnets be suddenly interrupted, the incandescent lamps will absorb the energy which otherwise would spend itself in piercing and burning out the insulation.

INCONSISTENCIES IN ELECTRIC WIRING.

BY HARRY N. GARDNER.

A SHORT article in a recent issue of a scientific publication commented upon the advancement made during the past few years in the methods of electric wiring. Certainly, with increasing knowledge upon the subject, improved methods have been the necessary result. But there are still many inconsistencies in the manner in which the improved methods are applied, and there is yet opportunity to improve upon the methods.

Many merchants who are compelled to go to the expense of having porcelain used to remove wires from contact with a varnished ceiling ask why it is any more permissible to encase the wires in a wooden moulding, and are told that the moulding is waterproofed with shellac or paint. While they will sagely admit that "that electricity is a great invention," it is difficult for them to understand wherein is the difference between a wooden moulding and a wooden ceiling, each with two coats of varnish. Can any electrician or insurance inspector explain this for them?

While there are still some such inconsistencies in the methods, present methods of electric light wiring, when carefully followed, offer the safest system of lighting now in use, but how often does the lack of observance of some minor detail in construction counteract the care bestowed upon all the other parts, and thus make the danger as great as though the earlier, cruder methods were followed?

Many wiremen will use the utmost care in doing their work in a certain manner, because " the rules say" that is the way it should be done, but in some detail upon which the rules are silent they will perform their work so as to cause more danger than would result from a non-observance of all the rules.

Supervising engineers and insurance inspectors also, no matter how much care they may bestow upon the broader details, often leave unspecified and unobserved some of these little things that counteract the good which would otherwise result from their care.

If the dictates of insurance inspectors could all be brought before them at one time, even they would have to admit the inconsistency proved by such an array of evidence. True, many of their oversights result from the inspectors being unable to inspect the entire work, in cases where the truthfulness and carefulness of the wiremen have unwisely been depended upon, but in some instances the blame could not be thus placed. A case was recently noticed where the usual care in other details had been observed, especially in keeping insulated wires well removed from all grounded metal, but a style of rosette had been used upon a stamped steel ceiling in which the metallic rosette ears were in no case removed more than one-eighth inch from the ceiling, and because of the stamped figures of the ceiling, in some cases not over one-thirty-second of an inch existed between the ear and the grounded metal. These rosettes were in plain sight, and the insurance inspector had given a certificate approving the work.

How many engineers who spend hours in studying out the more important features of a set of specifications, ever thought to specify or even suggest, where gas and electricity are planned for in combination, that gas nipples should be left protruding beyond the plaster but little more than the threaded part? Of course, insulation joints must be used, but many times where gas nipples protrude two or three inches, the soldered joints or horse shoe cut-outs in the fixture canopies are folded back so as to bring them in contact with the pipe above the insulation joint. Of course, such a thing should not happen, no matter how long the nipple, but care in the first place in bringing the insulation joint near the ceiling, by using a short nipple, makes it so that it could not happen, no matter how careless may be the person who puts up the fixtures.

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[1] Abstract of a paper read before the Northwestern Elec. Assoc.

The putting up of fixtures often illustrates another inconsistency of applied methods. Great care may be taken in all other parts of the installation, only the most careful and competent workmen being employed, but the fixtures are an afterpart, and anyone can put them up who knows a little about electrical work; perhaps it is a gas fitter or a wireman's helper. Even if there is no danger in the fixture itself, it being noncombustible, there is greater chance therefore for short circuits to cause trouble elsewhere, and is there any other one part of a system that offers more frequent danger than fixture canopies? Frequently there are loose ends of paper ready to be ignited, and in frame buildings, the plaster is frequently off close around an outlet, thus giving opportunity to any fire started under the canopy to communicate with the lath above.

In all canopies there are either soldered joints (if they are soldered), or fusible cut-outs. While it is undoubtedly better to have few enough lights upon each circuit to do away with fixture cut-outs altogether, if they are to be used at all there is no place where a cover over a fuse is more necessary. If soldered joints occur in fixtures they should be particularly well taped, but no matter what the rules say, how many joints are "taped until they are insulated equal to the original insulation of the wire?"

In connecting a dynamo with the switchboard, a representative of one of the larger companies recently had to use a lead covered million and a half c. m. cable. The holes in the floor were bushed with porcelain, and upon the timbers in the basement the cable was carefully run upon large porcelain insulators, but in several places where short bends were made the cable was tightly pressed against the timbers! Even if the porcelain was unnecessary with the lead-covered cable it looked inconsistent, to say the least, to use four or five dollars' worth of porcelain, and then counteract any benefit which might have resulted from its use to save five cents' worth of time.

While there is a difference of opinion regarding the relative merits of metallic conduit and porcelain knob and tube work for frame buildings, it is certain that poor workmanship often counteracts whatever advantage the conduit may have, for carelessness in a single point with metallic conduit will more easily impair the entire system than where porcelain is used.

The superintendent of construction for a company employing thirty to fifty wiremen, recently said that he never furnished crimpers for his men to use with brass armor, but had them use their pliers. It would be almost a miracle in a system of brass armor installed in that way, if the rest of the work was done with proportionate carelessness, if the insulated wire was not in contact with the metallic sheathing in several places, and even if it were not, the liability of the sharp edges of the metal cutting through the wire insulation, thus causing real danger, it certainly is a waste to spend money for conduit installed in that way.

Iron armor is often installed without using a reamer to remove the burrs and fins upon the ends of pipe made by pipe cutters, and such metallic edges are left sticking through the conduit insulation to cut the wire insulation as it is drawn in, or at least so that the insulated wire is left in contact with the metallic sheathing. Again, lead used at the unions is often put upon the ends of the pipe before a thread or two is entered, or within the sleeve itself, leaving it so the lead will squeeze up between the ends of the pipe, thus again giving metallic contact between the insulated wire and the conduit shell. Is it not inconsistent to spend money for conduit to be installed in that way? For what improvement over the old method of running the unprotected insulated wire in the plaster upon brick walls is offered by a conduit system thus installed?

Again, none of these defects may have been permitted to occur, but at the outlets the ends of the conduit are left projecting so that the fixture canopy comes in contact with them. Surely an insulation joint is useless in such a case if the conduit and gas pipe are anywhere in contact, as they usually are, and if the poorly taped joints are in contact with the canopy it leaves little or no benefit to be derived from the use of the conduit in the entire system.

One advantage of metallic conduit, we are told, is that it offers a fireproof protection to any wire which may become heated. But sometimes, especially in brass armor where poor connections are made at the unions, the resistance of the metallic shell is greater than that of the wire upon the inside. In such cases, if a stretch of the shell helps to produce a short circuit, the heating, if there is any, would be outside instead of inside the pipe.

But, we are told, the fuses at proper places should protect the wires so that in case of short circuits the only heating should be in the fuse block. True, but who knows how soon some one will insert a piece of copper wire in place of a fuse?

It may be argued that such slight defects as have been mentioned might exist in hundreds of cases without causing trouble. There are also hundreds of cases where electric lights installed under the old method have been in service for years, and no trouble has resulted. But no one denies the advantage of modern methods, properly followed, over the old; then why, by some such slight defects, leave new methods so that they offer but little real improvement over the old, practically wasting all the money spent upon the more expensive modern style?

To any one informed upon the subject it is evident that many little inconsistencies, such as those mentioned, everywhere detract from the advantages that would result from otherwise carefully installed electric systems. While the fact is apparent, the remedy is not so easy to prescribe.

To the system of insurance inspection, more than any other one cause, is due credit for the improvement of the new methods over the old. A continuation of the strict system of the inspectors, in spite of the occasional inconsistencies on their part, will undoubtedly do much to decrease the little defects. But the existence of the insurance inspectorship is itself indirectly responsible for one cause conducive to poor workmanship. Many business men and builders, when electric wiring is to be done, will not engage a competent man to oversee the work, often not even to do it, but award the contract to the lowest bidder, stipulating only that so many lights shall be wired for, and "an insurance inspector's certificate furnished." Many architects who get out a separate set of specifications for the plumbing, will devote to the electric light specifications the single sentence "outlets to be wired for as shown on plans, work to be subject to approval of underwriter's inspector."

Thus is saddled upon the insurance inspector a duty for which he was never intended, and an opportunity is given a "cheapest bidder" contractor to flourish, for he can figure on doing parts of the work over which the inspector has no jurisdiction in a much cheaper manner than would his more conscientious but unsuccessful competitor. He will hire cheap help and strives to cover up defects so they will be unnoticed by the inspector, or, if noticed, he counts on his ability to "work" the inspector, and so have them passed. The superintendent of construction before referred to, admitted that it cost him considerable to "buy cigars, etc." (he did not say what "etc." might be) for the inspector, but added that he always managed to have his work passed.

If architects and others having installations to make would engage the services of a competent man to make a complete set of specifications, it would give the conscientious contractor an equal show with his tricky competitor, and less poor work would result. If only reliable contractors should be considered at all in the letting of contracts, still more good would be accomplished.

Workmen themselves present an inconsistency in regard to good workmanship. While experience is, of course, necessary, many experienced workmen are responsible for little defects which weaken their otherwise good work, in fact, the last ten years have offered such opportunities for advancement in electrical work, that the man who has had ten years' experience as a wireman, because he has had ability to become no more than a wireman, is liable to make mistakes of which his wide awake helper of six months' experience would not be guilty.

If engineers, architects, their clients and the inspectors would co-operate in making it impossible for any but reliable contractors to secure contracts, if contractors would hire only competent workmen, if workmen would use greater care in the little details, if labor unions would devote more attention to instructing their members to become more competent to perform their work properly, than to quit work promptly, there would be no little inconsistencies to write about. But perhaps there will also be no need of electric lights in the millenium.

FOSTORIA, O.—A committee of citizens appointed by the city council have entered into a contract with B. G. Tremaine and associates of Cleveland, whereby they agree, in consideration of a bonus of $10,000, to erect a factory for the purpose of manufacturing incandescent electric lamps. The factory will be a two-story brick, and will have at the start a capacity of 4,000 lamps a day. The company will have an authorized capital of $100,000, all of which is taken.

DE PUYDT AND PONCIN'S CONTINUOUS CURRENT COMMUTATORLESS DYNAMOS AND MOTORS.

We have received from Messrs. A. de Puydt and M. Poncin, electrical engineers, of Birkenhead, England, the following communication:

We think it will be of some interest to your readers to learn that we have designed and constructed a continuous current dynamo without commutator. We know that several dynamos of that description have been made and tested, but they were all experimental machinery, without practical utility.

As far as we know, the principal cause of these failures has been mechanical difficulties of construction in dynamos of that description, based on the present rules of magnetism and electricity.

We may now say that for some years past we have been compelled to think that at least one of the fundamental rules of magnetism and electricity was wrong, because it is, if not in contradiction, at least in non-accordance with other well known phenomena of nature.

These reflections have led us to try something other than the present rules would suggest and so have enabled us to avoid the mechanical difficulties stated before, and, we believe, with full success.

First, we have made a very small dynamo for the purpose of justifying our reasoning, and on it giving the expected results, we have made a 200 horse-power dynamo for the purpose of testing efficiency, etc.

As soon as we are clear with our patents we shall be very pleased to show one of our commutatorless dynamos in our Birkenhead works to any competent person applying by letter.

DEAD WIRE ON ARMATURES.

BY PROF. W. A. ANTHONY.

The article by M. R. Pfund, in your issue of Feb. 10, 1897, upon "Dead Wire on Armatures," leads me to offer a few suggestions. In my view, the question whether a given portion of wire on an armature is "dead" or not, depends not so much upon whether it is actually cutting lines of force or not, as upon whether it can, by proper design, be made to aid in producing a higher total e. m. f. in the machine, or, can be dispensed with so that while the e. m. f. of the machine remains the same, its armature resistance is made less.

Take the case of the Gramme ring. There is no question that the armature coils must enclose an area. There is no question that the e. m. f. of the machine is measured by the mean rate of change in the number of lines of force that pass through that area. The number of lines of force that can practically be made use of in the area enclosed by the armature coil depends upon the quality of the iron of the core and the speed of the machine. At a certain speed only a certain degree of saturation is permissible, as too high a saturation would cause too great a development of heat.

Assuming this maximum permissible number of lines to exist in the core, the number passing through the area enclosed by any one coil changes from zero to this maximum and from this maximum to zero twice in each revolution. Now, it is impossible for the lines to get into or out of the area enclosed by a coil without cutting the wire enclosing that area somewhere, and it is immaterial where, whether throughout the whole length of the wire or only a small part of it, the e. m. f. developed is the same in any case.

If, by the use of external pole pieces only, the permissible number of lines is sent through the core, then only the outside wires cut the lines and the e. m. f. may be considered as developed there. But there would be no advantage in adding internal pole pieces with a view of rendering active the wires on the inside of the ring, for by the hypothesis all the lines that are permissible already enter the core from the outside, and if lines enter from the inside it will be necessary to diminish the number entering from the outside, so that the total number of lines cut by the coil is not increased; therefore, no increase of e. m. f. can be developed under the conditions assumed by the use of internal pole pieces and so rendering the inside wire active. The inside wire, therefore, is not dead in the sense that it is useless unless the design of the machine is such that a useless length of wire is employed to enclose the given area.

Mr. Pfund refers to Mr. Hering's experiment in which he obtained, by oversaturating the armature core, an inverse e. m. f. in the inside wire. Note that this result was obtained by oversaturation of the core. The total e. m. f. of the machine was then greater, notwithstanding the inverse e. m. f. of the inside wires than it was at a less degree of saturation when the inside wires gave no e. m. f. In other words, the increase in e. m. f. in the outer wires was more than sufficient to make up for the inverse e. m. f. in the inner wires.

The total e. m. f. of the machine in this experiment was undoubtedly greater than could be practically maintained without overheating the armature core. The coils could not have been made to cut any more lines by trying to cause some to enter the core from the inside. Why then consider the inside wire as "dead" or useless? It is needed to enclose the area. If all the lines that can practically be used in that area can be introduced by one side so that only one-half, or one-fourth, or even one-tenth the wire cuts those lines, the machine will still give the maximum e. m. f. of which it is capable.

Mr. Pfund's Figs. 2, 3 and 4, and the accompanying explanation show that he has some erroneous idea about the development of e. m. f. in a magnetic field. It is the wire in the position shown in Fig. 3 which has developed in it an e. m. f., while in the positions shown in Figs. 2 and 4 no e. m. f. is developed.

DEAD WIRE ON ARMATURE.

BY W. C. BOYRER

I note in your issue of Feb. 10 an article by Mr. Richard Pfund, relative to the action of "dead wire" on dynamo armatures. While I agree with the author as far as the results obtained are concerned, I think his method of obtaining them is somewhat misleading. He speaks of a stationary conductor, with lines of force suddenly shot across it. In the practical working of dynamos, we have, on the other hand, a moving conductor in a constant field; so that his method does not treat the case as it actually exists.

In the accompanying diagram let A and A' represent the cross-sections of two conductors on a ring armature, let lines of force be passing in the direction indicated by the arrows, and let the direction of rotation of the armature be clock-wise. Let us also suppose there is no leakage across the armature, and no distortion of field.

The coil A having a motion at right angles to the lines of force will be cutting them at a maximum rate and will therefore be generating a maximum e. m. f. That part of the coil lying on the periphery of the armature, cuts lines in such a manner as to produce an e. m. f. tending to send a current away from the observer; while, since there is no leakage, that part of the conductor lying on the inside of the armature cuts no lines and produces no e. m. f.

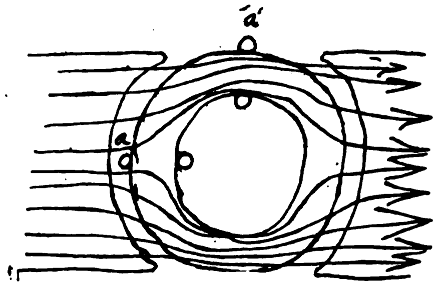


FIG. 1.

Since there is no distortion of field, the coil A' having a motion parallel to the lines of force, does not cut them, and therefore produces no e. m. f.

The introduction of leakage has the effect of producing a field across the air space inside the armature. When this obtains, that part of the coil A lying on the inside of the armature will cut lines in such a manner as to produce an e. m. f. antagonistic to that generated on the periphery; while the coil A' will still generate no e. m. f. in any of its parts.

The introduction of distortion of field simply changes the position of the coil A' at which it generates no e. m. f.

These considerations bring us to the conclusion that in the practical working of a ring armature, since there is always some leakage across the armature, those portions of all active coils lying on the inside of the armature generate more or less e. m. f., and this e. m. f. is always antagonistic to the e. m. f. of the generator.

PITTSBURGH, PA. A very complete electric power and lighting plant is now being placed in position in the extensive works of the Shoenberger Steel Company, Pittsburg. The power plant consists of one 400 horse-power vertical cross compound engine direct connected to 225 kilowatt generators, and one 175 horse-power vertical compound engine direct connected to 125 kilowatt generator. The engines were furnished by the Ball Engine Company, Erie, Pa., and the generators by the Siemens-Halske Electric Company, Chicago.

ELECTRIC LIGHTING

THE ENCLOSED ARC LIGHT.—V.

BY L. B. MARKS, M., M. E.

IN the candle power curves, Figs. 9 and 10, which I have given for comparative purposes, the same difference in distribution of light will be noticed as in the case of the efficiency measurements. The mean hemispherical candle power of the enclosed arc as determined from the curve is 431, the watts per candle being 1.17. The corresponding values for the open arc are 425 and .953. In the case of the enclosed arc the maximum candle-power as may be deduced from the curve, is 595, while the corresponding candle power of the open arc is 1080. The figures for the open arc are taken from a brand of carbon in extensive commercial use in the United States. In the candle power curve for the open arc the readings begin at 200 instead of 0.

It will be noted that although the maximum candle power of the open arc is almost twice that of the enclosed arc the mean hemispherical candle power of the former is a trifle less than that of the latter; in general it will be found that because of the comparatively deep crater in the positive carbon of the open arc, the difference between the maximum candle power and the mean candle power is very great; in the enclosed arc, on the other hand, especially when the bulb is made of a slightly translucent glass, this difference is very slight.

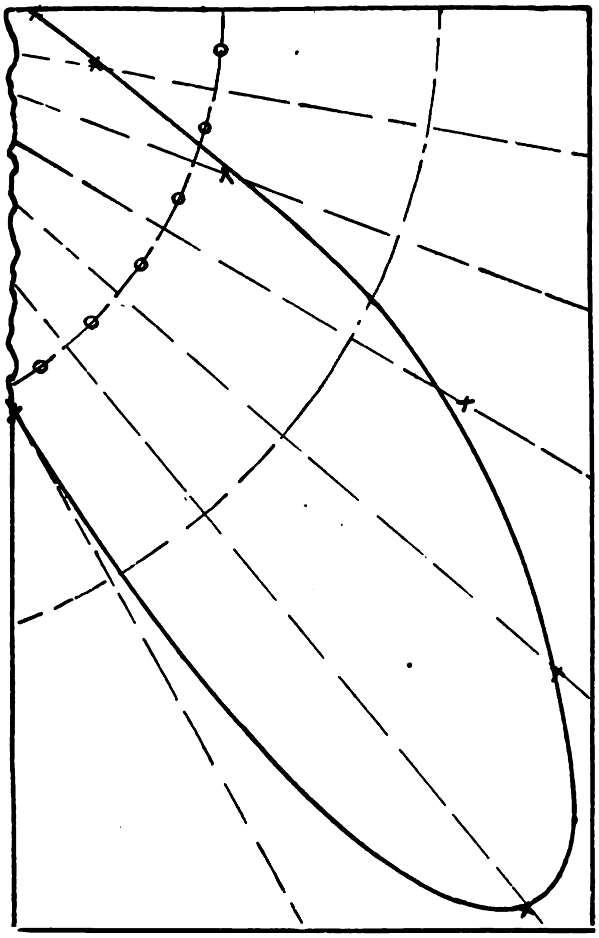


FIG. 9.

A comparative test of candle power of the open and enclosed arc lamps, respectively, was made recently by one of the illuminating companies, and I submit the report of same to you, Table VI. The candle power measurements represent the relative illumination produced in actual practice. The open lamp was provided with the usual opal globe in common service here, and the enclosed lamp with an opalescent inner and a thin opal outer globe such as used in the standard enclosed arcs. For the same wattage the excess of candle power was slightly in favor of the enclosed arc lamp.

It is difficult if not impossible to obtain a true value of the effective illumination of an arc lamp, especially of the enclosed arc, in terms of candle power. In interpreting the candle power tests of arc lamps this fact must be taken into consideration. The quality of the light emitted by the enclosed arc differs from that of the open arc and on this account comparative candle power measurements must always be lacking more or less in truly representing the relative values of the lights. I have found in some cases that an enclosed arc, although producing actually less candle power than an open arc, has given more available illumination, and on this account met the demands of the consumer better than did the open arc. The number of open arc lamps which are daily being displaced by enclosed arcs in the city of New York alone is the best evidence in proof of the fact which I have cited.

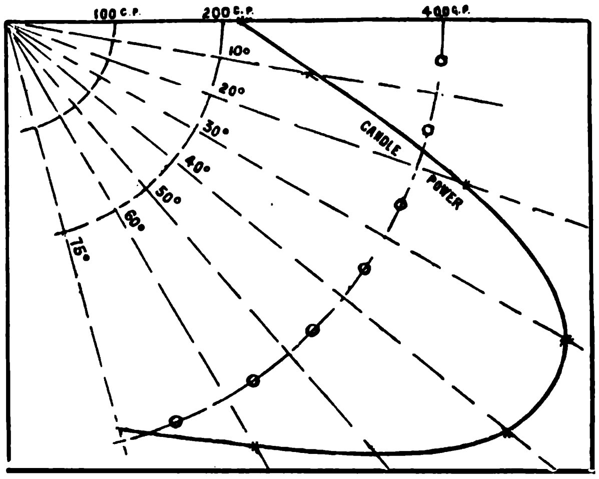


FIG. 10.

TABLE VI.

Candle power test; "Pioneer" 4 ampere enclosed arc, and "Ward" 8 ampere open arc.

Mean watts arc, enclosed lamp = 349
" " " open " = 346
Excess of watts, enclosed arc = 1 per cent.
" " c. p. " " = 2¼ " "

Rush of Current.—The amount of current consumed at the start by open lamps run two in series on incandescent circuits, is generally excessive compared with the normal current passed by the lamp. The amount of current consumed by such lamps just after the latter have fed often rises to a comparatively excessive point; this latter is true especially of lamps, the mechanism of which has been clogged with dust or grit in the ordinary course of commercial usage. In the enclosed lamp which you have before you, on the other hand,

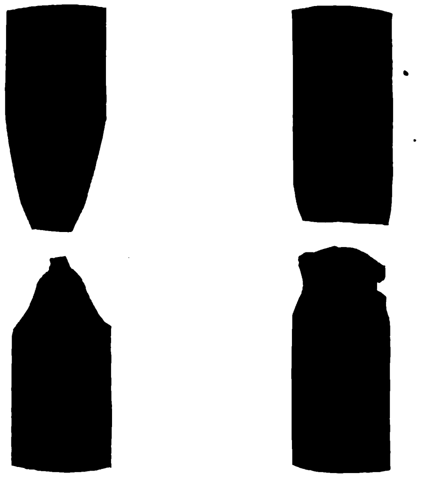


FIG. 11.—OPEN ARC. 6 AMPERES; 45 VOLTS.

ENCLOSED ARC. 6 AMPERES; 45 VOLTS.

the inrush of current, that is, the starting current, is practically as small as the normal current of the lamp; there is no excess of current after feeding as in the other case.

Measurements made on an average pair of commercial open lamps are given in Table VII., and will illustrate the above points. It will be noted from this table that the starting current of the lamps was 25 amperes; at the end of 3 minutes the current had fallen to 16 amperes, but then jumped up again to 21; the normal current was reached after 5½ minutes, the feed having taken place at 7 minutes after start. Thus in this case the starting current was 150 per cent., and the current after feed 20 per cent. greater than normal. With many kinds of open lamps in commercial service the current after feed is often from 50 to 100 per cent. greater than normal. With the enclosed lamp the inrush of current does not exceed the average by more than 20 per cent. and the current after feed seldom rises over 10 per cent. more than normal.

TABLE VII.
Rush of current in open arc lamp; rated current = 10 amperes.

Time. (minutes.)	Current. (amperes.)
0.	25.
1.	20.5
2.	19.
2.5	16.8
3.	16.
3.25	21.
3.5	14.
4.	12.
4.5	12.
5.	11.
5.5	11.
6.	10.
6.5	10.
7.	12.
7.5	11.

Formation of the Carbon Points and "Building" of the Negative; Observations of the Arc.—You are all familiar with the typical formation of the carbon points of an arc in open air. When the arc is enclosed in a small bulb, however, from which the air is excluded or to which it has very limited access, the carbon points take an entirely different form, even though the current and voltage of the arc be the same in both cases. Here are two pairs of carbon tips, Fig. 11, which have been operated under the same conditions except as to the enclosure. The carbons were burned at 6 amperes in each case, the drop across the arc being maintained at 45 volts. You will note that when the carbons are burned in open air, the negative is well pointed, while the positive tapers at the tip and has a well formed crater. Contrasting this formation with that of the enclosed arc carbon points, you will note that the positive in the latter case has a blunt and almost square tip, and the negative, instead of being pointed, has a "mushroom" formation at its tip. The enclosed arc at the voltage cited was 1.7 millimetres long, and the open arc almost 3.5 millimetres long between the tip of the negative and the center of the crater in the positive.

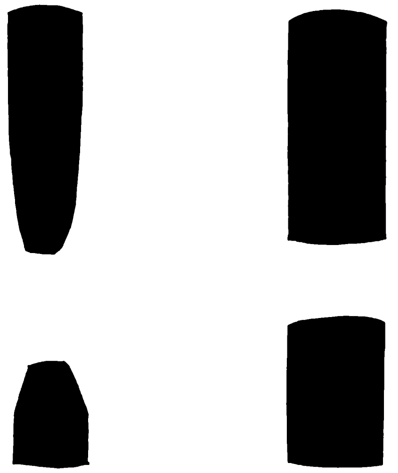


Fig. 12.—Open Arc. 6 Amperes; 45 Volts. Enclosed Arc. 6 Amperes; 85 Volts.

When the voltage of the arc is increased, the carbon points assume a different shape. Fig. 12 is a reproduction of carbons of the same quality and diameter as the last; these carbons were burned at the same current, viz., 6 amperes, but in each case the voltage was raised from 45 to 85. You will note that the formation of the carbon points in open air at 85 volts is entirely different than at the lower voltage; the positive carbon is eaten away for a greater part of its length and has no perceptible crater; the negative carbon instead of being pointed, is rounded off at the tip. In this case the arc was about 15 mm. (9-16 in.) long and "flamed" continuously. The formation of the points in the enclosed arc under the same conditions as to current and voltage is in striking contrast to that of the open arc. You will observe that the points are flattened and are indeed almost square; the positive and the negative tips, respectively, have almost the same shape; the arc in this case was 9 mm. (⅜ in.) long.

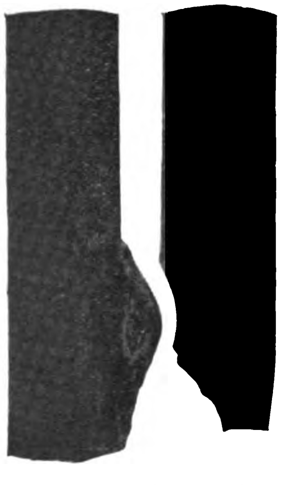


Fig. 13.—Graphitic Nib on Side of Carbon Negative.

The "mushroom" deposit or nib on the negative carbon which has been referred to several times, consists of graphitic carbon, which is deposited electrolytically on the lower carbon by the action of the arc. The deposit of this carbon is in no sense due to gravity as the same formation takes place if the current is reversed, in which case the graphitic bead forms on the upper carbon. When carbons are operated in the enclosed arc at the same voltage as is ordinarily used in an open arc, this nib will always form on the negative, provided the access of oxygen to the enclosure is very limited. When the voltage is raised to a sufficient degree, however, this nib is eaten away or its formation entirely prevented; in the last

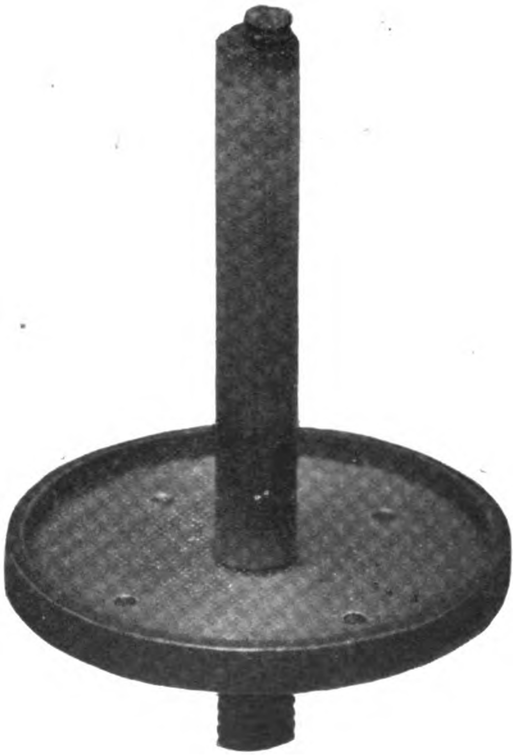


Fig. 14.—Metallic Negative with Graphitic Carbon Nib.

case the carbon particles from the positive while in transit to the negative are combined with oxygen to form carbonic acid and carbonic oxide gases. The point at which the electrolytic deposit ceases to be fixed, depends upon the current passing, the voltage of the arc, the amount of free oxygen present, and other conditions. The voltage of the arc in the high potential low current enclosed lamp is from 80 to 85, but even when this voltage is decreased to 70, as occurs sometimes on account of fluctuations on the circuit, the graphitic formation does not take place at small currents; when the voltage falls appreciably below this point the nib may make its appearance on the negative. See Fig. 13.

The attempt to utilize this principle to secure an indestructible negative has already been alluded to in the case of the metallic negative with the carbon nib, shown in Fig. 14. In all cases where such negatives were used, it was of course necessary to operate at a low voltage in order to preserve the deposit intact. At this low voltage the arc is very short and frequently unsteady; moreover, the difficulty of adjusting lamps to meet the conditions required is very great. Aside from other disadvantages there is always a deposit of uncombined carbon on the walls of the enclosure when a lamp is operated at low voltage in this manner. The "building" of the negative becomes quite marked in some cases where a more powerful current is passed. I have known an instance where the negative actually increased almost 2 inches in length during a run of 11 hours, the mean current being 10½ amperes and the mean tension of the arc 50 volts.

LATEST TYPES OF GENERAL ELECTRIC SEARCH LIGHTS.

THE use of electric searchlights on board vessels, not only of the navy, but those of the merchant marine, as well as on yachts has, within recent years, been steadily growing, as improvements in the mirrors and the operating and controlling mechanism have given to the owners and Government reliable projectors. All the fine war vessels of the new fleet, the ocean, Sound and Lake steamers are fitted with searchlights of tremendous power and range, and almost every steam yacht with any pretensions is equipped with its pilot house projector. The searchlight in the navy is the night-heliograph, so to speak, and beyond its main use to show the whereabouts of an enemy's attacking boats, or the equipment and lay of an inimical coast, its value for signaling purposes cannot be overestimated. The magnificent spectacle of the searchlight beams, as the signal codes of the warships, gathered in New York Harbor on the occasion of the Columbian festivities, will remain an unforgotten incident.

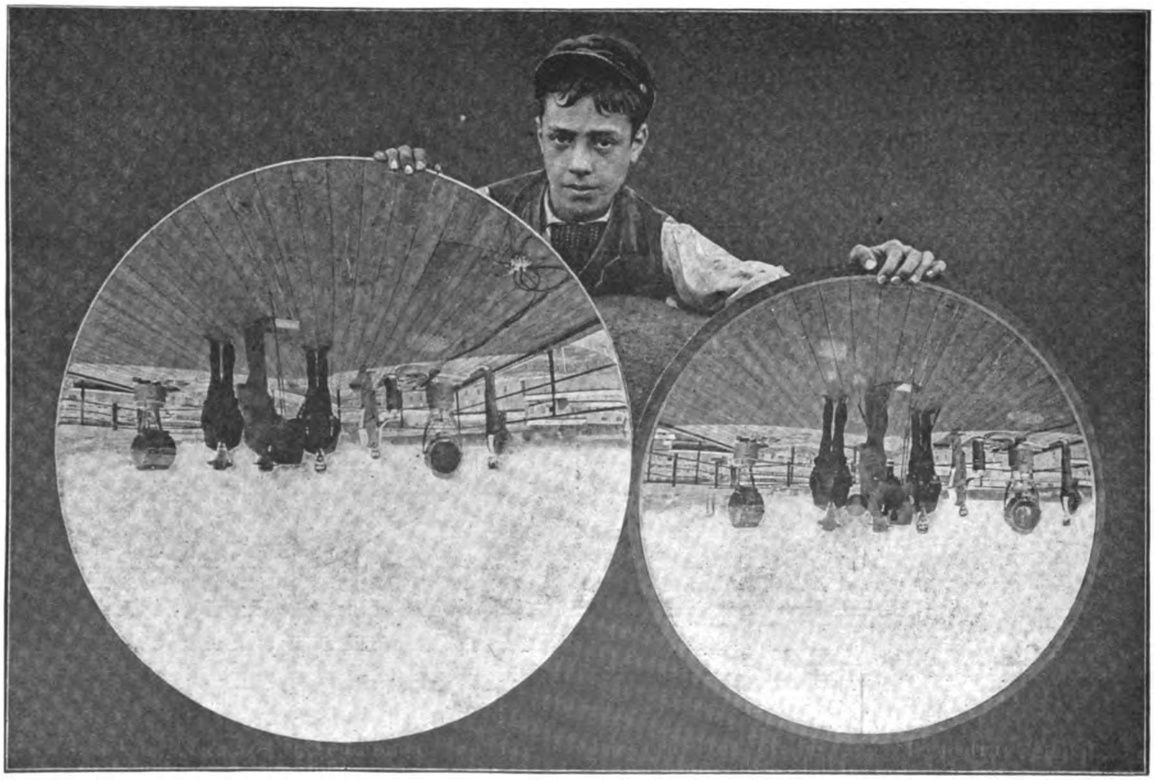


FIG. 1. –SEARCHLIGHT REFLECTORS.

In the manufacture of a perfect searchlight are two main parts, each of which must of itself be perfect—the lamp and the reflecting surface—and unless the greatest of care is given to the design and workmanship of the first, and the grinding and polishing of the mirror, the result must be failure or only semi-success. The former requires electrical and mechanical knowledge of the highest grade, the latter grinding and polishing machinery operating with mathematical accuracy. Up to quite recently, the mirrors for searchlights manufactured in this country were imported from Germany and France, at considerable expense, but when the General Electric Company decided upon the manufacture of the projectors on an extensive scale, it cast about for a manufacturing optician who could be trusted to develop mirrors of as high a grade as those of European make. A firm was found, but it took three years of the most painstaking experiment to bring its mirrors to the necessary degree of perfection. To-day, the mirrors used in the projectors of the General Electric Company are of American manufacture and are equal, if not superior, to those which it had hitherto imported, and it is for that Company alone that these splendid examples of the opticians' art are made.

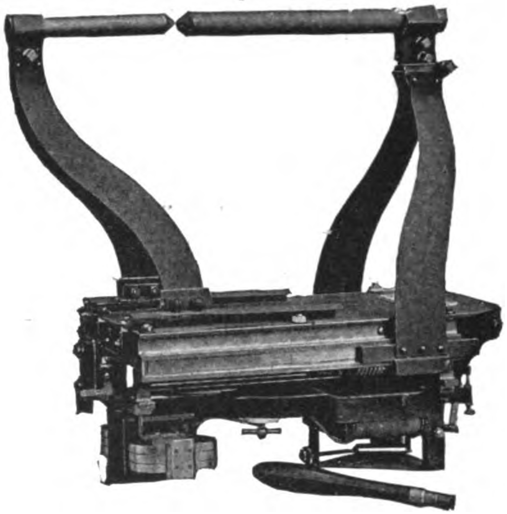


FIG. 3.—HORIZONTAL SEARCHLIGHT LAMP.

At Schenectady, N. Y., one entire department of that company is occupied in the manufacture of projectors. It is located in a building on the corner of which a square tower has been erected carrying a railed platform. It is from this that tests are made of the power and range of the searchlight beams which sweep over the wide expanse of the valley of the Mohawk. A system of distances and intensities has been calculated by which the carrying power of the beam is gauged and the capacity of the projector tested.

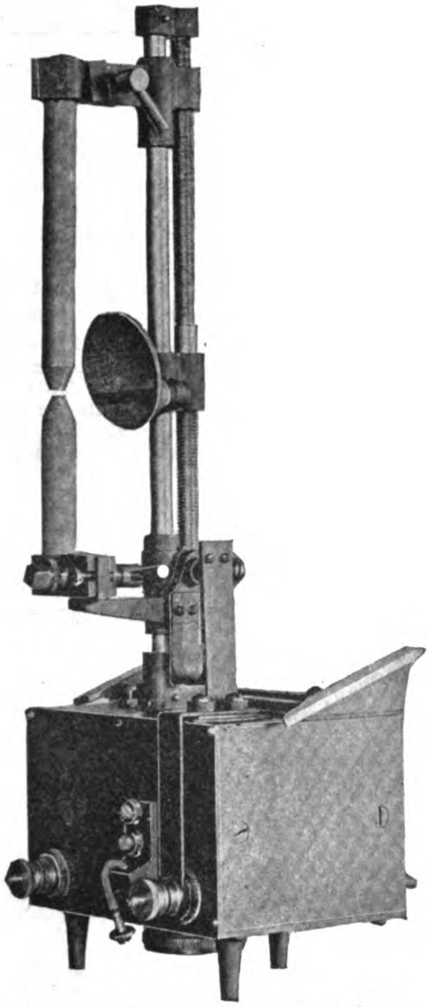


FIG. 2.—INCLINED SEARCHLIGHT LAMP.

The light reflecting surface is a silvered glass concave lens, so ground that when the arc of the lamp is in its focus, the reflector beams which proceed from the mirror are parallel. Two types are used—the Mangin and the parabolic—the former having two spherical surfaces of different radii, the reflection and refraction causing the rays to be projected in straight lines, the latter having true parabolic surfaces. Still a third type is used where the illumination of a large area at short range is desired—the hyperbolic—but in this case the mirrors are of metal silvered.

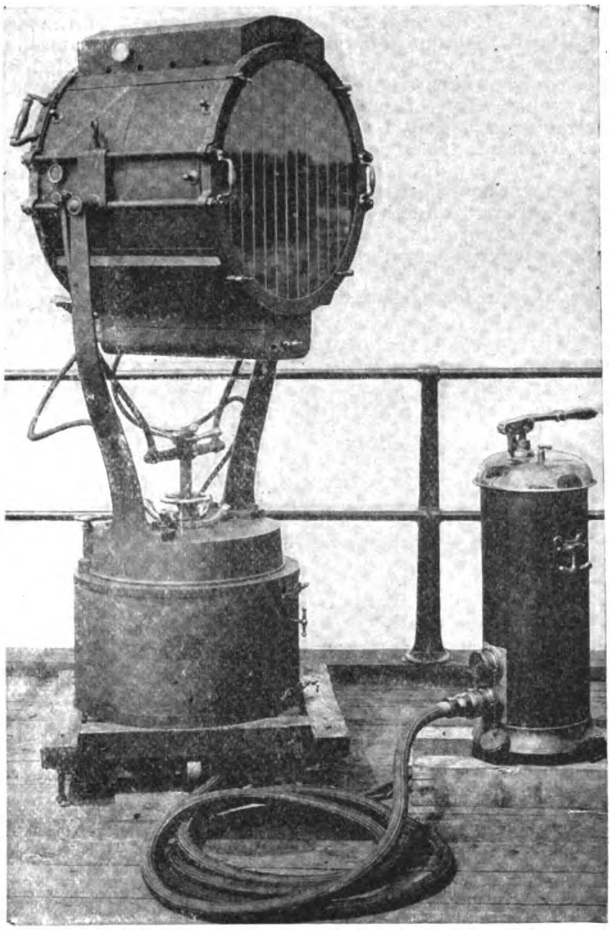


FIG. 4.—ELECTRICALLY CONTROLLED SEARCHLIGHT.

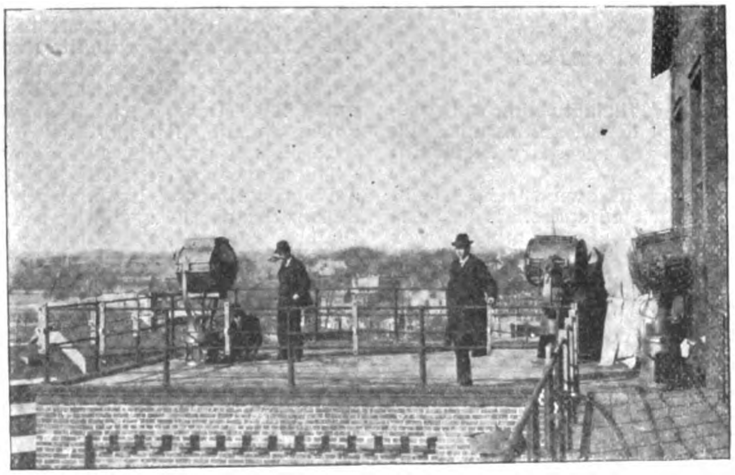


FIG. 6.—THE SEARCHLIGHT TESTING TOWER AT THE SCHENECTADY WORKS OF THE GENERAL ELECTRIC CO.

The lamps are of two types—the inclined and the horizontal—according to the position occupied by the carbons. Both lamps are automatic and focus in feeding. The first type is used in the 12-inch projector, either type in the 18-inch, while for larger sizes the horizontal type has been found the most suitable. All the lamps are designed to operate on direct current incandescent circuits, a regulating rheostat being connected in series with the lamp to bring the voltage to that point at which the best results can be obtained, which is from 40 to 60 volts, according to the current taken.

In order that the person controlling the direction of the beam may most satisfactorily direct it, three systems of control have been devised—pilot house, rope and electrical—depending upon the location of the projector. The electrical control can be applied to any size, but is more suitable to the 24-inch and larger sizes. Horizontal and vertical movement of the drum containing both lamp and mirrors is given by two small motors concealed in the pedestal at the base, and controlled by a single lever set on a small pedestal containing the resistances and switches. By throwing certain disengaging clutches, the electrical control may be cut off, and the projector be controlled by hand. Electrical control allows the projector to be operated from a point almost any distance from it. The same result may almost be attained at less cost by means of the rope control—horizontal and vertical movement also being attained by the movement of a single lever. In this case, however, the distance between operator and lamp must necessarily be limited.

When the projector is set on the pilot house of a steamer, pilot house control is usually employed, the actuating rod passing down through the roof of the pilot house, and terminating in a lever, movement of which gives the necessary horizontal and vertical deflection to the beam.

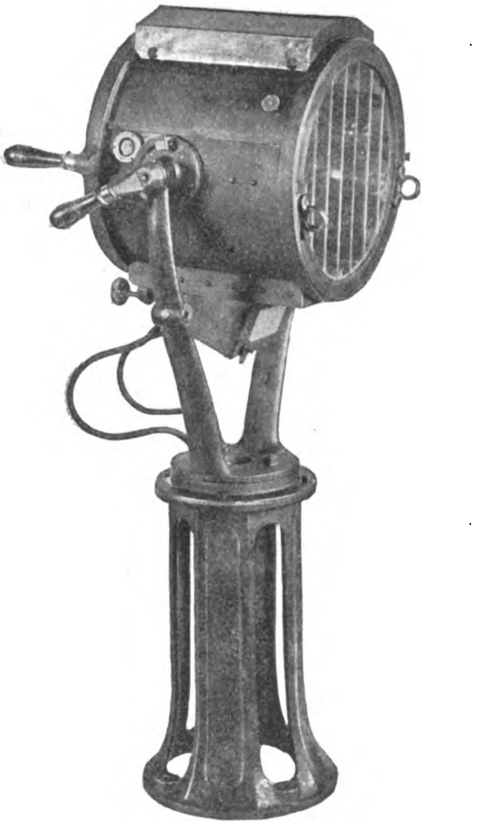


Fig. 5.—Hand-Controlled Searchlight.

The solid beam of parallel rays has its own special use in throwing an intense light upon a restricted space. It is, however, sometimes necessary to illuminate a very much larger space, and instead of a beam to project upon it a horizontal band of light. This is effected by diverging lenses, set in a frame similar to that of the plain glass door, which it replaces when occasion arises for its use.

To allow of observation of the arc from outside without exposing the eye to the blinding glare from the mirror, each projector has a prism let into the side of the drum carrying both lamp and mirror. Through this prism the arc may be observed and regulated. The heat generated by the burning carbons is carried off through ventilators let into the drum at the top and bottom.

The standard sizes of these searchlights are based on the diameter of the reflecting lenses—12, 18, 24, 30, 36 and 60 inches. The greatest searchlight in the world, that exhibited by the General Electric Company at the Chicago Exposition, was of the latter size. This light is now placed on the top of Mount Lowe, in California, whence its beams are visible many miles over the waters of the Pacific.

NEW WHITTINGHAM AUTOMATIC MOTOR STARTER AND QUICK-ACTING SWITCH.

The Automatic Switch Company, of Baltimore, Md., has just brought out the latest designs of Whittingham automatic motor starter and quick acting switch, illustrated in the accompanying engravings.

The operative principle of the starter, Fig. 1, is now so well known, that a description is hardly necessary, but for those not familiar with it we may state that the automatic movement of the rheostat is accomplished by means of a small belt, connected directly with the motor, whereby each revolution of the motor armature cuts out, with absolute certainty, a predetermined part of the starting resistance. This method possesses advantages which are of great value in elevator and pumping work, as it acts as a safeguard against too rapid starting and forcing the motor under an overload. The main feature is that the resistance is always cut out directly in proportion to the speeding up of the motor and can never crowd on current before the armature is prepared to receive it. The construction of the starter has been so modified as to do away with all outside wires, the resistance terminals being completely encased and protected from accidental damage, and the bearings are of graphite and require no oil.

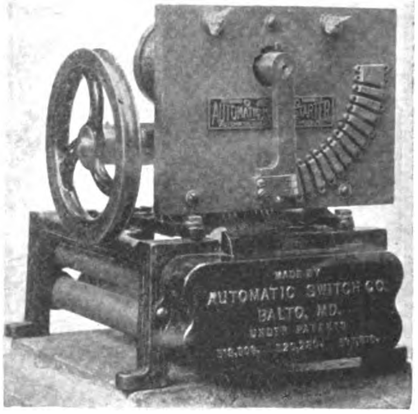


Fig. 1.—The Whittingham Automatic Motor Starter.

Fig. 2 shows a type of quick-acting switch, embodying a number of novel and valuable points which should recommend it to those desiring a substantial circuit breaker for power control. It is designed especially for use in connection with electric pumping and elevator work.

The movement required for the operation of the switch is a reciprocating one, having a stroke of about two inches, which allows the use of a sliding rod passing through bearings on the base castings, and stopping thereon at each end of stroke. The switching mechanism is thus relieved entirely from any strain or pull of the actuating rope, and is operated by the compression springs arranged to give the quick motion, when making or breaking the circuit.

The contacts of the switch are pure copper castings, turned up to a true bearing surface and arranged to engage each other, under spring tension, in a manner somewhat similar to the ordinary street car controller, each set of contacts being detachable and renewable without disturbing the operating parts of the switch.

By means of this switch, in connection with the Whittingham automatic rheostat, open tank, and pressure tank elevators may be operated automatically with satisfaction. It will also be found equally useful in maintaining a certain level in the supply tanks of automatic sprinklers, etc.

Such electric freight elevators as allow the motor to run continuously during the time the elevator may be used, can be more economically operated if arranged to be started and stopped from any floor, as needed, and the apparatus shown is just what is required for the purpose.

A rope, passing up the elevator shaft and over pulleys at top and bottom of same, is connected to the rings of the quick acting switch, which, in connection with the automatic starter, enables anyone wishing to use the elevator to safely start the motor and afterwards cut off the current consumption when it is of no service. There are instances where this saving has amounted to between $200 and $300 in one year.

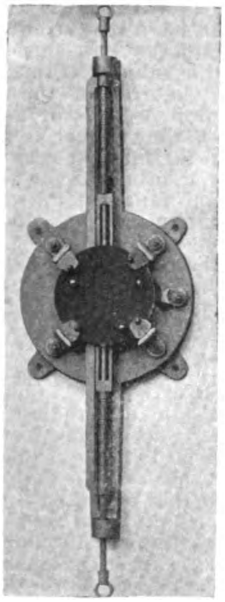


FIG. 2.—QUICK-ACTING SWITCH.

The automatic motor starters are made in sizes ranging from 2 horse-power to 30 horse-power, and the switches supplied in two capacities, viz., 20 amperes and 60 amperes.

The Automatic Switch Company will shortly put upon the market a new form of automatic reversible controller and reversing switch which combines many desirable features and will furnish a reliable means of automatically handling elevator motors without the use of dash-pot or moving magnets.

ELECTRIC PLANT IN THE GOVERNMENT PRINTING OFFICE, WASHINGTON.

THE reports of the chief engineer and chief electrician of the Government Printing Office, Washington, show that during the year 1896 there were no substantial changes in the boiler plant and the power plant. Additions have been made to the steam-heating coil plant, and the entire heating system of the office, with the exception of the business offices, has been put under low pressure steam. The entire office is now lighted by electricity, and all the machinery, except about twenty printing presses, are being operated electrically. When the rest of the presses are connected the office will be controlled exclusively from the dynamo room instead of having to depend on the various engines located at different parts of the building, as formerly.

There are at present connected to the electric lighting mains over 4,200 16 candle-power incandescent lamps. This number will be increased to about 5,000 when additions now under way are completed. Gas is used for the pilot lights only during the hours when the electric plant is not in operation. From January 1 to November there was used in the office 3,877,300 cubic feet of gas less than during the corresponding months for the year 1895.

The application of electric motors to the machinery, owing to its great variety, presented many problems, as well as complicated conditions, which were successfully met and solved. There are now being electrically operated printing presses of all sizes and types, from large web presses, printing at the rate of 11,000 per hour, down to an eighth medium Gordon press; also cutting, indexing, stabbing, folding and case-making machines, signature presses, blowers, ruling and sewing machines. The latter are operated by a one-sixth horse-power motor connected direct to worm gear reducing motion. A reduction in some cases is required of from 1,800 revolutions per minute down to 35.

There are now in daily use 117 direct-connected and 10 belted motors, varying in size from one-sixth to 30 horse-power, making a total of 383 horse-power in electric motors. Added to this is a 30 horse-power motor, used in connection with the Sprague elevator in the new west wing, making a total of 413 horse-power of electric motors thus far installed in the office. Three small engines in foundry, carpenter and machine shops have been stopped and their work is being done by belted motors. During the year there have been no shutdowns or delays in work during the installation of the various motors, which have in every case given the best results.

All the power necessary for the entire work of the office at night, including the running of the large web presses on which the Record is printed, did not amount to within 15 to 20 per cent. of the friction load of the press-room engine and shafting. This is a striking indication of the gains which have been effected over the old belt system by the electrical transmission of power. The chief electrician strongly recommends that the power plant be supplemented by the addition of a large direct-connected unit of, at least, 300 kilowatt capacity, or the installation of a storage battery sufficient in size to supply the office with light during the hours the electric plant is not running. This will not only be more economical, but will enable the plant to be run always at its highest efficiency. The cost for maintenance and necessary repairs of the lighting and power branches of the plant during the year was exceedingly small.

SOME ROENTGEN RAY OBSERVATIONS.

BY W. C. PECKHAM.

IN an article which recently appeared in an electrical journal is the statement that "Röntgen rays will make all sorts of vacuum tubes to glow." I subjected this statement to experiment as follows:

A strong tube was enclosed in a light-tight box and set into action, so that a fluorescent screen glowed brightly. A large number of tubes, both Geissler and Crookes tubes, were tried at the ends and sides of the box. Some of each failed to glow at all; others glowed at both ends and sides. I would say that the Röntgen rays were to be found mostly at the end of the box.

The following tests were then applied to determine if Röntgen rays caused the tubes to glow: Two thick sheets of lead were placed against the end of the box and the tubes were held against these. They glowed better. Then a plate of ebonite a half inch thick; still they glowed as well. Then a plate of brass a quarter inch thick; no diminution of the light. Then a piece of plate glass three-eighths inch thick; still the tubes kept up a glowing through one and one-quarter inches of stuff. Then the fluorescent screen; no glow there, but plenty in the tubes. The screen could find no rays, but the tubes found something to glow with and plenty of it.

It is, of course, evident what it was to every experimenter in electricity. It was electrostatic induction, and all the metal, ebonite or glass one might put in would not hinder it.

Wouldn't it be nice if the papers only printed things that are so, and if all phenomena were traced to real sources before being sent to the papers. We have had a vast amount of false deductions from wrong premises in these X-ray researches.

The strength of the electrostatic induction around an X-ray tube has often surprised me. Sparks fly from my finger tips or my spectacle rims if I approach them too near the tube in action, and I confess I am hardly convinced that the loss of hair and skin, or the sore fingers are due to Röntgen rays, rather than to electricity directly. I have hesitated to subject myself to experiment to prove this, but when I do so I shall proceed in this way: One finger will be exposed bare to the tube to receive its full power; the next will be encased in an ebonite tube; the third in aluminum tubing, and the fourth protected by a heavy U-shaped piece of lead so that X-rays will be cut off from it, but electrical induction will act on it. Thus, finger number one will be acted on by both induction and the rays; number two by the rays, but not by induction; number three by the rays but not by induction, though different from number two; and number four by induction but not by the rays. This, it seems to me, would be conclusive in the case. Has anyone tried it?

THE

ELECTRICAL ENGINEER

[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY

203 Broadway, New York.

Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE	1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE	916 Betz Building.

Terms of Subscription

United States, Canada and Mexico	per year.	$3.00
Four or more Copies in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies		.10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, FEBRUARY 24, 1897. No. 460.

WIRING INCONSISTENCIES.

A CONTRIBUTOR to our columns this week draws attention to the inconsistencies which are frequently met with in the carrying out of electric wiring installations, though the facts that he points to are well known and will be admitted as true by all whose experience entitles them to be heard on the subject. Yet it seems a pity that these inconsistencies should be allowed to exist. If, as would appear, the best rules which can be framed by electrical engineers and by the Underwriters are nullified by even slight defects and poor workmanship, is it not time that the proper remedy be applied to give wiring rules their full force? It has often been pointed out that some of the very earliest wiring installations are to-day in successful operation, and we know more than one case where owners of buildings have preferred to forego insurance rather than rip out their old wiring and conform to the new rules of the Fire Underwriters. While we do not advocate so determined a course on the part of owners of buildings, these facts show that there is a great reluctance to the obliteration of old work which has proved to be satisfactory for many years. So far as making the present improved rules nugatory by bad workmanship is concerned, our contributor is probably right in laying the blame largely at the door of the insurance rules themselves. An architect who merely calls for wiring to be subject to the approval of the Underwriters' inspector, gives a direct encouragement to that unfortunately large number of jerry wirers, who by the many tricks known to the trade, are able to successfully hide from the inspector their bad work, leaving only that which is in sight to conform strictly with the requirements. If wiring were not given out to the lowest bidder, but to responsible firms, and more particularly, if the wiring of buildings were done according to the specifications of competent electrical engineers, there would practically be an end to unsafe wiring and a corresponding gain to all concerned, to the insurer, by a reduction in the insurance rate, which would ensue upon a decrease in the number of electrical fires; and of diminished work for the insurance inspectors themselves, who would know that their own inspection has been largely forestalled by that of a competent electrical engineer, who has visited the work and followed it in the course of its installation.

Apropos of interior wiring, we have noticed of late an increasing tendency towards the use of the older materials and even Underwriters' wire seems to be coming into favor again. Thus, in a recent large building now being wired in New York the heavy risers running up through the metal and brick elevator shafts are insulated with the old Underwriters' wire insulation, painted braiding, and tied to porcelain insulators. Of course the use of this type of insulation is only permissible in special locations, but it emphasizes the fact that when properly installed in dry places even the Underwriters' wire can be made to do proper service.

ELECTRICITY AND BURGLARS.

BURGLARY has long been looked upon as one of the fine arts and if this was so in the past, how much more has the art risen in dignity by bringing to its aid all the resources of modern science. Electricity has been largely drawn upon to impede the burglar in the exercise of his profession, but if we are to believe current reports the long suffering burglar is now taking up electricity on his own account, as an aid, and the results of some experiments, magnified by the imagination of the daily newspaper reporter, have, we are told, caused bankers and merchants sleepless nights. The story runs in effect that by means of a current tapped from any convenient street main the skillful burglar can insidiously melt his way through any thickness of iron or steel by means of the electric arc. A recent article in our columns by a writer signing himself "Sleuth" has shown some of the difficulties that would stand in the way of the enterprising safe-breaker, and a communication which we have received from Prof. Elihu Thomson, that eminent authority on electric metal working, sheds additional light on this subject. Prof. Thomson believes that there is no doubt whatever of the possibility of melting through masses of iron or steel of even considerable thickness, provided there is time enough to do it and sufficient current is available; but he thinks it very doubtful, whether any burglar could tap a lighting circuit and obtain the current required, which might range in the neighborhood of 200 to 300 amperes. He would not only need to tap the mains, but he would have to arrange a resistance in circuit so as to produce a stability in the arc formed; that is, he would have to cause a drop of a certain number of volts between the constant potential mains and the arc produced and get rid thereby of a considerable amount of energy. Prof. Thomson does not think that he could, with much less than the current stated, melt into the iron or steel at a rate sufficient to be of much effect in a reasonable time. Furthermore, the use of such an affair produces an intense light and radiant heat, which demands ventilation, particularly as vicious fumes are given out besides. This would seem to make it impossible for work to be done in a restricted space and it certainly could not be accomplished without attracting notice on account of the glare and fitful light, unless very effective screening were used to prevent the light from getting out through windows and attracting attention. To put it in another way, Prof. Thomson thinks the paraphernalia which the burglar would have to carry along and have at his disposal for the attempted work would be a sufficient discouragement in itself, while the time required and the risk of discovery would be so great as to remove the operation from among the possibilities, except under very exceptional circumstances.

That the anxiety of those interested is not imaginary, is shown by the fact that we have received several letters from safe experts asking for further information on the subject. Prof. Thomson's views will go far towards quieting the nerves of the owners of safes containing valuables.

CROOKES BRAIN WAVES.

WE have heard much of late of the scientific use of the imagination and its value in pushing our ideas farther into the realms which are not yet subject to known natural laws, but which may at any time be brought within their domain. A past master, among recognized scientific men, in this use of the imagination is Prof. Crookes, and certainly no living experimenter has so well sustained the claims of those who believe that speculation is in a sense as important as experimentation, and that without it the scientist would be reduced to the level of the alchemist of old. Prof. Crookes' leanings towards spiritualism are well known and hence it is rather a matter for congratulation that he is seeking to place upon a firmer scientific and logical basis some psychic phenomena, closely allied to the manifestations of spiritualism, among them telepathy. We will not here enter into a discussion as to whether telepathy, or thought transference, is or is not an established scientific fact; evidently Prof. Crookes assumes that it is and has recently given a tentative explanation of the phenomenon. Without entering into all the details of the explanation leading up to the final theory, it may be said that Prof. Crookes divides vibratory phenomena into various groups, each of which finds its responsive chord within the human organism. Passing through the vibratory regions of sound, heat, light and electricity, we reach the Röntgen rays, and ascending still higher in the scale, it does not, according to Prof. Crookes, require much stretch of the scientific imagination to conceive that at the sixty-second or sixty-third step, representing vibrations requiring for their numerical expression nineteen digits, the trammels from which rays at the sixty-first step were struggling to free themselves have ceased to influence them, and that these emancipated rays pierce the densest medium with no diminution of intensity, and pass unrefracted and unreflected along their straight path with the velocity of light. Prof. Crookes then assumes the existence of rays of still higher vibration, waves of ether ceasing to have the properties of those known to us and overcoming all obstacles caused by distance or intervening matter. May not these rays, he asks, enable intelligence to be transmitted from one sensitive being to another? "Is it inconceivable that intense thought concentrated towards a sensitive being with whom the thinker is in close sympathy may induce a telepathic chain, along which brain waves can go straight to their goal without loss of energy due to distance?" Prof. Crookes' brain wave theory, anticipated long ago by a similar one from Prof. Houston, is entertaining, if nothing else, but we are inclined to the opinion that some will look upon it as a case of scientific imagination run riot. At any rate, si non e vero e ben trovato. It may be remembered that Mark Twain once, speaking of theorectical or hypothetical science, said it was the finest example in the world of doing the largest business possible on the smallest amount of capital. He might think this case was what he was talking about.

ELECTRIC LOCOMOTION IN NEW ENGLAND.

AT the beginning of the year, in these pages, General Superintendent Fitzgerald, of the B. & O. Railroad, gave to the public a full statement of the work done by his company in electric traction at Baltimore, and made a frank avowal of his entire satisfaction and confidence in regard to the use of electricity on steam railroads. That article seems to have made a great impression, for it has been copied all over the country. Even had it stood alone, as the opinion of one railroad manager, it would have been important, but it becomes more significant when taken in conjunction with the recent remarkable address of President Clark, of the New York, New Haven and Hartford Road, made before the committee on railroads of the Connecticut Legislature. As a matter of fact, Mr. Clark appeared for the purpose of opposing an electric road between Hartford and New Britain, but his whole address was in praise of electricity and his main plea was that his company was already deep in the vital transition work of converting a great system from steam to electricity.

It is not necessary for us to repeat here the details cited by President Clark, as to the experimental work done by his company; it is already familiar to our readers. But the language used in more than one place is worthy of note. Speaking of the first tests at Nantasket Beach, with the regular trolley system, Mr. Clark says: "It was determined, first, that electricity with a given volume of business was a cheaper way of applying power generated in a single station, than by generating it at the head of a train in a locomotive; and, second, that it was no longer a plaything, but would answer for serious work." He then went on to describe the third rail experiments, and bore testimony to the wonderful ease, efficiency and economy of transmission, as well as to the success in operation.

We come now to the pith of Mr. Clark's neat little argument, namely, his remark: "You may tell everybody who is engaged in investing their own or anybody else's money in lines competitive with steam lines, that they cannot long prosper when the day comes to lay down third rails in this country. * * * There is no mistake about this use of electricity so far as we can see." In other words, progressive steam roads will hold their own against trolley parallels by running trolley cars themselves, with the third rail system; and we do not see how they can then fail to retain much of the passenger traffic that has been leaving them. As we have before pointed out, in discussing this very matter, a main feature in favor of the ordinary cross-country trolley car is its ability to stop anywhere, but even in this respect steam roads run by electricity, with frequent small units can closely rival them, with the advantage of being able to make much higher speed between regular stops on a clear, undisturbed track that the buggy and the dray cannot haunt.

The bottom must certainly drop out of some of these trolley "parallels" when the steam roads thus get down to business and adopt electricity, but none of us can tell just yet how the whole thing is going to work out and adjust itself. It is still very much in the air, and the only obvious thing has been that if something were not done, a large part of the capital invested in steam roads would be in serious peril of being destroyed by the new competition.

ELECTRICITY ON THE ELEVATED.

RIP VAN WINKLEISM in the New York elevated management has cropped out from time to time in the statement that it was presently going to try electricity as a motive power and see if there really was anything in it. Now comes the report that after considerable uncertainty and recent investigation, the Manhattan Railway has finally determined to substitute electricity for steam power on its lines The determining factor appears to be an examination of the Chicago elevated system, running for two or three years past, over which the manager of the New York elevated utters exclamations of delight, as though he had just struck something new and wonderful. In reality, the dense ignorance of what electricity has done and can do, shown by some people high in elevated affairs, is pitiable if real, and shameful if assumed.

However, the public is at last to have electric travel on the "L," and it is to be hoped that the company will give the best that the latest resources of the art now allow, and thus reap some benefit from its long delay. We venture to predict that when it does make the change, it will not continue as now to lose passengers, but will enjoy its fair and normal rate of increase, no matter what the surface lines may do. The estimated requirement of new capital by the company is put at $10,000,000, but the recovery of its ordinary share of the business will more than offset the charges on that sum at 5 or 6 per cent. That the public knows this is seen by the strength at once developed in Manhattan stock. Securities go down usually on a declaration that money must be borrowed, but in this case everybody knows that the return is sure, and the value of the property will improve. All that was needed was a little courage. The Second avenue line is first to be equipped.

"ONE-SIDED" PRIZE ESSAYS.

WE had hoped that so far as we were concerned the comments which appeared in our last week's issue, relative to the one-sided report which our contemporary, the American Machinist, has accused an electrical engineer and contributor to our columns, of being guilty of making, would be the last we had to say on the subject for the present; but as our contemporary has evidently been imbued with the idea that compressed air is not getting a fair show, we cannot refrain from calling to its attention a recent prize essay contest inaugurated by the Iron and Coal Trades Review, of London. This enterprising journal gave as a subject for its prize essay the comparative advantages and disadvantages of steam, compressed air and electricity for power purposes in coal working. The prize for this essay was won by Mr. G. E. J. McMurtrie, A. M. I. C. E., and in the course of somewhat extended investigation and discussion of the subject, the author calls to his aid quite a number of reports of tests made on plants of this nature. It is hardly necessary for us to go into all the details of this most interesting essay, but what our readers and contemporary will perhaps be most interested in are the conclusions which Mr. McMurtrie draws from all the data which he has been able to procure. He summarizes as follows:

"The author has now considered steam, compressed air, and electricity for haulage, pumping, and coal cutting purposes. He has endeavored to show that while probably rope-haulage driven by steam engine at surface, and also rope-haulage driven by steam engine below, with the steam taken down the pit, are more economical than similar plants driven by either compressed air or electricity, yet that when the time has arrived for the haulage to be extended, and for subsidiary engines to be put down electricity and compressed air only can be used. Also, that of the two, electricity, on account of both its greater efficiency and its reduced first cost, is then to be preferred. For similar and other reasons, he has considered that electricity should be adopted for both pumping and coal cutting."

To use a legal phrase, we now rest our case and leave the decision in the hands of Mr. McMurtrie's brother engineers, noting only the curious fact that all these people making "one-sided" reports against compressed air are mechanical or civil engineers by profession, and not electrical, unless they have become such by deliberate choice.

THE tests made by Admiral Bunce's invading squadron at Charleston, S. C., have been very interesting as to the aid that can be given by searchlights to prevent blockade running. There are four heavy ships in the squadron and it appears to be well proved that no runner could pass even so small a squadron as that if the weather conditions allow the searches to be used up to the full measure of their efficiency. On a very foggy night, when the runner would be assuming heavy risks on other accounts, the little dynamite cruiser "Vesuvius" got through, but she tried four times in vain on an ordinary dark night to cut undetected across the fourteen-mile belt of light from the men-of-war. Such tests show that the searchlight is a very useful appliance in modifying the old conditions under which blockades were often run with success. Part of the Charleston tests comprised, it is said, a tabulation of the distances at which specific objects could be picked out by lights of given powers.

LETTERS TO THE EDITOR

SAFE BREAKING BY ELECTRICITY.

An article appearing in The Electrical Engineer of February 3, 1897, under the heading of "Fin de Siècle Safe Burglar" puzzles me to know just what its contributor endeavors to bring out. He apparently strains to emphasize a great difference between laboratory experiments and practical application, without seemingly understanding that the latter is but a natural sequence of the former and evidences a desire to allay all anxiety on the part of bankers, who, he claims, have had shudders of fear, ghostly and terrible, sent through their brains and bodies by a "profoundly scientific and eminently practical" newspaper reporter. If he will stop to investigate a little more closely he will discover that the newspaper reporter has been far more scientific and practical than he himself.

It is evident that "Sleuth" contends that it is not practical to obtain from 350 to 500 amperes at 40 or 50 volts pressure outside of a laboratory or under the condition in which a burglar would have to work. As a matter of fact the experiment under discussion was not made in a laboratory but under exactly the same conditions which in practice would exist and might be made use of by an unscrupulous person for a surreptitious purpose. That is, flexible wires were connected to electric light mains under the sidewalk—the same as could be done in any city—and led to the safe which was pierced. One wire was connected to the safe and the other having a suitable resistance in circuit was connected to a carbon electrode. The remainder of the operation—that is, the burning of a hole through the safe—is so simple that I have seen persons who have had little or no knowledge of electricity do it with perfect ease almost the very first time.

An electrician who is at all versed in the variations in electric currents of the present day would not be at a loss to skillfully handle his volts and his amperes and that without the necessity of placing the volts in one pot and the amperes in another. Sleuth says "no one can be quite sure of proportions in ordinary commercial currents, and consequently he might err fatally in picking up the wrong conductor." This probably accounts for his claiming to know of parties "taking a large current from the street mains, more than is required to melt through safes, though the parties maintained most perfect silence about it ever after." Finally Sleuth assumes that banks are properly protected against access such as would be gained by the use of the electric current by electrical burglar alarms, and here is where I differ from him most emphatcailly, for the prevailing system of burglar alarm has been beaten several times by experts and I have been told that those who recommend its use have admitted this to be a fact.

I desire here to emphasize a few points. The operation of burning holes through safes by the use of the electric current such as can be drawn from an electric light main or a trolley wire, is a perfectly practical and feasible operation, and it is one which many bankers to my knowledge have investigated. The result is that any safe or vault, no matter how thick, can be readily and quickly pierced, consequently there is no security whatever in safes and vaults by themselves. They must be protected and the most practical and economical method which suggests itself is that of electrical protection. The system now largely in vogue and which Sleuth, as a detective I suppose, refers to, is open for considerable argument which can be easily brought out if he so desires.

SAMUEL RODMAN, JR.,
Late First Lieutenant 2d U. S. Artillery, Electrician and Explosive Expert.
Chicago, Ill., Feb. 12, 1897.

THE INAUGURATION.—General Passenger Agent Scull, of the B. & O. R. R., recently announced that he had secured the concession from the Joint Traffic Association which makes it possible to give a stop-over in Washington on all first-class tickets sold over the B. & O. through that point. The fight over this concession was quite a bitter one and lasted for a long time, but Mr. Scull finally triumphed. In order to successfully handle the great crowds that are expected in Washington during the inauguration of Major McKinley, the B. & O. has arranged to lay about ten miles of additional side track to store sleeping cars and special trains on. The facilities this year will be very much greater than ever before.

LITERATURE

ACCUMULATEURS ELECTRIQUES.—By F. Loppé. Ganthiers-Villars et fils, and Manon & Co. Paris, 1896. pp. 203. 4½ x 7 in. Paper cover. Price 85 cents.

This forms one of the volumes of the "Encyclopaedie Scientifiques des Aide-Memoire." It gives a concise view of the state of the accumulator art at the present day, but makes no pretensions to being as exhaustive as some other works on the same subject.

LA PHOTOGRAPHIE à TRAVERS LES CORPS OPAQUES PAR LES RAYONS ELECTRIQUES, CATHODIQUES ET DE ROENTGEN.—By E. N. Santini, 4th Edition. Charles Mendel. Paris, 1896. 102 pp. 5 x 7 in. Paper cover. Price, 75 cents.

This is a popular treatise on the Röntgen ray, though we hardly think that the author has made the best of his opportunities, considering the abundant material at hand. For those interested in the still obscure manifestation of images of objects produced by lightning flashes the book will perhaps prove of more interest than its principal title implies. The author has gathered a record of the most notable lightning images from the year 360 to 1864. A chapter on psychophotography or the transference of brain images to sensitive plates is also embodied in the work.

A COMPLETE TEST OF MODERN AMERICAN TRANSFORMERS OF MODERATE CAPACITIES.—By A. H. Ford, S. B. Published by the University, Madison, Wis. 1896. 88 pp. 6 x 9 in. Paper cover. Price, 25 cents.

This is a graduation thesis of the most practical kind. The author tested the transformers manufactured by nearly every builder of such apparatus in the United States, the converters varying in capacity from 1,000 to 10,000 watts.

It must be admitted that with one or two exceptions the transformers under test show up remarkably well both as to maximum and as to all-day efficiency. But as the author points out in his conclusions, the results show more than ever the necessity of exercising the greatest care in the selection of the type of transformer. The most notable difference found by the author is in the iron losses. This was to be expected and goes to show once more the necessity for constant vigilance in the testing of such material by manufacturers of transformers.

Another interesting conclusion reached is that the regulation of transformers with the coils arranged so that their cross-section forms a rectangle, is better than it is when the cross-section of the coils is a square.

An introductory note by Prof. D. C. Jackson gives some additional data and calls attention to the important facts that transformers which do not meet the insulation and heating guarantees are unsafe to use, while those which do not meet the iron loss, regulation and exciting current guarantees, waste the company's money.

Incidentally it may be remarked that the tests showed that perhaps as much, if not more improvement is desirable in commercial wattmeters and other measuring instruments, as in the apparatus the latter were employed to test.

The work is the most exhaustive of its kind which has yet come under our notice and every operator of an alternating current station should be familiar with its contents.

ELECTRICITY IN PATERSON. By Wm. M. Brock, 65. pp. 5½ x 8½ cloth.

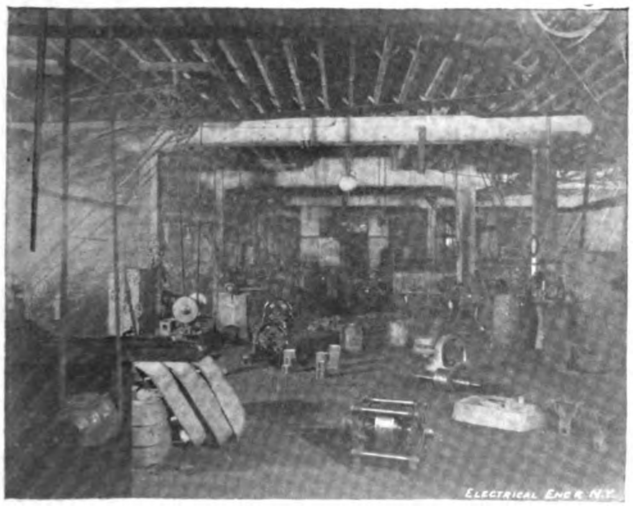
Believing that a better knowledge of the applications and simple laws governing the electric current would be of interest to their customers and further their business, General Manager, Mr. William M. Brock, of the Edison Electric Illuminating Company of Paterson, N. J., has written a book for distribution, in which he has given a concise and clear elementary statement of the A B C of the science. The explanations are ingeniously made by a practical man, and the stereotyped analogies are conspicuous by their absence. An appendix gives a list of electric power users in Paterson, which seems to include practically all work from silk weaving to ice cream freezing. The book is well illustrated, and might with advantage be read by central station managers with a view to the issuance of similar brochures to existing and prospective customers.

NEWS AND NOTES.

THE MANUFACTURING PLANT OF THE TRIUMPH ELECTRIC AND ICE MACHINE COMPANIES.

THE record of the past few years in business can unfortunately show but a small percentage of manufacturing concerns which have been compelled to enlarge their facilities to cope with the demand for their goods, yet such is the fortunate position in which the Triumph Electric and Ice Machine Companies of Cincinnati, O., find themselves. Being cramped in their old quarters, the Electric Company have recently removed to the new and commodious works, some views of which are given in the accompanying engravings. The new works cover a block just opposite the freight depot of one of the principal railroads entering Cincinnati and are so located as to be lighted on the four sides. This site is a remarkably convenient one for factory purposes,shipping facilities are excellent, and reached as it is by six different lines of electric cars, customers and visitors find it readily accessible from any part of the city. A short flight of steps leads directly from the street into the main office, a large, well lighted room, where the visitor comes immediately in contact with the heads of the various departments. From the office the visitor passes into a large wareroom filled with finished material so arranged that prompt shipment of any machine, either motor or generator, of any standard voltage could be made.

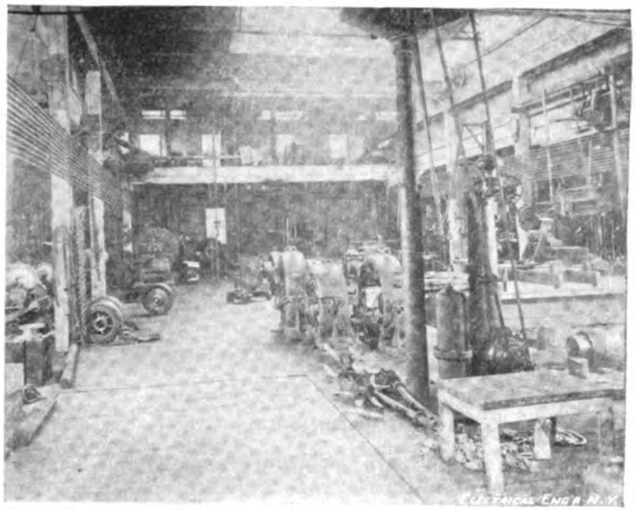
WORKS OF THE TRIUMPH ELECTRIC CO., CINCINNATI, O.



MAIN MACHINE SHOP.

From the wareroom a gangway leads to the main erecting floor, on which electric generators and compressors are in process of erection. At the sides of this room the heavy machine tools are so arranged that they, as well as the main floor, are covered by a traveling crane, which will shortly be equipped with motors. The heavy tools on this floor are arranged in groups, each group driven by a separate motor, which plan the management believes to be the more convenient and efficient in this instance as distinguished from that of a separate motor equipment for each tool.

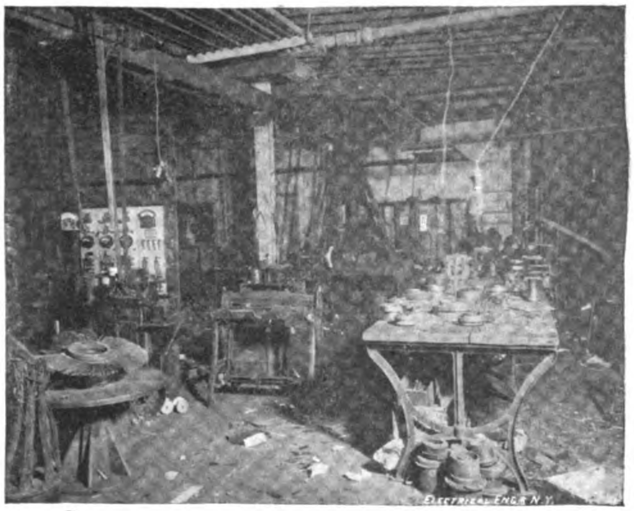
In the rear of the erecting floor is the testing room equipped for the testing of several machines at once, and for any desired load. From the erecting floor one passes to the main machine shop, where again is found the same principle of grouping, with the idea of economical application of electric motors. Here also is located the tool room, itself about thirty-five by forty feet, with rows of shelves filled with special reamers, cutters, gauges, templets and jigs, insuring the economical production of good work and its exact reproduction.



MAIN ERECTING FLOOR AND TEST ROOM.

The small tool department, where are located lathes under fourteen-inch swing, all the turret lathes and screw machines, is a room 40 x 125 and opening from it is the commutator and field winding room 30 x 75.

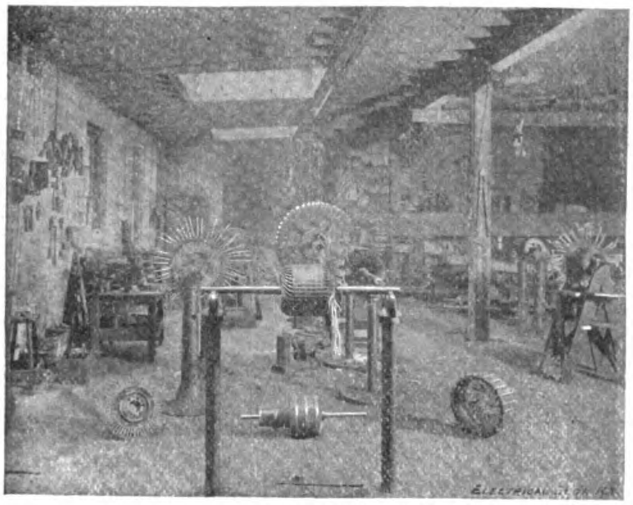
The armature winding room is adjacent and measures 40 x 75. Here one is greatly impressed with the number of special devices apparently in use on each tool, but this is explained by the fact that as far as possible each tool is equipped for its own special work and is seldom changed. An especially noteworthy instance is a group of lathes employed exclusively in the manufacture of the special ice machine fittings, for which this company has an enviable reputation. A rough casting set in one of these lathes is turned out a finished fitting. Great ingenuity is also displayed in the manner of testing these fittings, each one being subjected to severe pressure and with a rapidity that is surprising. One of the especially noteworthy details of the entire equipment is the careful attention given to testing, both in the ice machine and



COMMUTATOR AND FIELD WINDING ROOM.

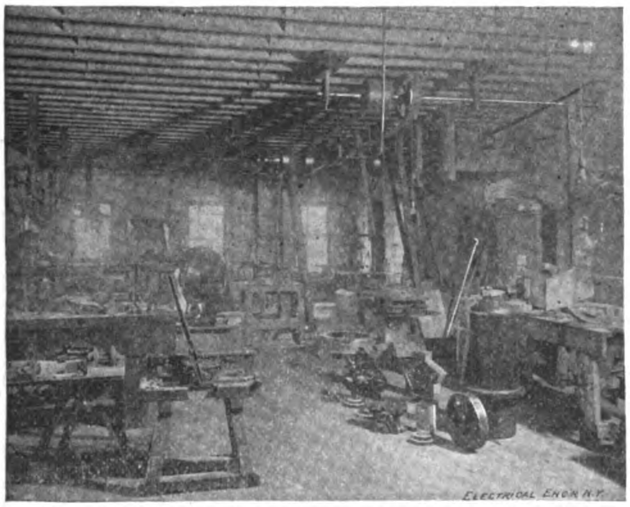
electrical department and the many ingenious devices employed for detecting imperfect material or workmanship. The pipe shop is a room 60 x 125, fully equipped with modern appliances and racks for the storing of the various sized pipe.

The power equipment consists of two high speed 125 horsepower engines driving two generators, one 120 volt, supplying current for lighting and for various motors, and the other a 220 volt, used for test purposes only. The machinery in the pattern shop is driven by a motor hung from the ceiling; the room is 40 x 75 and is adjacent to the draughting room, the best possible location.



The Armature Winding Room.

With the facilities now at their command, the Triumph Electric Company are able to turn out the best quality of apparatus economically, and the busy aspect apparent throughout the worke is evidence of the appreciation of the company's products by their customers.



The Pattern Shop.

TESLA ON LONG LIFE AND SLEEP.

Being asked for his views on reasons and signs of longevity, Mr. Tesla said: "A man receives a certain term of life; so many hours to pass on this earth—I mean hours when he is alive, awake; I do not count the hours when he is sleeping; I do not believe they are, strictly speaking, included in his term of life. When a man really lives he is dying hour by hour, but when he sleeps he is accumulating vital forces which will make him go on living. In other words, in measuring out our dole of hours to each one of us, the great timekeeper stops his count while we are sleeping. Therefore, the longer a man sleeps the longer he will remain on earth. Nearly all long-lived people have been great sleepers. When De Lesseps was on the ocean he would sleep twenty hours on a stretch. Gladstone is a great sleeper, and averages twelve hours a day. I can believe that a man who would learn to sleep eighteen hours a day might live 200 years." Mr. Tesla is himself a very poor sleeper.

TELEPHONY AND TELEGRAPHY

COMMERCIAL CABLE FINANCES.

President Mackay, of the Commercial Cable Company, in a letter to the Barings, of London, says of the bonds they have just placed: "Apart from the issue you are now making, the amount outstanding is widely distributed among holders throughout the United States, Canada and Europe, or held by myself; and I undertake to sell none of my holdings under par for two years, except with your consent. In amount the mortgage is limited to $20,000,000 4 per cent. bonds, or the sterling equivalent in 4 per cent. debenture stock, viz. £4,120,000; of this, $15,000,000 have been issued to purchase $15,000,000 Postal Telegraph Cable Company's shares and property, $1,000,000 to pay for additions to the property made last year and to provide for contemplated extensions during 1897, and $4,000,000 to remain in the Commercial Cable Company's treasury for future requirements. The business contributed by these land lines to the Commercial Cable Company has been increasing yearly, and in 1895 amounted to 30 per cent. of the latter's gross earnings. To secure this traffic in perpetuity the Commercial Cable Company decided to buy the Postal Telegraph Cable Company, and the purchase has recently been ratified by the shareholders of both companies. For the past three years (1896 partly estimated) the net earnings of the land lines have been about sufficient to pay 4 per cent. on their purchase price. I believe that these lines will continue to be self-supporting, and that the interest charge for their purchase will form no burden upon the earnings of the ocean cables proper."

TELEPHONY IN NEW YORK.

The City and Suburban Telephone Company of New York has been incorporated, with a capital of $100,000, to operate a telephone system through the State. The company is to operate to and from New York, Albany, Brooklyn, Buffalo, Schenectady, Amsterdan, Fonda, Fort Plain, Little Falls, Utica, Rome, Ogdensburg, Syracuse, Watertown, Oswego, Monticello, Binghamton, Auburn, Elmira, Geneva, Corning, Rochester, Olean, Batavia, Lockport, and various smaller cities and villages. The directors are: Alfred H. Teller, Charles B. Minshall, Charles A. Teller and G. Rowland Munroe, of Brooklyn; Henry B. Oakman and Samuel Bear, of New York City, and Charles E. T. Tomkins, of Jersey City. The company states that it will operate under the patents of the Make & Break (M. & B.) Telephone Co., of Philadelphia, which it has virtually bought. Mr. Oakman is active in the enterprise.

AMERICAN DISTRICT TELEGRAPH SYSTEM.

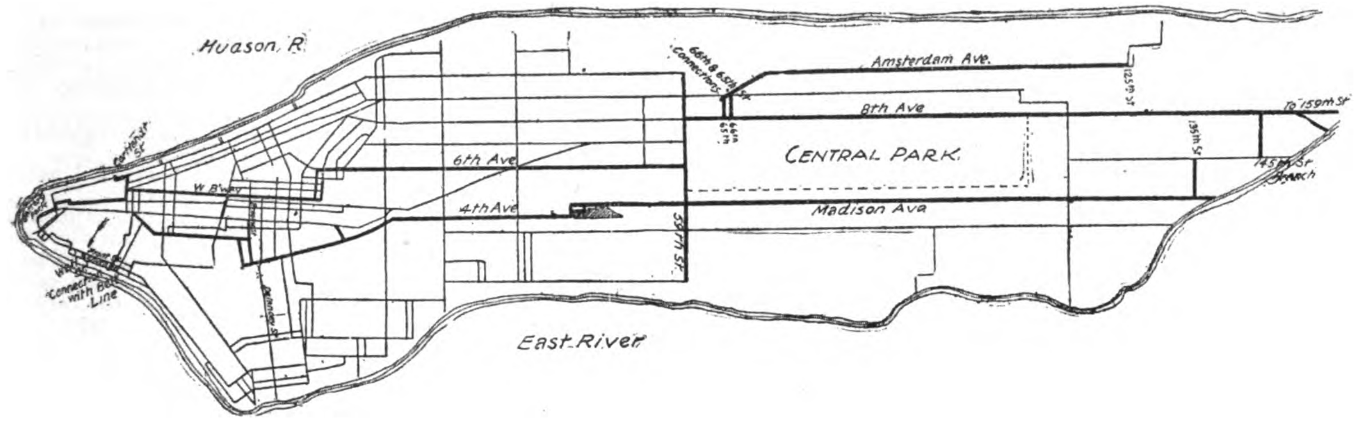
The report of the American District Telegraph Company in New York City for the year ending December 31, 1896, shows a continuation of the business depression which had already been felt for the three years previous. In the report for 1895 it was noted that the old tariff rates had recently been resumed, making a reduction of 25 per cent. in the rates for messenger service, but this is reported to have been already partially recovered by an increase in the volume of business, so that the loss of earnings of the messenger department was about 9 per cent. for the year, while there was an increase in the service performed on messenger calls. The cost of construction and maintenance of lines, rentals of subways, etc., increased 8 per cent. The facilities of the company are reported to be maintained in excellent order, so that it can easily profit by increased business, without any material increase in cost of operation.

CLEVELAND, O.—The Home Telephone Company has made a contract with the New York Construction Company to furnish a complete system of 6,000 telephones within the limits of the city of Cleveland, within eighteen months from January 1, 1897. It will be the Minnis system, described in The Electrical Engineer of July 1, 1895. The company began operating on February 3, and already has its telephone directory out.

ELECTRIC TRANSPORTATION

CONDUIT RAILWAY ROUTES IN NEW YORK.

During the past week the Metropolitan Railway Company applied to the New York State Railroad Commission for permission to change its motive power from horse and cable to electricity, using the underground trolley system, as recently illustrated in The Electrical Engineer. The accompanying engraving shows a map on which the routes to be changed over to electricity are indicated by the heavy lines, together with the extensions to be established between them. The existing street car lines are also indicated in fine lines on the same map. Some slight opposition was developed before the Commission by opposition street railway companies and the hearing on the matter has been postponed until the 10th of March.



Map Showing Route of Proposed Electric Lines of the Metropolitan Traction Co., New York.

ELECTRIC ROADS IN JAPAN.

A leading export house interested in Japanese trade was informed recently that the following street railways were about to complete organization with an aggregate capital of about $3,500,000: The Fushimi Electric Railway, promoted by Okubo Yoskio, of Tokio, will construct a line 28½ miles long, running from Fushimi to Nishinomiya. Another line 5½ miles long between Inamimachi and Demachi. The Tokio Circuit Tramway will build a line 44⅓ miles long in Tokio. All these lines will require, the exporters claim, the necessary materials and rolling stock. American manufacturers will have as much of an opportunity to furnish it as their foreign competitors.

A SCHEME FOR TROLLEY TRACKS FROM MASSACHUSETTS TO THE CANADIAN FRONTIER.

The railroad committee of the New Hampshire House held a hearing last week on bills to incorporate the Manchester, Chester and Haverhill Street Railway, the Nashua, Salem and Haverhill Street Railway, Nashua, Manchester and Concord Electric Railroad Company, and the Merrimac Valley and St. Lawrence Street Railway. These bills cover the scheme to establish a continuous line of electrical railway from the Massachusetts boundary on the south to the Canadian line on the north. The Concord and Montreal and Boston and Maine Railroad Companies and the Concord Street Railroad Company, Manchester Street Railroad Company, Nashua Street Railroad Company, and the Lowell Street Railroad Company opposed the scheme.

SOCIETY & CLUB NOTES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Institute held Feb. 17, seventy-five members and guests were present. A paper was read by Mr. John W. Howell on "Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them." The discussion was participated in by Messrs. Kennelly, Colby, Wolcott, Sheldon, Wirt and Burnett. At the meeting of the Executive Committee in the afternoon the following associate members were elected: Albert W. Brown, assistant manager of Telephone Exchange, American Telephone and Telegraph Company; Alva C. Dinkey, superintendent electric department, Homestead Steel Works, Munhall, Pa.; Budd Frankenfield, instructor in electrical engineering, the University of Wisconsin, Madison, Wis.; Wm. Howe Ripley, student, in department of electrical engineering, Columbia University, New York City; Edward B. Rosa, Professor of Physics, Wesleyan University, Middletown, Conn.; Chris. Van Deventer, student, Columbia University, New York City; Geo. K. Woodworth, electrician, Crawford Manufacturing Company, Hagerstown, Md. The following associate members were transferred to membership: Philip Dawson, associate and chief engineer with R. W. Blackwell, 39 Victoria street, Westminster, London, Eng.; Lucius T. Gibbs, manager and chief engineer, Gibbs Electric Company, Milwaukee, Wis.; Frank J. Sprague, vice-president Sprague Electric Elevator Company, 253 Broadway, New York City; Edward Andrew Leslie, vice-president and manager Manhattan Electric Light Company, Limited, New York City.

MR. K. B. MILLER is to lecture before the Chicago Electrical Association on March 5, upon the subject of "Electrical Resonance."

OBITUARY

EDWIN W. JENNEY.

The death is announced of E. W. Jenney, secretary and treasurer of the Jenney Electric Motor Company, of Indianapolis, of cancerous tumor. Mr. Jenney had been a sufferer from this disease for several months, but only in the last few weeks gave up his work. He leaves a wife and four children. He was associated in the electric company with his two brothers—Charles D. Jenney, president of the company, and Arthur E. Jenney. Mr. Jenneywas born in New Haven, Conn., in 1855. He married Miss Gertrude Smith in Detroit, Mich., and a little later went to Indiana. The Jenneys were a family of electricians. The father, James A Jenney, is still living in Fairhaven, Conn. The deceased was a graduate of Michigan University.

EDUCATIONAL

25th ANNIVERSARY OF THE STEVENS INSTITUTE OF TECHNOLOGY.—THE ELECTRICAL EXHIBITS.

THE celebration of the twenty-fifth anniversary of the Stevens' Institute of Technology, last week, was begun by a banquet at the Hotel Waldorf, in which over three hundred graduates, undergraduates and guests took part. Among the latter were Andrew Carnegie, Abraham S. Hewitt, Commodore G. W. Melville, and J. E. Watkins, of the Smithsonian Institute.

One of the features of the celebration was an exhibition of the work of the graduates of the Institute, which formed quite an extensive collection of apparatus, drawings and photographs which were placed on view in the various laboratories, the machine shop and the library of the Institute. It was noticeable that many of the exhibits of the graduates were of an electrical character, and showed that the excellent course followed in mechanical engineering at the Institute, together with the practice in its electrical laboratory, has eminently fitted the graduates of the Institute to take up electrical work after graduating.

Among the many exhibits of the graduates we noticed that of Mr. John F. Kelly, which consisted of a 40 k. w., 2,000-volt, induction alternator of the type manufactured by the Stanley Electric Manufacturing Company. There was also an original model of a 1 k. w., 500-volt, induction generator, and a 4 h. p., 2-phase alternating motor. On the wall beside the machines were specimens of the Kelly static voltmeters and the static ground detectors, which were illustrated in our issue of last week. The exhibit itself was in charge of Mr. H. L. Fridenberg, also a graduate of the Institute, and now with the Stanley Electric Manufacturing Company.

Close beside this exhibit was that of Mr. L. H. Nash, the designer of the well known Nash gas engine. The exhibit contained a 20 h. p. Nash gas engine direct connected to a Riker 20 h. p. generator, both mounted on the same base. The two were connected by a special flexible clutch coupling, and the current generated fed all the incandescent lamps throughout the shops and buildings during the exhibition. The exhibit was in charge of Mr. C. Baylis, of the Baylis Company.

Mr. H. A. Wagner, in person, presided over the very handsome exhibit of the apparatus designed by him and manufactured by the Wagner Electric Manufacturing Company. This consisted of a 5 h. p., single phase non-synchronous alternating motor, which possessed the excellent characteristic of running at the same speed for which it was designed, in spite of the fact that the voltage obtainable was barely one-half of that for which the motor was designed, the number of alternations being the same, however. There was also shown a 1½ h. p. direct current motor, and various sizes of the Wagner transformers, ranging from 20 to 500 lights' capacity. On a table adjoining the motors and converters were various switches and cut-outs designed by Mr. Wagner, including the high potential non-arcing switch. On the wall adjoining was also shown the alternating current Wagner switchboard voltmeter, with illuminated dial. Added to this was a group of photographs, showing views of additional apparatus and of the shops of the Wagner Electric Manufacturing Company, at St. Louis. Our last issue contained descriptions of much of the admirable apparatus shown.

Mr. H. S. Prentiss, of New York, exhibited his time switch, ally, from the controlling mechanism which releases it, so that intended to cut out lights in show windows, and in other locations at stated periods. The switch is exceedingly simple in construction and the switch is entirely disconnected, electrically, from the controlling mechanism which releases it, so that from the underwriters' standpoint, and also from the standpoint of personal safety, there is no objection to its use in any situation. Mr. Prentiss also exhibited his calendar clock, a marvel of ingenuity and simplicity. The exhibit also contained Mr. Prentiss' synchronizer, a master clock for governing any number of other clocks for general and accurate time distribution.

Mr. J. Van Vleck, consulting engineer for the New York Edison Company, showed a series of photographic views of the steam engineering work of that company, designed by him and carried out under his supervision, and his system of edgewise indicating instruments. Our readers are no doubt familiar with Mr. Van Vleck's work through the description of the New York Edison stations, which appeared in The Electrical Engineer of January 8, 1896.

Mr. A. R. Wolff, of New York, exhibited the complete plans for the steam power, heating and ventilating of the new Astor Hotel, New York.

Mr. W. S. Chester, of the C. & C. Electric Company, exhibited photographs and diagrams of the method of applying electric motors to the driving of organ blowers. A letter of encomium from the celebrated composer and organist, M. Guilmant, formed a part of the very interesting exhibit.

Mr. Joseph Wetzler's exhibit consisted of a set of volumes of The Electrical Engineer, and a copy of "The Electric Motor and Its Applications."

Mr. E. P. Thompson had on view copies of his work on the X-Ray, and the book entitled "The Science of Invention."

Mr. Burhorn, of Burhorn & Granger, exhibited photographs of the power plant of the Dodge Coal Storage System of the Erie Railroad Company, at East Buffalo.

Mr. H. Russell Smith, of Chicago, exhibited illustration and description of a new type of electric elevator designed by him.

Mr. W. D. Pierson exhibited a continuous wire drawing machine designed by him for the Waterbury Machine Company. This machine is designed to draw wire continuously from No. 14 to No. 26 gauge, and from No. 26 to No. 40, with copper or brass. With iron it will draw from No. 18 to No. 30.

In the electrical laboratory was exhibited an electrical laboratory furnace, designed by Mr. W. R. King. This furnace consists of a strip of carbon, placed between heavy carbon terminals, the passage of the current heating up the strip sufficiently to cause the heating of the substances to be decomposed. Mr. King illustrated the action of the furnace by making calcium carbide on a small scale.

Mr. F. E. Jackson exhibited one of the Aylsworth & Jackson celebrated X-ray apparatus and fluoroscopes.

Mr. E. A. Uehling exhibited in operation his useful pyrometer, manufactured by Uehling, Steinbart & Co., and his gas composimeter. The pyrometer measured the temperature of the chimney gases of the Institute's boilers and at the same time the gas composimeter measured the amount of carbonic oxide contained in the chimney gases. The operation of the latter instrument depends upon the absorption of the carbonic oxide by caustic potash, and utilizes in connection with it the same principle as that employed in the pyrometer. This exhibit also contained a specimen of the Steinbart recording gauge, used in connection with both instruments mentioned above.

Mr. E. P. Roberts exhibited drawings of a 2,000 h. p. power house, designed by him for the Lorraine & Cleveland Electric Railway. He also showed plans and photographs and specifications, etc., for other plants installed in municipal and various county institutions, as well as some literature describing the well known Correspondence School conducted by Mr. Roberts, at Cleveland.

Mr. J. W. Lieb, Jr., exhibited a series of views of the pioneer electric light station of the Milan, Italy, Edison Company, of which Mr. Lieb was general manager until recently, when he received a call from the New York Edison Company, of which he is now general manager.

Mr. B. C. Ball showed a steam engine governor and a tachometer, depending upon the stroboscopic effect between the sparks and the spokes of the revolving flywheel; the rate of the vibration of the reed being known, the speed of the engine is also determined when the spokes appear stationary.

Mr. H. M. Brinkerhoff showed photographs and drawings of the intramural and electric elevated railroads.

Mr. John W. Howell, engineer of the Edison Lamp Works, at Harrison, N. J., exhibited a set of incandescent lamps, showing their development from 1880 to 1897.

Mr. H. A. Korneman and W. Strong exhibited dynamos built while students. Mr. F. Uhlenhaut exhibited photographs of the Philadelphia Traction Company's system.

Messrs. R. T. Kingsford & W. H. MacGregor exhibited a continuous steam engine indicator, which gives a separate diagram for each stroke of the engine on a continuous strip of paper.

Among the exhibits of the faculty of the Institute was that of Prof. Alfred M. Mayer. He showed his classical experiments illustrating how a series of floating magnetic needles arrange themselves in regular geometrical figures under the influence of a magnet suspended above them. Prof. Mayer also exhibited some wonderful examples of the floating upon water of polished metals, such as rings. A ring one millimetre in diameter floated, though sunk to a depth of nearly five times its diameter below the surface, the surface tension of the water, of course, keeping it afloat. The influence of vapor on this suspending power was shown by Prof. Mayer. When a ring was floating, the mere opening of a bottle of ether above the water and the coming in contact of the ether vapor with the water surface so reduced the surface tension of the latter that the ring sank immediately. Prof. Mayer also exhibited a series of photographs of the magnetic lines of force made with iron filings, which first appeared in the Franklin Institute Journal in 1871. A number of acoustic apparatus and experiments were also shown by Prof. Mayer, including his topophone for locating the position of fog horns in foggy weather, and his sound mill consisting of a series of acoustic resonators, mounted so as to revolve when placed beside a vibrating tuning fork.

Prof. W. H. Bristol and Mr. B. B. Bristol exhibited a complete line of the Bristol recording pressure gauges, ammeters, voltmeters, etc., which are now so familiar an object in many electric light plants. The exhibit also contained specimens of all sizes of the Bristol steel belt lacings; and views of the factory of the Bristol Company, at Waterbury, Conn., adorned the walls. These photographs were also the work of Prof. Bristol, who is an expert photographer. The exhibit was in charge of Mr. B. B. Bristol.

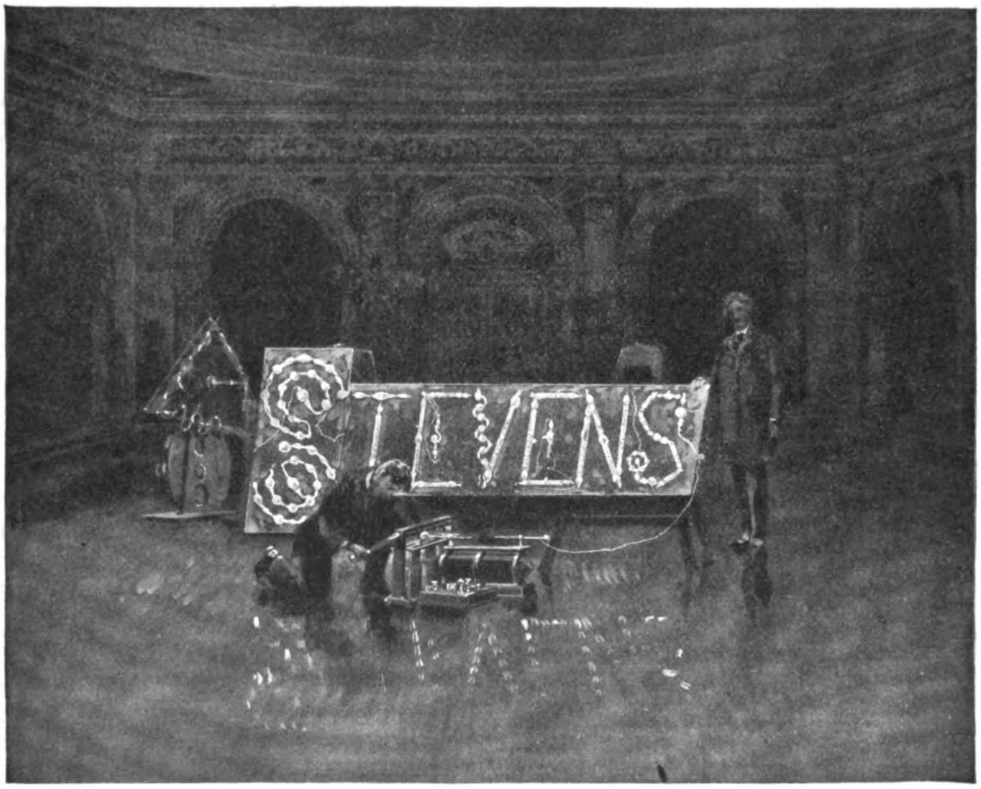
Prof. J. B. Webb exhibited a disc dynamometer, adapted especially for absorbing power at high speeds. This ingenious dynamometer consists merely of a disc running in water, placed within a casing coming close to the sides of the disc. This dynamometer applied to a Curtiss turbine with a disc about 3 inches in water absorbed 180 h. p. at 2,500 revolutions per minute, and about 60 h. p. with 1 inch depth of water. In the apparatus exhibited the disc was driven by a Crocker-Wheeler motor, and the torsion measured by a pointer passing over a scale.

STEVENS INSTITUTE LECTURES IN 1871.

IN connection with the celebration of the 25th anniversary of the Stevens Institute of Technology, which took place last week, there is in course of preparation an illustrated volume which will contain among other things a history of the Institute during its quarter century of existence. One of the illustrations already prepared we give herewith.

It shows one of the experiments used at a lecture given twenty-five years ago, soon after the opening of the Institute, in which a large number of Geissler tubes of unusual size and brightness made by Alvergniat, of Paris (then one of the most prominent manufacturers of these tubes), were arranged to form the word "Stevens" and were illuminated by means of an induction coil built for President Morton of the Institute by E. N. Ritchie, of Boston, and the largest of its kind constructed up to that date. It readily yielded sparks in the air of 21 inches and penetrated blocks of glass 3 inches in thickness. A detailed description of this coil is found in Du Moncel's large work on The Applications of Electricity, vol. II., p. 253; in the Journal of the Franklin Institute for 1871, vol. 61, p. 213 and elsewhere.

In the experiment shown in the accompanying illustration the various Geissler tubes were illuminated with different colors depending upon the nature of the residual gas left in them when exhausted, the material of the tubes,—as when they were made of canary glass which yielded a brilliant green light by fluorescence, or the fluorescent liquids with which the outer tubes or "jackets" of some were filled, as, for example, a solution of quinine sulphate yielding sky blue.



An Experiment with Geissler Tubes of 25 Years Ago.

PERSONAL

MR. H. A. WAGNER, of the Wagner Elec. Mfg. Co., St. Louis, Mo., was a visitor to New York last week in order to attend the Stevens Institute celebrations. An exhibit of his work was a feature of the display of what the Stevens men have done in various lines.

MR. RALPH B. COLEMAN, of Middletown, has been appointed electrical engineer of the Manhattan State Hospital, New York City.

MR. S. A. BARTON, so long prominent in Thomson-Houston affairs in the busy and prosperous days of old, is the latest victim to the hard times through the failure of the Chicago Interior Decorating Company, in which he was the heaviest stockholder. His many friends extend their heartiest sympathies.

MR. W. H. FAIRCHILD, for fifteen years cashier at the Western Union telegraph office at New Haven, Conn., has accepted the management of the Postal Telegraph Cable Company's office there, to succeed Mr. A. L. Page, who died recently. Mr. Fairchild will probably remove his family from Manchester, N. H., where he has been identified with the telephone business for the past eight years.

MR. J. T. NICHOLL, general manager of the Chattanooga Company, Limited, has resigned in order to become general manager of the Rochester, N. Y., Electric Railway Company. In Chattanooga, Mr. Nicholl has done a great deal to build up the company's suburban property and develop local rapid transit. He has also been instrumental in carrying to success the Chattanooga Normal University.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

BY MAX OSTERBERG.

Alternating Currents :

THE PRINCIPLES OF ALTERNATE-CURRENT WORKING.—By Alfred Hay, B. Sc. In his series of articles the author refers to the advantages of parallel working of alternators, asserting one of the principal advantages to be the ease with which an additional dynamo may be thrown in or out of the circuit. He then considers synchronous working, and explains that successful parallel working of alternators is a very different matter from mere synchronous running. Successful parallel running depends on the ease with which each alternator will immediately take up its share of the load as it is switched into circuit, and with which it will keep in exact step with all the others during the whole of a period.—Lond. "Elec. Eng'r.," Jan. 22, '97.

Biographical :

E. CARL BREITHAUPT.—Obituary notice with portrait. —Can. "Elec. News," Feb., '97.

Central Stations :

ELECTRIC CENTRAL STATIONS VERSUS ISOLATED PLANT.—By R. S. Hale. In reply to an article published showing the advantages of isolated plants, the author gives details of costs which are rarely counted against small installations, thus proving the superiority of central stations over isolated plants. "Eng. Mag.," Feb., '97. For editorial comment, see "Elec. Eng.," Feb. 10, '97.

Dynamos and Motors:

NOTE ON THE RELATION BETWEEN THE SPEED AND EFFICIENCY OF A DYNAMO.—By Arnold G. Hansard, B. A. A graphic solution of this problem which gives the result that the speed which gives the highest efficiency is that which makes the eddy current losses equal to the C^2R losses. The following assumptions are made: (1) Output varies as the speed. (2) C^2R losses at full load are the same for all speeds. (3) Hysteresis and friction losses are proportional to the speed. (4) Eddy current losses are proportional to the square of the speed.—Lond. "Elec.," Jan. 22, '97.

DISEASES OF DYNAMOS AND MOTORS; THEIR SYMPTOMS AND REMEDIES.—By J. C. Lincoln. Simple rules for finding open circuits, short circuits, and grounds.—Sc. Mach., Feb. 1, '97.

NEW DYNAMO FOR THREE-WIRE DISTRIBUTION.—By M. Alimet. After reviewing several methods previously employed that designed by Müller and built by Lahmeyer is described in detail.—Lond. "Elec. Rev.," Jan. 22, '97, from "l'Elect."

Electro-Chemistry:

ALUMINUM MANUFACTURE IN EUROPE.—An exhaustive review of all the leading European establishments taken from "The Mineral Resources of the United States," 1895, by Dr. David T. Day. Reprinted in full in "Jour. Frankl. Inst.," Feb., '97.

Electric Railways :

DETAILS OF TRAMWAYS, AND THEIR WORKING IN ENGLAND.—A return ordered by the House of Commons has just been issued, giving a good many details as to the tramways and their working. This return gives a total of 153 undertakings, 37 of which belong to the local authorities. The total authorized capital is £18,039,704, while £15,195,933 has been expended. The length of line open for traffic is 1,009 miles, worked by 35,621 horses and 568 locomotives, with 4,663 cars. The number of passengers carried in 1896 was 759,466,047, giving gross receipts £4,152,016. The working expenses came to £3,105,511, leaving as net receipts, £1,046,505. These figures are for the United Kingdom. Of the miles opened, 792 are in England and Wales, 96 in Scotland, and 121 in Ireland.—Lond. "Elec. Eng'r." Jan. 22, '97.

THE ELECTRIC RAILWAYS AND TRAMWAYS OF THE UNITED KINGDOM.—A supplement giving details of track, line equipment, rolling stock, and power house equipment of all the electric railways in operation, and all those in progress in Great Britain and Ireland.—Lond. "Elec.," Jan. 22, '97.

Measurement :

CABLE TESTING CARRIAGES FOR THE CITY ELECTRICITY WORKS IN MUNICH.—By F. Uppenborn. A carriage containing all the necessary measuring instruments for the testing of underground cables, built and designed by the author. Line drawings illustrate the arrangement of the instruments.—"Elek. Zeitschr.," Jan. 21, '97.

Miscellaneous :

ELECTRICAL ENGINEERING IN CANADA.—An editorial note stating in most optimistic terms the chances for constructing and operating engineers with rather poor outlook for the mere laboratory expert.—Can. "Elec. News," Feb., '97.

IMPORT DUTIES IN FOREIGN COUNTRIES ON DYNAMO ELECTRIC MACHINERY AND ELECTRIC LAMPS.—A statement showing the rates of import duties leviable on electric machinery and electric lamps in the principal European countries, and India, recently prepared by the English Board of Trade.—Lond. "Elec. Rev.," Jan. 22, '97.

Power Transmission :

THE LOCAL DISTRIBUTION OF ELECTRIC POWER IN WORKSHOPS, ETC.—By Ernest Kilburn Scott. Author explains the methods of control employed by Mr. Leonard, and the method of control introduced by the Niles Tool Works Company, of Hamilton, Ohio, and gives results of efficiency obtained from actual tests.—Lond. "Elec. Eng'r," Jan. 22, '97.

Storage Batteries :

THE ACCUMULATOR OF FAURE AND KING.—The description and illustration of a new electrode which is said to offer a larger exciting surface to be acted upon.—"Elek. Anz.," Jan. 21, '97.

Telephony, Telegraphy, etc:

TELEPHONING IN GERMANY.—Considerable progress has been made lately in long distance telephony, being due principally to the low price charged. A three-minute conversation over the longest distance, about 580 miles, costs 75 cents. The long distance lines are all metallic circuits, the wires varying between 2, 3, 4 and 5 millimetres, according to the distance.—"Eng'g," Jan. 22, '97.

Transformers :

PROTECTIVE DEVICES FOR TRANSFORMERS.—By Herbert C. Wirt. A paper read before the N. W. Elec. Assoc. Jan. 20, '97. The general conclusion which the author arrives at, after investigating a considerable number of accidents to transformers, is that oil should be used for insulation in every case, as he found by experience that no fire was ever started by the primary of the transformer when oil was used as an insulator.—"Elec. World," Jan. 23, '97. "Elec. Rev.," Jan. 27, '97.—Elec. Eng'r, Jan. 23, '97.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEBRUARY 16, 1897.

Alarms and Signals :—

SIGNAL. P. G. Feuerstein, Milwaukee, Wis., 577,128. Filed Oct. 26, 1896.

Comprises a clock having its dial provided with hour and minute contacts, the clock hands as electric conductors that travel against the contacts on the dial, a switchboard having contacts wired to the contacts on the dial, electric signal wires, and an electric split plug for connecting switchboard contacts with signal wires.

Batteries, Primary :—

ELECTRICAL BATTERY. E. Burnet, Wigan, Eng., 577,282. Filed Nov. 30, 1895.

A battery or compound cell applicable for a pocket electric lamp.

Connectors, Conduits and Insulators :—

CONDUIT SHEATHING. H. B. Camp, Akron, Ohio, 577,284. Filed Feb. 10, 1896.

A conduit suitably metallically sheathed externally, and having the sheathing composed of an inner section and outer sections embracing the longitudinal edges of the inner sheathing section.

Dynamos and Motors :—

SPACE BLOCK FOR ARMATURES. H. Geisenhoner, Schenectady, N. Y., 577,130. Filed Nov. 20, 1896.

Consists of a main portion of cast metal, having recesses for the projections of the space block, and projections of strips of metal secured to the casting portion.

BINDING BAND FOR ARMATURES. H. G. Reist, Schenectady, N. Y., 577,148. Filed Nov. 18, 1896.

Consists of a number of turns of wire, loops formed at the ends of the band, and means for securing the ends.

Electro-Metallurgy:—

PROCESS OF ELECTRODEPOSITING ALUMINUM. C. G. Collins, Woodsburg, N. Y., 577,186. Filed May 18, 1896.

Consists in passing an electric current successively through a positive solution containing a salt of aluminum, a porous partition, and a negative solution containing potash, phosphate of aluminum and aqua-ammonia.

ELECTRICAL CASTING OF METALS. N. Slawianoff, St. Petersburg, Russia, 577,329. Filed Jan. 29, 1891.

The metal to be cast is made in the shape of a rod which forms the one electrode of a self-regulating arc.

ELECTRIC FURNACE. F. J. Patten, New York, 577,317. Filed Sept. 15, 1896.

Adapted for the manufacture of calcium carbide.

ELECTRIC FURNACE. F. J. Patten, New York, 577,370. Filed Nov. 6, 1896.

An electric arc being established between the electrodes is made to move by magnetic influence from one point to another.

ELECTROMAGNETIC ARC CONTROLLING DEVICE. F. J. Patten, New York, 577,371. Filed Sept. 8, 1896.

Consists in causing the arc in an electric furnace to traverse a magnetic field in which the lines of force are substantially transverse to the direction of the arc, and reversing or alternating either the arc-producing current or the magnetic field.

Electro Therapeutics:

ELECTRICAL ATTACHMENT FOR BARBERS' CHAIRS. N. H. Burger, Benzonia, Mich., 577,233. Filed Oct. 23, 1895.

Means for supplying an induced current to a brush or similar device.

Lamps and Appurtenances:—

INCANDESCENT ELECTRIC LAMP. C. S. Dolley, R. Hawkins and T. M. Lightfoot, Philadelphia, Pa., 577,159. Filed April 22, 1896.

Consists of an incandescent filament compressed between two non-conducting plates, and from between which plates the air has been exhausted.

Miscellaneous:—

ILLUMINATED SIGN. C. Holland, Millis, Mass., 577,033. Filed March 17, 1896.

A holder adapted to be connected with an incandescent lamp, having spring acting jaws, and a single plate held by the jaws.

METHOD OF PRODUCING MOULDS FOR PAPER MAKING MACHINES. H. Sandham, Spokane, Wash., 577,070. Filed Jan. 20, 1896.

Employs electrolysis.

WATER PURIFIER. J. H. Harrison, New York, 577,134. Filed July 21, 1896.

Consists of a voltaic pile placed in a cylindrical casing.

RESONANT ELECTRIC CIRCUIT. J. S. Stone, Boston, Mass., 577,214. Filed Sept. 10, 1896.

Contains inductance resulting from the magnetization of independently magnetized paramagnetic material.

APPARATUS FOR GENERATING AND APPLYING HEAT TO THERMOCOUPLES. H. C. Reagan, Jr., Philadelphia, Pa., 577,270. Filed April 1, 1896.

Comprises a boiler provided with water tubes, fire tubes passing through the latter, a series of thermocouples supported upon the water tubes and means for holding the couples in position.

ELECTRIC GAS LIGHTER. J. T. Armstrong and A. Orling, London, Eng., 577,279. Filed Nov. 19, 1896.

Details of construction.

METHOD OF REPRODUCING PHOTOGRAPHS. N. S. Amstutz, Cleveland, Ohio, 577,373. Filed April 9, 1895.

Consists in forming an image with continuous parallel lines of varying widths, except where they are discontinuous through the inherent composition of the subject and causing variable electrical impulses to be formed through the medium of such lines and a suitable transmitter and then recording such impulses upon another surface.

ELECTRICAL WARP STOP MOTION FOR LOOMS. A. C. Shuttleworth, Philadelphia, Pa., 577,077. Filed April 30, 1894.

Details of construction.

ELECTRIC IGNITER FOR EXPLOSIVE ENGINES. W. F. Davis, Waterloo, Ia., 577,158. Filed Sept. 24, 1896.

Details of construction.

FIRE EXTINGUISHING APPARATUS. H. F. Maxim, Norfolk, Va., 577,307. Filed Aug. 15, 1895.

Details of construction.

Railways and Appliances:—

ELECTRIC CONTROLLER. E. A. Sperry, Cleveland, Ohio, 577,081. Filed Sept. 21, 1896.

The reversing-switch contacts are mounted directly upon the commutating cylinder.

ELECTRIC RAILWAY MOTOR. A. Schmid, Pittsburg, Pa., 577,071. Filed June 4, 1895.

Comprises a motor supported at one side by the axle, a plurality of springs circumferentially arranged around the axle and bearing against it, a bearing for the motor interposed between it and the outer ends of the springs and gearing between the motor armature, the bearing and the axle, whereby all of the parts rotate together.

ELECTRIC BRAKE. E. A. Sperry, Cleveland, Ohio, 577,119. Filed Feb. 19, 1895.

The combination with an electric motor, of an auxiliary field coil, and means for automatically connecting the coil in circuit with the motor when the cource of supply is interrupted.

Regulation:—

MEANS FOR PREVENTING DESTRUCTIVE FIELD MAGNET DISCHARGES. F. Mackintosh, Schenectady, N. Y., 577,141. Filed Oct. 31, 1896.

Comprises an exciter supplying current to the field coils, a dynamo electric machine in circuit therewith, and a switch for interrupting the exciter circuit and causing the motor to act as a generator and supply current to the field coils.

Switches, Cut-Outs, Etc.

ELECTRIC SWITCH. C. D. Jenney, Indianapolis, Ind., 577,037. Filed April 7, 1896.

An automatic locking device whereby a switch may be locked in the "on" or "off" position, and which will unlock and place it in the "off" position when the circuit is broken.

Telephones:—

TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 577,101. Filed Sept. 19, 1896.

Comprises an electrothermal generator at the subscriber's station which is designed to supply current for the microphone.

PARTY LINE TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 577,102. Filed Sept. 19, 1896.

Provides selective signals for eight separate subscribers' stations placed upon a single metallic circuit.

TELEPHONY. W. L. Bradshaw, Cincinnati, Ohio, 577,231. Filed March 30, 1896.

Interior telephone system.

LEGAL NOTES

THE WURTS-HARRINGTON INTERFERENCE ON AUTOMATIC CIRCUIT BREAKERS DECIDED IN FAVOR OF WURTS.

The Court of Appeals of the District of Columbia has reversed the decision of the Acting Commissioner of Patents, in the case of A. J. Wurts and the Westinghouse Company, appellants, vs. W. E. Harrington. The interference related to automatic circuit breakers now largely used in electric railway work and involved the following claim in Wurts' patent, No. 500,456:

"A fixed contact point, a movable conducting part making normal contact therewith; a wire of fusible metal in shunt around said parts, and means whereby the parts are automatically separated on the occurrence of an abnormal current."

The decision of the examiner of interferences was in favor of Wurts, and was affirmed on appeal to the examiners-in-chief, but reversed by the Acting Commissioner, who awarded priority to Harrington. The present decision reverses the latter's decision and awards priority to Wurts.

A DECISION ON HEATER SWITCHES.

On February 15, in the United States Circuit Court, State of New York, at Utica, Judge Coxe handed down a decision in favor of the American Electric Heating Corporation as against the Consolidated Car Heating Company, of Albany. The title of this suit was, "The Dewey Electric Heating Company vs. The Albany Railway Company." The former is owned by the American Electric Heating Corporation and the latter are users of the Consolidated Car Company's heaters. The object of the suit was to prevent the use of a switch in combination with electric heaters for varying the amount of heat in cars as covered by patent No. 464,247, granted to Mark W. Dewey, December 1, 1891, for "Improvement in Electric Heating Apparatus." In granting the decree Judge Coxe says: "The invention consists in combining any desired number of distinct sections each complete in itself, adapted to be connected with the supply conductors in series, in multiple arc, or in multiple series with a switch for controlling these connections and an indicator operated by the movement of the switch to show how the connections stand." . . . "Matters relating merely to form and location are not the essence of the invention." . . . "The defendants' combination operates in substantially the same manner and accomplishes the same result as the combination of the claim."

REPORTS OF COMPANIES

BOSTON EDISON CO.

In his annual report President Rogers of the Edison Electric Illuminating Company of Boston states that there has been no increase in the capital stock during the year, but to provide additional capital for conservative development purposes, the stockholders on Dec. 10, voted to increase the capital stock by an issue of 5,000 shares. During the year $130,000 debenture certificates were converted into stock; there remain of this issue $178,000 now outstanding, the convertible privilege attaching to which expires May 1, 1897. The figures of operation show:

Year Dec. 31.	1896.	1895.	1894.
Earnings	$773,478	$709,002	$628,406
Expenses	498,298	456,301	311,242
Net	$275,180	$252,701	$317,164
Inc. lamps connected	134,381	108,476	100,047
Arc. lamps connected	1,422	901	853
Motors con. (h. p.)	5,354	4,857	4,349

The Boston Edison Company's balance sheet, Dec. 31, compared thus:

ASSETS.		
Dec. 31.	1896.	1895.
Installation	$3,245,074	$2,857,218
License under Edison patents	338,105	338,105
Liverpool wharf estate	225,912	225,912
Cash on hand	31,260	115,574
Stock on hand	49,803	59,394
Notes and accounts receivable	105,894	112,347
Open accounts	15,418	17,702
Total	$4,011,468	$3,706,454
LIABILITIES.		
Capital stock	$3,240,800	$3,110,800
Debenture bonds	178,000	308,000
Trust mortgage bonds	180,000	180,000
Notes and accounts payable	185,389	15,285
Interest and dividends payable	58,494	57,519
Rents	....	817
Reserve for maintenance	120,000	....
Profit and loss	48,785	34,033
Total	$4,011,468	$3,706,454

THE STOCK MARKET

SOME IMPROVEMENT.

But for the war cloud overhanging the spot where the gallant little Greek is pulling the nose of the sick and bloated Turk, general trade and financial conditions would be in much better shape even than they are. But our markets are largely one with those of Europe, and move more or less in sympathy. General trade has been larger and better, railroad returns are good, and in many lines of industry there is a tendency toward old-time activity.

The stock market has been deadly dull. Western Union has been depressed by a revival of the old rumor that the block of B. & O. stock, issued for the Garrett telegraph lines was coming on the market; but it has not come. General Electric has stayed around 34½, although touching 35⅛; and Am. Bell telephone has reached 219.

TRADE NOTES & NOVELTIES

TNE LATEST LAMP "POOL"

With regard to the reports current about the plans which have been carried out for maintaining the price of lamps at 20 cents, etc., Mr. W. T. Uptegraff, of the Westinghouse Electric and Manufacturing Company, said in Pittsburg last week that the Westinghouse Company was in no combination and knew nothing of any such as reported. Under a recent decision of the Supreme Court of the United States, he said, it was decided that the patent on the vacuum principle of the incandescent lamp was the property of the General Electric Company through purchase from Thomas A. Edison, but as some of the terms of the Canadian and British patents had expired, that fact terminated the life of the patents in this country. The effect of the decision gives to the Westinghouse Electric and Manufacturing Company valid patents on several details connected with lamp manufacture, particularly on the carbon filament, and the means of attaching it to the electric wires for use. Until this decision was rendered no royalties were collected by the company on its detail patents, but notice has been served on all manufacturers that, beginning with March 1, royalties will be demanded.

The companies manufacturing under royalty rights, Mr. Uptegraff stated, would want to hold prices steady in order to prevent ruinous competition, but the Westinghouse Company has no relation with any combination. It demands a royalty from all makers using its patents, and at the same time will make lamps on its own account.

We are informed that no attempt has been made to exclude any lamp manufacturers from the pool, and that negotiations are now pending with a dozen of them. Rumors are afloat as to suits against three concerns.

THE MACINTIRE ARC LAMPS.

At the invitation of Mr. G. R. Macintire, of the International Arc Lamp Company, of New York, we visited last Saturday the first installation of his new arc lamps in the new restaurant of J. Kamsler, at 713 Broadway, New York. Besides the good things provided for the inner man, the proprietor has scored a signal success by the method of illumination adopted, which, we may say at once, was specially remarked and received the unanimous praise of all the patrons.

The lighting of the restaurant is effected by six Macintire enclosed arc lamps suspended from ,or, rather attached directly, to the ceiling; and projecting downward not more than 19 inches, of which 3 inches are taken up by the canopy. The bulb enclosing the arc is shaded from below by a regular incandescent lamp shade, while at a distance of 6 inches, a ring of crystal prisms carried from an ornamental brass canopy gives a finished and artistic appearance to the whole. The lamps are run directly off the Edison mains. They take 80 volts and the resistance in circuit with each is mounted on the switchboard, and does not encumber the lamp, as is usually the case. The lamp burns 150 hours. For artistic appearance and small compass, these new Macintire arc lamps exceed anything which has thus far come under our notice, and they constitute a real step forward toward the utilization of the arc light in interior illumination, not only on land, but for marine purposes, for which they are pre-eminently adapted.

CARBON ELECTRODES FOR ELECTROLYSIS.

The importance of a suitable carbon electrode for industrial electrolysis becomes evident with the increasing production by electrolytic methods of either chemicals or metals in this country. Mr. Hugo Reisinger, 38 Beaver street, New York, who is well known to the electrical trade for his "Electra" arc light carbons, has had great success in the introduction of his carbon electrodes, which are used in the electrolytic production of aluminum, copper, chlorate of potash, etc. The carbon electrodes supplied by him are made of pure carbon. They are homogeneous throughout, of the very highest conductivity, and have a very great life. The European factory which Mr. Reisinger represents in this country has the greatest facilities for turning out large quantities of these carbon electrodes, and among others, has a running contract to supply all the carbon electrodes used in the world-renowned aluminum factories at Neuhausen, Switzerland.

THE ELECTRICAL MANUFACTURERS' AND DEALERS PROTECTIVE AGENCY CO., OF CLEVELAND.

A brief review of the methods of the Electrical Manufacturers' and Dealers' Protective Agency Company will no doubt prove interesting reading to our subscribers, and through the courtesy of Mr. C. S. Horner, secretary of the company, we are enabled to present the general outlines and the methods used to protect its members.

"First of all," said the secretary, "while our general offices are located at Cleveland, Ohio, we are by no means confined to a local territory, but includes each and every State in the Union. Where we find an association that covers a local field, we work in perfect harmony and energetic co-operation with them, as this is the most desirable method of securing maximum results for our members."

Each member of the Electrical Manufacturers' and Dealers' Protective Association as he locates an irresponsible debtor reports the fact to the secretary of the company. The association in turn, by means of a weekly bulletin, reports the facts, without comment, to all members of the association, thus preventing other members from becoming involved by the same debtor. The debtor is notified that his name is placed upon the bulletin, and usually makes an effort to have it removed.

The company maintains a legal department which in case of last resort proves effective, but the experience of the association has demonstrated that about 80 per cent. of reported delinquent debtors square their accounts by resortng to the routine methods of the association.

A number of blank forms are used and each member is furnished with them. Every effort is made to secure a quiet settlement in advance. This is for the welfare of the delinquent debtor who is by this means enabled to make arrangements with his creditor and thus avoid being reported to other members of the association. This method is by no means in the nature of a threat, but is done out of fair consideration, so that if a dispute in accounts has been the reason for a delay in settlement it will in this manner develope before the delinquent's name has been bulletined. This friendly co-operation has resulted in settling many accounts already of long standing without the least unfriendliness.

Now let us take up a class of concerns who are doing business on little or no capital, and who conduct it by being able to procure thirty, sixty, ninety days or more time on their purchases, and who when their credit is about exhausted with one supply house resort to another, who are doing business on credit alone, and are unscrupulous in their methods. The only capital such firms have is credit, and when such a concern is reported and the members of the association demand cash for delivery of goods they usually try to re-establish their credit, which, if successful, accomplishes the ends of the Electrical Manufacturers' and Dealers' Protective Agency Company, if not, it sounds the warning to its members promptly.

The general offices occupy spacious quarters in the Society for Savings Building, Cleveland, O., and in an unostentatious work corresponds with that done by the credit protective associations in New York and other cities; with interesting variations.

ADVERTISERS' HINTS

FREDERICK RECKENZAUN, E. E., 44 Pine street, New York, announces that he makes a specialty of storage battery work designing, examining and testing plants for lighting, power, signaling, etc.

WILSON & WINKLER COMPANY, 779 Greenwich street, New York, are doing a good business in repair and construction work, as well as in furnishing dynamo and engine supplies, brushes, oil cups, gauges, etc., and switchboards.

E. J. WARING, 136 Liberty street, New York, advertises the "Daylight" desk lamp for which he claims many valuable points. Circular and price list will be sent to those requesting them.

THE WESTERN ELECTRIC COMPANY, Chicago and New York are headquarters for tools and supplies. They have recently issued an illustrated price list on brushes and type "E" and "Q" knife switches.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPany, Syracuse, are manufacturing a full line of panel and distributing boxes for any number of circuits in two or three-wire systems.

THE STANLEY ELECTRICAL MANUFACTURING COMPANY, Pittsfield, Mass., call attention to the S. K. C. static ground detector. Among the advantages it possesses they mention, it consumes no energy, can be left in circuit continuously, designed for any e. m. f. from 500 to 10,000-volt.

WESTINGHOUSE ELECTRIC & MFG. CO. present a list of plants equipped with their apparatus for the transmission of power. It aggregates over 55,000 h. p.

THE ELECTRIC STORAGE BATTERY COMPANY have recently installed the largest storage battery plant in the world.

THE WESTINGHOUSE MACHINE CO.'S foreign business steadily increases. The Paris agency recently sold four Westinghouse compound engines, aggregating 1,100 h. p., for electric railway service in Russia.

NEW YORK NOTES.

DOW, JONES & CO. issued an announcement last week that they have leased the entire operating plant of the Printing Telegraph News Company, operating the "page ticker," and will henceforth extend the use of this machine for instantaneous delivery of news. The newsslip deliveries will continue as usual to be employed, either with of without the "page ticker." The development is somewhat interesting in Wall Street news gathering. It was the same bureau of information which ten years ago revolutionized the newsslip service by introducing the printed bulletin in place of the old-fashioned tissue manifold.

VICE-PRESIDENT HENRIQUES, of the Brooklyn Bridge trustees, states that the introduction of electric motive power on the Bridge will not only improve the service, but result in a saving of $10,000 a year.

W. C. BALLDA, manager of the Utica, N. Y., Electrical Manufacturing and Supply Company, has closed a contract with the Walcott & Campbell Spinning Company, of New York mills, for a complete modern lighting plant for their new yarn mill. The installation will consist of an 800-light Eddy incandescent dynamo, 45 of the Manhattan 150-hour enclosed arc lamps and 262 Buckeye incandescent lamps, together with switchboard.

LANSINGBURG, N. Y.—At the annual meeting of the local Beacon Electric Company large extensions of the plant were ordered. The company is doing a good business. The officers for 1897 are: J. George Kaelber, of Rochester, president; S. Bolton, Jr., vice-president; A. Hill, secretary; W. M. Lea, treasurer.

WAVERLY, N. Y.—The Waverly Electric Light and Power Company has elected as its officers for 1897 Mr. J. G. Kaelber, president; H. L. Lang, vice-president; A. Will, secretary, and G. Koch, treasurer. The plant furnishes current in Waverly, Sayre and Athens. Extensive improvements have been ordered, and a 2 per cent. dividend was declared.

M. J. MURPHY.—At a meeting of the creditors of T. J. Murphy & Co., New York, manufacturers of switchboards, etc., the assignee was authorized to accept the bid of $4,800 of the Eureka Tempered Copper Works, the successor of the Eureka Tempered Copper Co., North East, Pa. The plant is turned over to them, and includes everything except the bills receivable. Business to be resumed at once.

THE CROUSE-HINDS ELECTRIC COMPANY, 500 East Water street, Syracuse, N. Y., have just been organized to manufacture electric switches, switchboards, panel boards and electric headlights. The organizers are H. B. Crouse and Jesse L. Hinds. Mr. Crouse is a favorably known young man of Syracuse, possessing energy and business tact, while Mr. Hinds is an old-time mechanic and electrical man, having spent over thirty years in the shops of the Brown & Sharp Company and the Davis Sewing Machine Company. Mr. Hinds entered the electrical field in 1889 as one of the organizers of the Electrical Engineering and Supply Company, being elected vice-president and superintendent, which position he has filled up to the present time.

THE NEW YORK STOCK EXCHANGE is after the bucket shops again and will make new arrangements to control quotations.

THE J. L. CHAPIN COMPANY, of New York City, has been formed to make and sell electrical apparatus. A. C. Chapin, M. I. Oakley and R. H. Oakley are interested. The capital is $1,000.

MR. F. B. TORREY is fitting up an extensive factory at Bath, Me., for the general manufacture of trolley wheels, brass goods, electric car fittings, etc., to be in operation early in March. The plant will be a large one and will be run by electric power.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY of Utica, N. Y., are about to move their extensive plant into larger quarters, on account of the increase in business. Their novel and ingenious sheet steel switch boxes were illustrated and described recently.

TH7 PIONEER ENCLOSED ARC has been selected for the 14-story building recently erected on Broadway and Twelfth street and occupied by the cloak manufacturers, Meyer Jonasson & Co. The lamps have already been installed and the illumination of the building is regarded as simply perfect.

PHŒNIX INTERIOR TELEPHONE COMPANY are now well housed in their new factory occupying the first story building located at 93 Washington street. There Mr. Sutton reports better trade since the first of the new year, and with its now largely increased facilities for manufacturing the Phœnix Interior Telephone Company is fast getting in position to fill very large orders for all kinds of electrical supplies.

NEWARK, N. J.—The Stucky & Heck Electrical Manufacturing Company, Newark, N. J., are busy on electric railway repair work.

VAN NEST, N. Y.—The contract for the steel work in the new building for the Catholic Protectory at Van Nest, N. Y., has been awarded the Berlin Iron Bridge Company, of East Berlin, Conn. This building is two stories high, having a floor supported by steel posts and girders. The roof construction is to be steel trusses supporting slate covering. The building is 60 feet wide and 160 feet long, having projections 60 feet long and about 30 feet wide on either side at the center for the organ loft and gallery. The ceiling of the upper floor or main auditorium will be arched and the gallery erected of light steel work will be much lighter than it would have been had clumsy construction of wood columns and beams been used.

SOUTHERN NOTES.

AUGUSTA, GA. The business of Moore & Edenfield has been formed into the Moore-Edenfield Electric and Manufacturing Company, with G. P. Weltch as treasurer and R. J. Edenfield as general manager. The concern will carry on a general electrical business and make dynamos and motors.

THE WESTINGHOUSE MACHINE COMPANY has sold to the Tennessee Centennial Exposition Company, four Westinghouse compound engines, each 400 horse-power. The engines will be installed in the Exposition Company's power plant.

WESTERN NOTES

THE BULLOCK ELEC. MFG. CO. is the new name of the Card Elec. Motor & Dynamo Co., of Cincinnati, and a certificate of incorporation to that effect has been issued. The change is desirable for many obvious reasons, and the use of Mr. Bullock's name is regarded by the trade as wise, on account of his active and energetic part in its affairs, and the weight that his name carries.

BALL ENGINES.—An electric light plant has lately been placed in the Wauwatosa County Insane Asylum, Wisconsin. The Ball Engine Company, Erie, Pa., furnished the engines. The direct connected engines and dynamos for the Chicago Public Library are now being put in position. The Chicago Edison Company furnish the dynamos and the Ball Engine Company the engines. The plant consists of five direct connected sets, amounting to 900 h. p.

THE KINLOCH TELEPHONE COMPANY, of St. Louis, which started out on its campaign January 8, claims to have already 2,661 five-year contracts, beginning July, 1898. It offers metallic service at $50 a yeear. Eighty-five miles of McRoy's terra cotta conduit have been contracted for and seven miles supplied.

PACKARD LAMPS.—The manufacturers of the Packard lamp have always had the reputation of doing something handsome in the catalogue line, and this reputation has been maintained by the appearance of their catalogue for the season of 1896-1897. This catalogue is a little more pretentious than any of its predecessors, and a goodly number of its pages are devoted to general data on incandescent lamps, and other general information of a very valuable nature. The Electric Appliance Company have prepared a special discount sheet for this catalogue, giving the present market prices on hign grade Packard lamps, so that the catalogue when supplied with this discount sheet makes a complete lamp reference book. It will be sent to the trade on application.

THE WESTERN ELECTRIC FAN MOTOR does its own blowing and claims to be the breeziest on the continent. Its ability as a never ceasing trade wind can be proved now.

AKRON ELECTRICAL MANUFACTURING COMPANY.—At the annual meeting of the stockholders of the Akron-Electrical Manufacturing Company the following directotrs were elected: S. H. Pitkin, L. C. Miles, W. B. Doyle, D. A. Doyle, F. A. Wilcox. A report of last year's business was favorable and showed a good business was done. The outlook for the coming year is equally favorable.

THE CENTRAL ELECTRIC COMPANY has taken the agency for the new Benjamin waterproof socket. This socket, designed by a man of many years' experience in construction work and particularly work pertaining to street railroad operation, is all that its name implies; it is so constructed as to be attached directly to a 7-16 or 9-16 iron armored conduit; has sufficient metal in its shell to stand a great amount of very hard usage, and wherever used has easily proven its superiority.

THE METROPOLITAN ELECTRIC COMPANY of Chicago have been given the Western Agency of the Bernstein lamps, both arc and incandescent. These lamps are among the best sellers on the market, and those not already using them would do well to give them a trial.

NEW ENGLAND NOTES

PARAGON LAMPS.—A very pretty little brochure of their arc lamps has been issued by the Paragon Arc Lamp Company, of Devonshire Building, Boston. It is an enclosed arc of 150 hours; or, in the plain series form, of 15 hours. Different styles are shown. Conover & Goe, Monadnock Building, Chicago, are the Western agents.

HON. GARDINER C. SIMS has resigned his position as treasurer of the Armington & Sims Engine Company, his resignation being accepted, and he will sever his connection with that corporation in a short time.

ATTLEBORO, MASS.—Contracts for the construction of an Odd Fellows Building, at Attleboro, Mass., have been let by the architect, Albert H. Humes, of Pawtucket, R. I. The building will be five stories high and about 70 feet square. The interior construction supporting the floors will be steel girders resting on steel columns. The contract for furnishing and erecting the steel work has been let to the Berlin Iron Bridge Company, of East Berlin, Conn..

PHILADELPHIA NOTES

THE APOLLO IRON AND STEEL COMPANY, Vandergrift, Pa., have ordered a direct connected set for electric lighting. The engine, which is a 150 horse-power vertical compound, built by the Ball Engine Company, Erie, Pa., is direct connected to a 90 kilowatt General Electric alternating machine. This company already has an electric light and power plant, consisting of three 400 horse-power tandem compound engines made by the Ball Engine Company, which are direct connected to Westinghouse generators of 225 kilowatt each.

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The Electrical Engineer.

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ELECTRICITY AT THE HEBREW TECHNICAL INSTITUTE, NEW YORK.

BY W. W. KER.

On February 12, Lincoln's Birthday, the fine new building of the Hebrew Technical Institute was formally opened with appropriate exercises. This Institute was founded to give Jewish boys a training to fit them for the mechanic arts. It takes its pupils from the public schools at the age of about thirteen and gives them a three-years' course which enables them to enter manufacturing establishments as advanced apprentices. Due to the close association with tools, such as wood working, metal working, including instrument making, moulding and casting, together with instruction from men who are expert mechanics and have had considerable experience in their respective trades, the students are prepared to earn a livelihood at once upon graduating from the Institute. After ten years of operation, statistics recently gathered show that 75 per cent. of the graduates are still working at the special branches of work which they pursued while at the Institute.

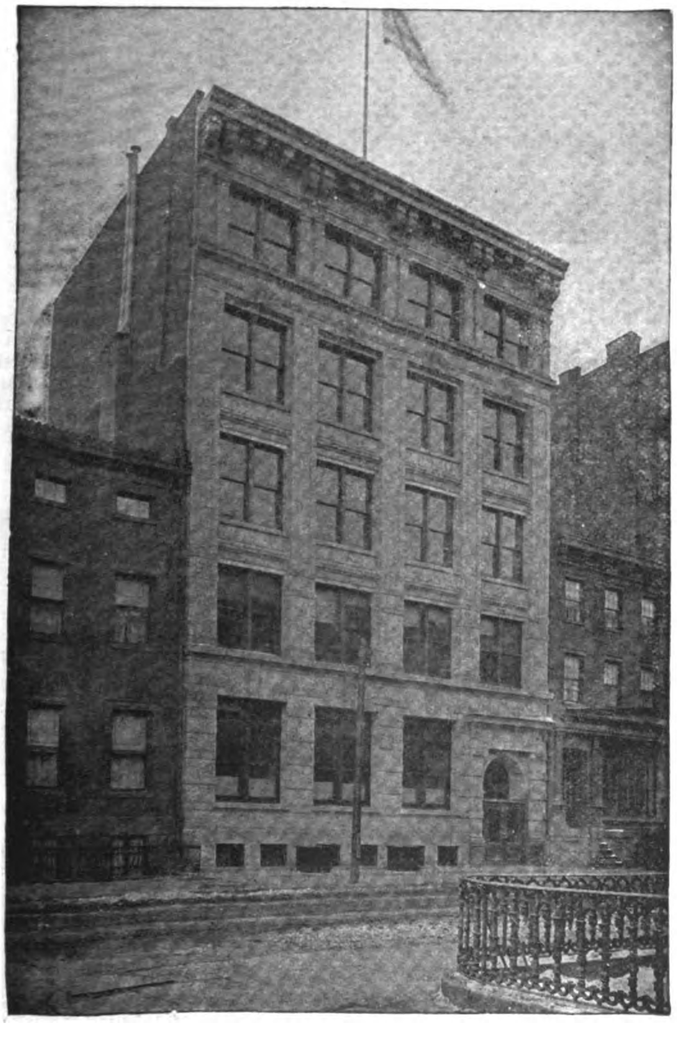

FIG. 1.—THE HEBREW TECHNICAL INSTITUTE, NEW YORK.

The Institute building, illustrated in Fig. 1, is situated at Nos. 34 and 36 Stuyvesant street, is five stories high and built of fireproof material, having a white brick front with sandstone and granite trimmings.

The rooms on each floor are partitioned off with fire and soundproof brick walls and are furnished with modern school fittings. Besides the class rooms used for the English studies, arithmetic and elementary mathematics, there are Junior woodworking, wood carving, Senior pattern making, machine, moulding shops, and drafting rooms.

The electrical laboratory, Fig. 2, is 21x50 feet in size, and is designed to accommodate thirty pupils. The equipment consists of a long bench containing sinks with running water and sewer connections for experiments in chemistry and cleaning and setting up primary and secondary batteries.

At the end of each term the cells are emptied, cleaned and put away. When the new class begins, each pupil is required to set up cells of the most important types, including accumulators, and make measurements of voltage and resistance, and determine the best type of battery for different purposes.

A dark room, containing a slate shelf built on brick brackets is provided for electrical measurements with the Wheatstone bridge and other delicate instruments. This room is also used for photometric and photographic work. The course in electrical measurements is based on the requirements of shop practice, and consists chiefly of tests made with a voltmeter, milli-voltmeter, standard resistances and amperemeter; measurements are also made with a Siemens electro-dynamometer, tangent galvanometer, ballistic galvanometer and standard condensers. The construction and calibration of instruments receive careful attention, and many instruments required in the laboratory are made by the pupils in the shops.

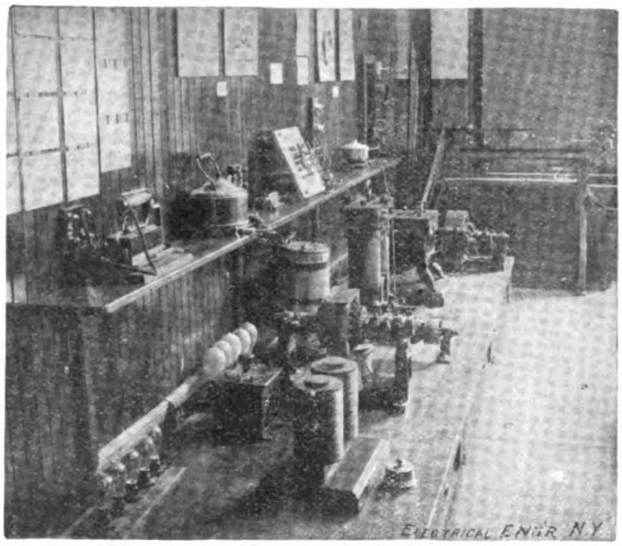

FIG. 3.—DYNAMO AND MOTOR PLATFORM

The two long benches in the center of the room contain sets of apparatus for experiments in static electricity and magnetism for the Junior class work, while the Seniors select their apparatus from the glass cases on the side wall which must be set up and adjusted by them, thus giving valuable practice in preparing for the work which is to follow; for, after all, it is the preparation for a test or measurement which requires the most careful consideration, the actual measurement often being completed by the closing of a circuit.

At the rear of the room, Fig. 3, a heavy yellow pine platform 15 feet long is arranged for holding dynamos and motors for making efficiency tests by the dynamometer method and with the Prony brake. Besides the above machines, which range in size from .5 to 2 kilowatts, there are a number of small models used for making the magnetic calculations of electrical machinery and making tannic acid prints of the magnetic fields of different types. These prints are made by placing a plate of glass on the model dynamo which is made flat, and sprinkling on it iron filings in the usual manner, then moistening a piece of thick white paper with a solution made by dissolving 5 grams of tannic acid in 50 grams of water. The moist side of the paper is then quickly spread over the filings and rubbed with a cloth, which brings the filings in contact with the acid and turns the paper dark, making a lasting print which can be placed in a notebook.

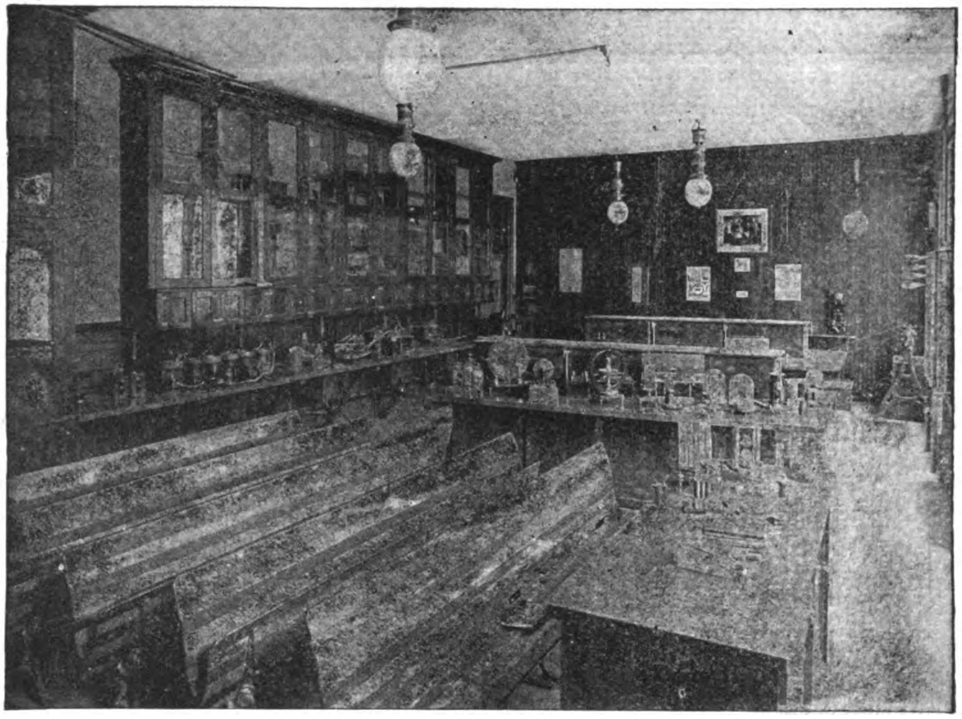

Fig. 2.—The Electrical Laboratory, Hebrew Technical Institute.

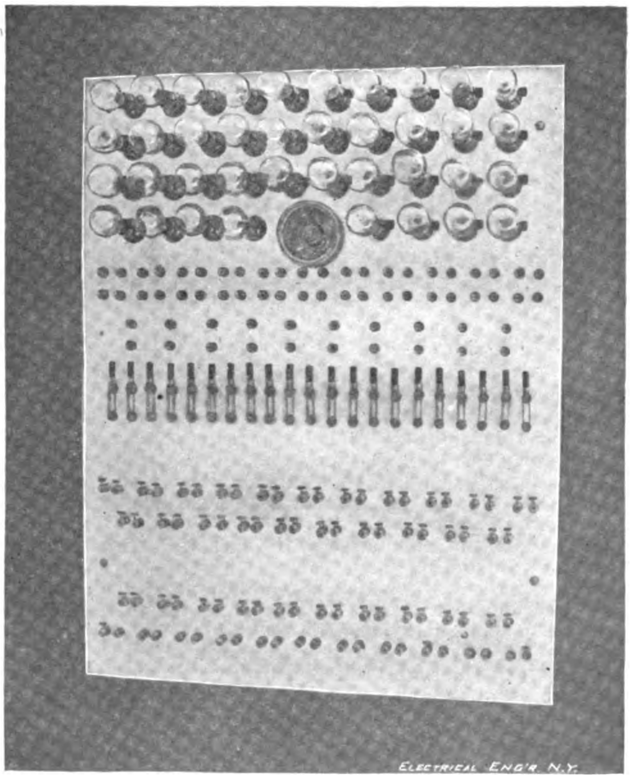

Fig. 4.—Laboratory Switchboard.

Another method tried in the Institute which gives excellent results is to place the magnet under a plate of glass, or, better still, one of porcelain, in order to have a white background; sprinkle the filings as before, and by means of an atomizer spray a thin solution of white shellac dissolved in alcohol over the plate and filings and allow it to harden. The filings will be held to the plate firmly and in their natural position. The shellac, being almost transparent, will give better results than paraffin as usually applied. In Fig. 3 two plates are shown, one of a Weston and the other of the Manchester type of dynamo field, hung on the wall.

Another feature of the laboratory will be a permanent exhibition of electrical appliances and fittings loaned and donated by manufacturing companies, which will be used to assist the pupils in obtaining an idea of their practical operation, method of manufacture, etc. This exhibit is not intended for finely finished models and historical apparatus, but for everyday necessaries used in installation work, from a useful chandelier cut-out bug to the working drawings of an installation.

Fig. 4 shows a white marble switchboard which is the distributing center of twenty-one outlets placed in different parts of the laboratory. It was made by one of the pupils during the past summer and almost any combination of circuits and current regulation can be made in a short time.

The machine shop is shown in Fig. 5.

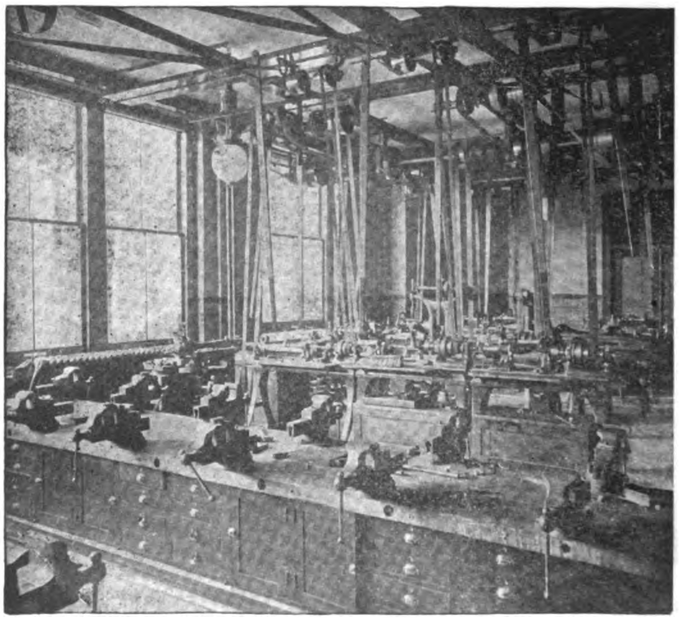

Fig. 5.—The Machine Shop.

The generating plant for the building consists of two 40 horse-power tubular boilers which supply steam to a 60 horse-power Fishkill-Corliss and a 25 horse-power Westinghouse engine. The current is generated by a 25 kilowatt dynamo built by Bréguet, of Paris, and a 20 kilowatt Eddy slow speed multipolar dynamo.

The shops are supplied with power by Eddy motors, and connections are arranged so that power measurements can be made by the pupils.

The machine shop is driven by a 7½ horse-power motor; the Senior pattern shop by a 10 horse-power motor. The Eddy generators and motors were installed by Messrs. H. B. Coho & Co.

The illumination of the shops received careful consideration. On account of the difficulty and expense of having a single 16 candle-power lamp at each machine or work bench, where the filaments are frequently broken and the sockets short circuited by getting tangled in the belts, etc., it was decided to employ arc lamps, and twenty "Pioneer" enclosed arc lamps of the Electric Arc Light Company have been installed. These were placed in position and the machines and benches arranged so as to produce the best lighting effect. As a result the illumination is much superior to that obtained with the old method and the troubles with incandescent lamps have ceased.

The wood-working shops are supplied with the American Electric Heating Company's electric glue heaters, which are under better control than the steam glue heaters, besides being cleaner and occupying less space. Each shop has one two-quart heater which is sufficient for a class of twenty pupils. Three heats can be obtained, the first bringing the cold water to 212 degs. F. in fifteen minutes; the plug switch is then turned to "slow," which provides a temperature of about 190 degs. for the rest of the day.

The building is equipped with a complete system of electric bells which ring in each room at ten minutes and five minutes before the hour and on the even hour, for the changing of classes from one department to another. Each bell has its individual set of batteries so as to avoid annoyances caused by the bells not ringing in some of the rooms as is often the case when a number of bells operated by one push button are connected in series or parallel. All the bell wires have been placed in iron armored tubing to insure their continuous operation. A complete telephone system is in operation using the Franklin movable transmitter.

The entire electrical equipment has been installed with a view to permanence, and extra heavy fittings have been used throughout the building.

THE UNIVERSITY OF NEBRASKA has just had its annual celebration of charter day, and has held its third annual electrical exhibit, in charge of the Society of Electrical Engineers. A large variety of interesting experiments and apparatus were shown in successful operation, reflecting great credit on the students.

ELECTRIC LIGHTING

THE ENCLOSED ARC LIGHT.—VI.

(Concluded.)

BY L. B. MARKS, M. M. E.

REFERENCE has been made to the cutting off of light by the carbon points in the case of short arcs. When cored carbons are used as positives which is generally the case in open arc lamps operated on incandescent circuits, the crater in the upper carbon assumes a distinctly concave formation; the walls of the crater thus cut off a large percentage of light at and slightly below the horizontal, and the interposition of the negative carbon in such cases also decreases the angle subtending the zone of most powerful illumination. The shadows thus thrown by the upper and lower carbon points respectively are distinctly discernible on the globe of the lamp. With the enclosed long-hour arc lamp, in which the carbons are separated from four to six times as much as in the case just alluded to, the concavity of the crater in the upper carbon is inappreciable, and the light is not intercepted by the side walls, not cut off by the negative as in the other case.

I have taken photographs of two lamps, the latter being types of those which are in extensive commercial use in the United States, the one an open lamp, Fig. 11, showing shadows on the globe, the other, the enclosed lamp, Fig. 12, with shadowless globe. The open arc lamp referred to was of the common 10-ampere type, operating at from 40 to 43 volts at the arc, with cored upper carbon 12.7 mm. (½ in.) in diameter, and solid lower carbon 11.11 mm. (7-16 in.) in diameter. The enclosed arc lamp was of the 5-ampere type, operated at from 80 to 85 volts at the arc; solid upper and lower carbons 11.11 mm. in diameter were used. You will note from the photographs that in the open arc the shadows on the globe are very marked, while the enclosed arc globe is shadowless.

In the case of the open arc, especially where cored carbons are used, the crater tends to center itself in the positive carbons. With the enclosed arc, however, the crater tends to wander; instead of issuing from a pointed negative tip located directly below the center of the positive, as is the case with the open arc, the arc stream of the enclosed arc issues from consecutive points along a flat surface, the crater in the positive always tending to be almost directly above the point from which the arc issues. The arc of the crater increases with the current strength; hence the greater the current density, the less marked are the migrations of the arc. When carbons not larger in diameter than about 11 mm. are used in the high potential enclosed arc lamp, the wandering of the arc is not objectionable, especially when the diffusion obtained by the use of the inner bulb is marked. The lamp which I have burning here, Fig. 13, you will note is very steady; the diffusion of light is so perfect that the eye does not detect any motion of the arc.

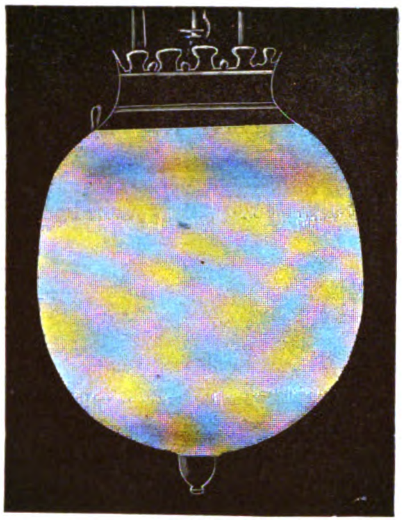

FIG. 11.

Conclusion.—It will be noted that in considering the commercial application of the enclosed arc light, attention has been concentrated on the adaptability of the lamp to direct current constant potential circuits. The introduction of enclosed arcs on circuits of this class has been phenomenally great in the United States during the past year, the open constant potential lamp being gradually relegated to the past. The field for the enclosed arc light, it is believed, will rapidly widen, the application to alternating current circuits being already an accomplished fact, while the adaptation to constant

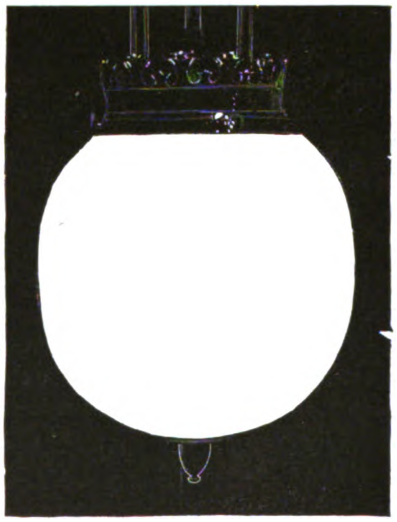

FIG. 12.

current high tension circuits will be simply a question of time.

Summarizing, we may set forth the advantages of the commercial enclosed arc over the open arc as follows: 1. Cost of carbons about one-twentieth of that of the open lamp. 2. Cost of attendance about one-tenth of that of the open lamp. 3. The annoyance of daily trimming no longer an objection to the arc lamp. 4. Absence of shadows of the carbon points; uniform distribution of light. 5. One or more lamps on small amperage, operated independently. 6. Cleanly; carbon dust entirely consumed. 7. Formation and escape of sparks prevented. 8. No flush of current at start or feed. 9. Simple lamp mechanism.

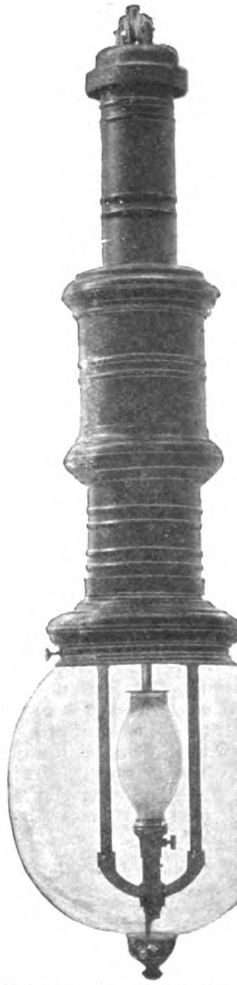

Fig. 13.—Enclosed Arc Lamp for Out-Door Use.

In conclusion I desire most kindly to acknowledge the courtesy of those who have assisted me in the presentation of the subject this evening. I trust this society will also accept my sincere thanks for the honor conferred on me by the invitation to address you on the subject of "The Enclosed Arc Light." Naturally it has been difficult for me to condense the experiences and researches of years into a short address, but I trust that I have thrown at least some light on the subject and opened up the way to further research and development.

CENTRAL STATION COSTS.[1]

In view of the small amount of accurate data obtainable regarding the actual workings of electrical plants, following collection of costs possesses considerable interest and value. The figures were obtained by averaging results obtained for the year included between April 1, 1895, and April 1, 1896, in a large modern Edison lighting plant. The equipment, including water tube boilers, triple expansion vertical engines directly connected to G. E. low tension generators, steam pumps, Wheeler surface condensers and an Edison 3-wire underground distribution, indicates low costs, more than likely below the ordinary run of station. As the costs are given per K. W. hour comparisons can be made with other existing stations.

Costs are as follows per k. w. hour.

Fuel cost per k. w. hour	cents	0.343	
Boiler and engine attendance, including chief engineers and assistants	“	0.281	
Generator and switch board attendance	“	0.058	
Oil, waste and packing	“	0.026	
Water[2]	“	0.002	
Removal of ashes	“	0.025	
Petty miscellaneous expenses	“	0.014	
Generating cost per k. w. hour	cents		0.749
Boiler cleaning and repairs	“	0.049	
Engine repairs	“	0.057	
Dynamo repairs	“	0.007	
Repairs to pumps, steam piping, filters, heaters, condensers, etc	“	0.022	
Repairs to switch board and electrical instruments	“	0.004	
Repairs and care of building	“	0.066	
Total repairs and maintenance of the station per k. w. hour =	cents		0.205
Repairs on customers premises installing of meters and hanging arc lamps	“	0.100	
Including lamp renewals, including lamps furnished for new installations	“	0.257	
Superintendence, maintenance and repairs of underground system	“	0.177	
Carbons, trimmers and repairs of arc lamps	“	0.253	
Reading and repairing meters	“	0.142	
Total distributing expenses	cents		0.929
Total operating, repairs and distributing expenses	cents		1.883
Supply department expenses	“	0.076	
General expenses, including salaries of officers, accounting department, advertising, canvassing, insurance, rentals, taxes, interest and discount, legal expenses, stationery, printing and postage, freight and cartage	“	1.113	1.189
Total cost per k. w. hour	cents		3.072
Interest at 6% on total cost of plant per k. w. hour	“		2.279
	cents		5.351

Kind of coal (soft coal) screenings.
Lamp efficiency, 3.1 watts per c. p.
Engine economy on test 13.45 lbs. steam per I. H. P.
Generator efficiency 92 per cent.

$$\text{Efficiency of station} = \frac{\frac{\text{K W hours}}{.746}}{\text{I.H.P. hours}} = .883$$

$$\text{Efficiency of distribution} = \frac{\text{K. W. hours customers meters}}{\text{K. W. hours switch board}} = .737$$

Of this loss of 26 3-10 per cent., 18 2-10 per cent. is loss by leakage and in current stolen; 8 1-10 per cent. due to drop in C. R.

Of the total output 54 8-10 per cent. was delivered to incandescent lamps, 15 8-10 per cent. to low tension arc lamps and 29 4-10 per cent. to motors.

The percentage of average to connected load was 10 5-10 per cent.

The percentage of maximum to connected load was 32 5-10 per cent.

GAS IN PHILADELPHIA.

Cities and towns tempted to try the experiment of municipal lighting, remarks the Providence "Journal," should investigate the condition of the gas works operated by the city of Philadelphia. The newspapers report that last year's leakage amounted to 1,132,646,138 cubic feet, or nearly one-fourth of the product, and that 40 per cent. of the gas sold was purchased water gas, on which there is a profit of 63 cents a thousand feet. The most curious fact brought out is that the city makes nothing on its coal gas and finds all its profit in handling purchased gas. It is possible, of course, that the exact figures were not obtained, but there is nothing improbable in the story. The best politicians in the country cannot be expected to manage a gas plant as economically as a private corporation can, and it is safe to assume that the legitimate profits of gas or electric lighting concerns will bear less heavily on the taxpayer than the losses due to ignorance and carelessness like that reported from Philadelphia.

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[1] The Sibley Journal of Mech. Eng.

[2] Condensing plant used water free of cost.

The Journal is indebted to Mr. Charles M. Henrotin for this information.

LIGHT: ITS DISTRIBUTION AND DIFFUSION AS RELATED TO QUALITY AND EFFICIENCY.—IV.

(Concluded.)

By E. LEAVENWORTH ELLIOTT.

THE latest attempt of this kind is the globe brought out by Messrs. Blondel and Psaroudaki, of Paris. These globes are provided with horizontal exterior rings and vertical meridianal groovings, the profiles of both being calculated mathematically, according to the laws of optics, so as to give the best distribution, with ample diffusion.

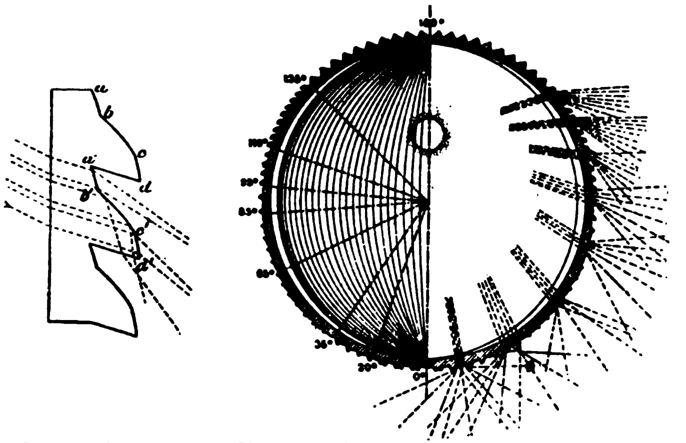


FIG. 2.—MERIDIANAL VERTICAL SECTION OF HOLOPHANE GLOBE.

The two sets of grooves and projection are so formed as to make the entire globe appear luminous, from which fact the inventors have given them the name "holophane," signifying wholly luminous. So ingeniously have the laws of optics been applied to the practical solution of this important problem that a description of the globes will doubtless be of general interest.

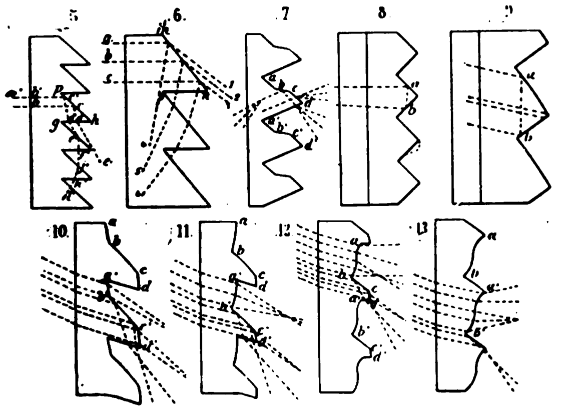


FIG. 3.—VARIOUS FORMS OF PROFILES OF EXTERIOR RINGS, SHOWING REFLECTING AND REFRACTING SURFACES.

The method of designing them is as follows: The general contour of the globe or envelope is first determined, which may be of any desirable form consistent with the process of manufacture. As an example let us suppose that a spherical form is chosen, Fig. 2. The location of the source of light is then decided upon, in this case being generally placed a little above the equator. Since the source of light has more or less surface, it is sufficiently accurate to consider the incident rays on a small section of the surface as parallel, and the surfaces of the section planes. The problem requires that we should deflect each beam in the most advantageous direction, and at the same time spread it out so as to secure diffusion. Theoretically we might accomplish this by giving each section of the

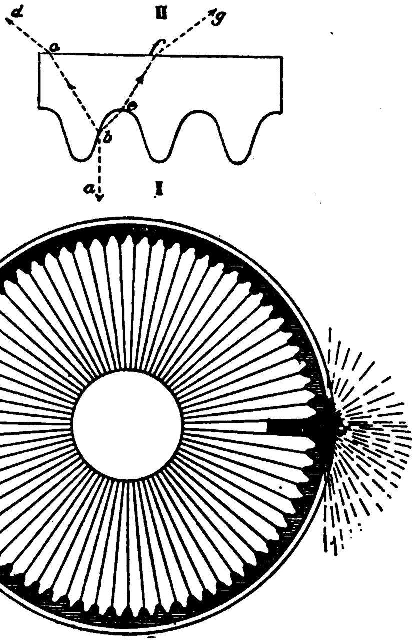


FIG. 4.—I, EQUATORIAL SECTION OF HOLOPHANE GLOBE. II, PORTION OF SECTION ENLARGED, SHOWING FORM OF INTERIOR GROOVES.

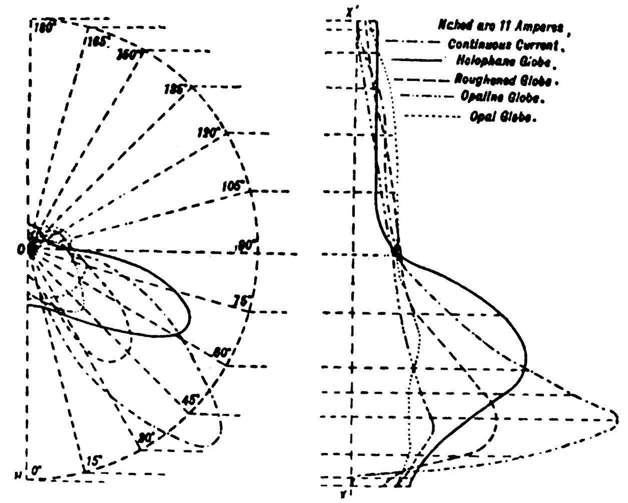


FIG. 5.—CURVES OF DISTRIBUTION AND OF FLUX, OF DIRECT CURRENT ARC, WITH VARIOUS GLOBES.

TABLE I.—Table of Values of the Intensities and Luminous Flux for Different Globes, with the Same Continuous-Current Arc Lamp, Taking 11 Amperes.

	Naked arc.	Holophane globe.	Roughened glass globe.	Opaline globe.	Opal globe.
Maximum intensities in pyrs	2,530	1,640	1,346	773	572
Mean spherical intensities in pyrs	787	692	550	383	434
Mean lower hemispherical intensity (below the horizontal) in pyrs	1,350	1,158	854	578	541
Total luminous flux (lumens)	9,885	8,591	6,968	4,810	5,450
Lower hemispherical flux (lumens)	8,478	7,272	5,363	3,629	2,054
Loss in total flux compared with the naked arc	...	13%	31%	51%	45%
Loss in lower hemispherical flux compared with the naked arc	...	15%	37%	57%	60%

exterior surface a simple, convex or concave profile. But, by such construction a portion of the beam striking the surface at a large angle, would suffer a considerable amount of reflection, the reflected portion being lost in the upper hemisphere. In order to avoid this loss a surface placed at the angle of total reflection b' c' is substituted for a part of the refracting curves. By properly calculating these curves, which is done by the use of mathematical formulæ too long to be given here, the beam may be spread out so as to secure the desired distribution and diffusion, with a minimum of loss. In a similar manner the entire surface of the globe may be divided into such rings, each having its profile so calculated as to distribute the light over the same solid angle, and hence appearing luminous in the line of sight to an eye situated anywhere within the angle. The dividing lines a d between the rings are made as nearly as possible in the direction of the incident rays. Theoretically, each ring should have a different form, due to the different direction of the incident rays; but in practice it is sufficient to divide the periphery into a number of zones, each zone having a special form of ring, as shown at the left side of the section, Fig. 2. Near the top of the globe the rings have the form of doubly reflecting prisms, which deflect the light downward through the lower portion of the globe. Great variety in the profile of the rings is possible. Some characteristic forms are shown in Fig. 3.

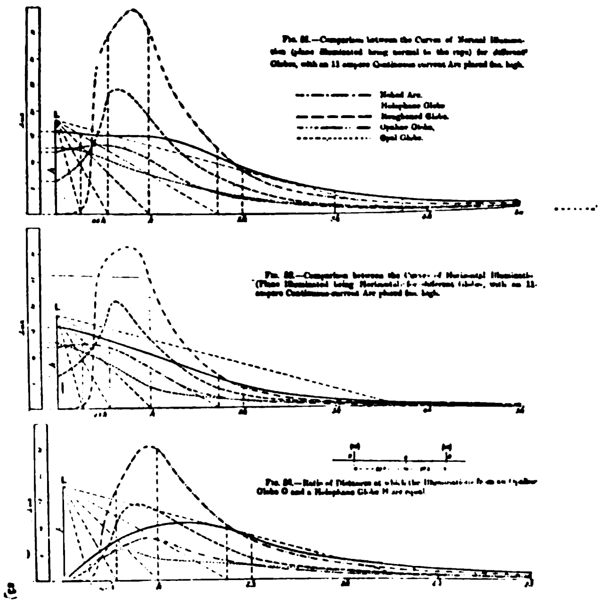
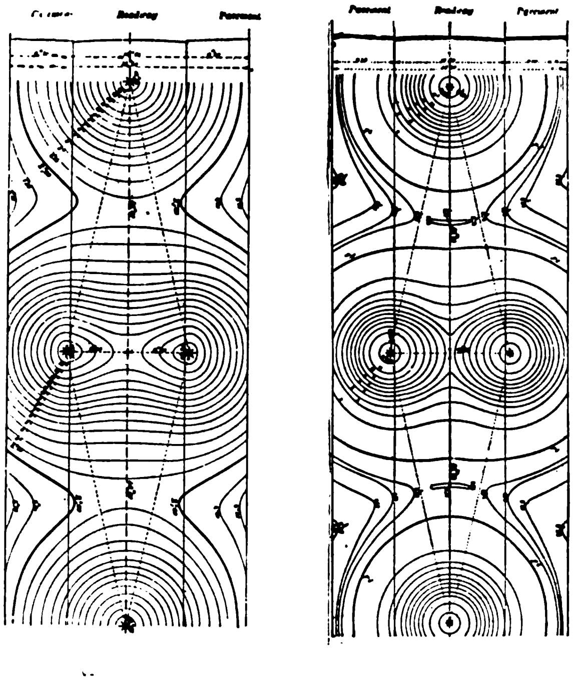


FIG. 6.—CURVES OF ILLUMINATION OF DIRECT-CURRENT ARC. WITH VARIOUS GLOBES.

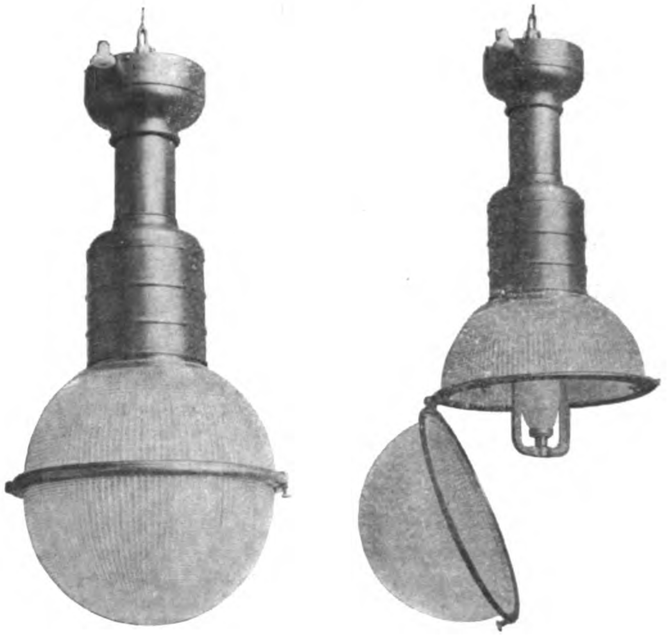


I. II.

FIG. 7.—DISTRIBUTION OF ISOLUX LINES. I., WITH HOLOPHANE GLOBES, II., WITH OPAL GLOBES.

A globe thus constructed with only horizontal groovings or rings will give only vertical spreading, and so appear luminous only in a vertical meridian. To secure lateral spreading of the light, the interior surface is formed of a series of meridianal grooves, from top to bottom, Fig. 4. These grooves all have the same profile since all sources of light give out their rays with practical uniformity in all directions laterally. The curvature of these interior flutings is therefore so calculated as to spread the beam out as nearly as possible over a solid angle of 180 degrees, i. e., tangent to the surface. Furthermore the curve is calculated to distribute the light according to the law of cosines, so that each meridian shall appear equally luminous when viewed from every point. Of the many curves which would fill these conditions theoretically, the one shown has been selected as having the greatest practical advantage.

The effect of diffusing globes is to make the source of light appear larger. If the diffusion is perfect, the entire surface of the globe becomes luminous, as in the case of opal and ground glass. Of all the variously ribbed and corrugated globes made of clear glass, the holophane is the only one which attains this perfection.



FIGS. 8 AND 9.—ENCLOSED ARC LAMP WITH HOLOPHANE GLOBE.

Photometric comparison of the results obtained with the various globes when used with a direct-current arc lamp have been made by Blondel and others, the results of which are very instructive. See table, p. 237.

The results have also been plotted and representative curves are given in Figs. 5, 6 and 7. From these results it will be seen that a better distribution coupled with complete diffusion is secured with much less loss of light by holophanes, than with either ground glass or opal globes.

In conclusion, we may say that the improvements in artificial lighting since the savage first set up his torch, have been chiefly in the direction of producing more intense sources, and more convenient methods of distributing the light units. In economy of production almost no progress has been made. In the improvement of the quality of light, with regard to its physiological effect, we have rather retrograded on the whole. In the means of using the light to best advantage for purposes of general illumination we are yet very far from perfection—in fact, far behind the progress that has been made in the other directions. The great discoveries in light production are yet to be made, viz., light without heat, having practically the same composition as sun light, and emanating from large sources of comparatively low brilliancy.

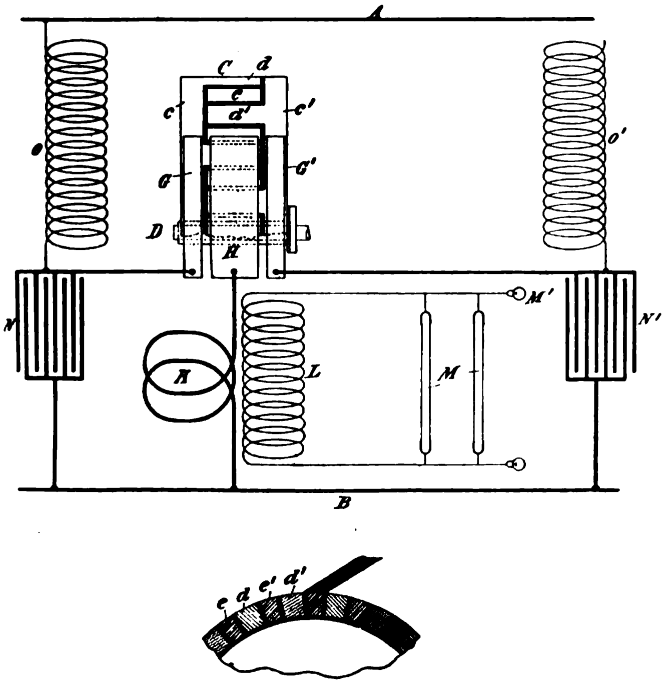
The enclosed arc lamp has been making very rapid strides in popularity of late, and is no doubt destined to play a very important part in interior lighting, and will undoubtedly make a place for itself in exterior lighting, under certain conditions. Its very manifest advantages have been offset to a considerable degree, however, by three disadvantages, viz., 1, waste of current by the use of resistance in series; 2, absorption of light by the opal globes used, and, 3, the discoloration and breakage of the enclosing globes. The first of these difficulties will no doubt be practically removed by the construction of lamps to run two or more in series; and the last two difficulties can be overcome to a large degree by the use of holophane globes. Convenience in trimming is also enhanced by their use, as will be seen from Figs. 8 and 9, which show the method of attaching a 13½-inch holophane to the usual type of enclosed arc lamp, and also the manner of opening the globe for trimming.

A NEW TESLA CONTINUOUS HIGH FREQUENCY GENERATOR.

IN the forms of high frequency generators heretofore devised by Mr. Tesla, and in high potential generators generally, a cessation of flow has naturally been caused during the interruption of the circuit necessary to obtain the "break." In order to produce a continuous high frequency discharge Mr. Tesla has recently designed the apparatus illustrated diagrammatically in the accompanying engravings.

Briefly stated, the apparatus consists in the combination of two condensers with a circuit-controller of such character and so operated by a single motive device as to charge and discharge the condensers alternately, whereby one will be discharging while the other is being charged, and conversely.

The spaces between two adjacent commutator bars d d', Fig. 2, are equal in arc to the width of one of the bars and are filled in with blocks of metal insulated from the other conducting portions of the device. The two heads c c' are insulated from each other. Upon the periphery of this commutator bear three brushes G G' H, the two former resting upon the continuous metallic portions of the two heads, respectively, the latter being in position to bear upon the projections d d' and blocks e alternately.



FIGS. 1 AND 2.

The brush H is connected to the main B through a primary coil K of low self-induction in inductive relation to a secondary L, which constitutes the ultimate source of the current of high frequency which the apparatus is designed to develop. The brushes G G' are connected with the main B through condensers N N', respectively, and to the main A through self-induction or choking coils O O', these latter being used in order that the inductive discharge of the accumulated energy therein may be taken advantage of in charging the condensers.

The operation of the apparatus is as follows: By the rotation of the commutator C the brush H is caused to pass over the projections d, closing the circuits through the primary K and the two cylinders alternately. These two circuits are so adjusted as to have the same capacity, self-induction, and resistance. When this brush is in electrical connection with any projection d' from the part c', the circuit is closed between mains A and B through coil O', brush G', brush H, and coil K. Energy is therefore accumulated in the coil O'. At the same time the condenser N' is short-circuited through the brush G', brush H, and coil K, and discharges through this circuit the energy stored in it, the discharge being in the form of a series of impulses which induce in the secondary L corresponding impulses of high potential. When brush H breaks the circuit through coil O', the high-potential discharge or "kick" from the latter rushes into and recharges the condenser N', but as soon as the brush H has passed over the intervening block e and reached the next segment d it closes the circuit through coil O and short-circuits the condenser N, so that high-frequency currents from either one or the other of the two condensers are flowing through the primary K practically without interruption. Thus without increasing the size or power of the motive device or complicating in any material degree the commutator these devices are made to perform double duty and the output of the apparatus as a whole greatly increased.

It is also evident that all phase differences in the charging and discharging of the condensers may in like manner be seand reached the next segment d it closes the circuit through the same motor and circuit-controller might be made to charge more than two condensers in succession and to discharge them in the same order.

TELEPHONY AND TELEGRAPHY

THE DUSSAUD MICROPHONOGRAPH.

SOME new experiments have been made recently by M. Dussaud relating to the perception of sounds by deaf mutes, by means of an apparatus called the microphonograph. The object of this apparatus is to magnify the voice just as a lens magnifies objects for the eye. The instrument is applicable not only to the magnification of the voice, but has also been shown to be extremely useful in ausculation and the study of the feeble sounds given out by healthy and diseased organs of the body. On the other hand it is destined to render immense benefits to the deaf and to deaf mutes.

The apparatus which is illustrated in Fig. 1 consists of two parts, the register and the repeater. The register consists of a horizontal cylinder driven by clock work. On this cylinder is fixed a wax barrel before which is placed, enclosed in a case about the size of a watch, a number of small electromagnets, which act on the diaphragm, to which is attached the graver, designed to scrape the surface of the wax barrel. In order to register feeble sounds a microphone of a special type is placed in the region of the organ to be studied, and the microphone connected to the register by wires carrying a current from sixty small sulphate of mercury cells. By means of the current the sounds gathered by the microphone are faithfully repeated by the diaphragm of the microphonograph, and inscribed upon the wax by the graver.

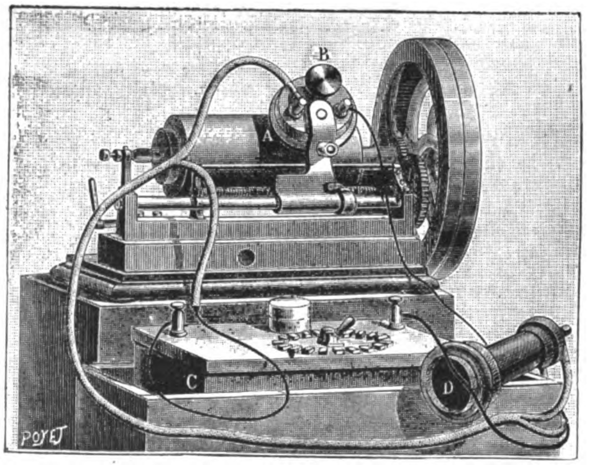


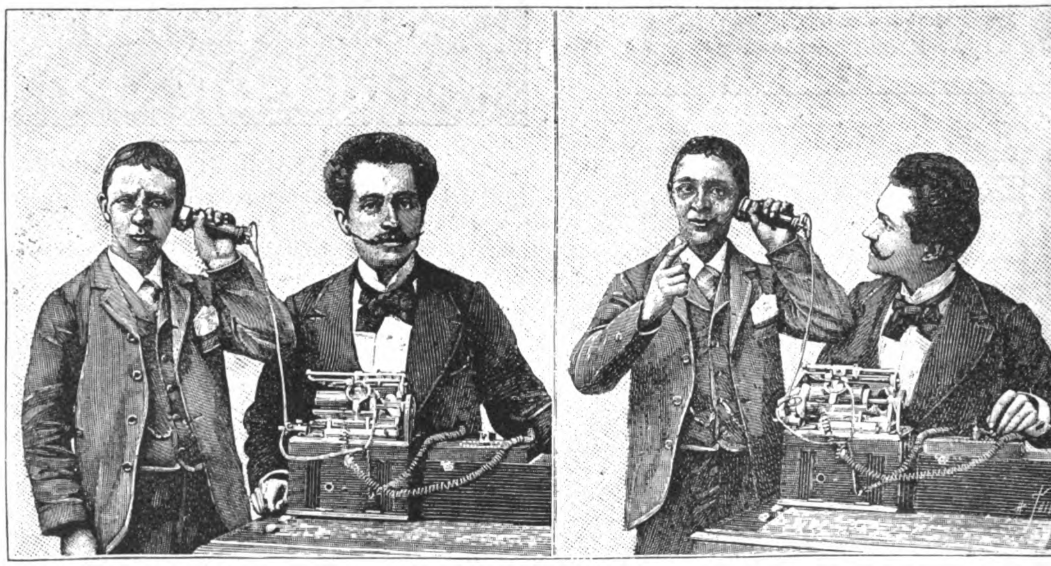
FIG. 1.—THE DUSSAUD MICROPHONOGRAPH.

The repeater consists also of a horizontal cylinder operated by clock work. Upon this cylinder is placed the barrel of wax engraved by the register, and in front of it a diaphragm carrying a rounded stylus which fits into the trace made by the graver previously used. Upon the membrane is fixed a small microphone provided with micrometric screws, springs and levers.

When in use the current of from one to sixty cells is passed through the instrument, after which the current goes to a hand telephone. There is then heard the sound inscribed upon the wax, the intensity depending upon the amount of current passing.

Our engraving, Fig. 2, taken from La Nature, shows a young deaf mute listening at the telephone when the apparatus is not in operation, his countenance showing the usual sad appearance. Fig. 3, shows the same lad, taken by instantaneous photography, while the apparatus is playing the Marseillaise. Immediately his face lights up, and instinctively he beats the time. This lad was so deaf that a word shouted into his ear with all possible force could not be heard by him, but as soon as the microphonograph was placed at his ear he manifested his joy, and quitted the instrument with great reluctance. The education of deaf mutes by means of the microphonograph is now being carried on.

The instrument, of course, is admirably adapted to studying the action of the heart. In this direction M. Dussaud has registered the crises due to the emotions of the artist and the orator. In this way one perceives not only the sound but even the movement of the soul; in a word, life itself is registered.



Figs. 2 and 3.—Deaf Mute Listening to Microphonograph Reproduction.

Besides the main object for which it was originally designed the apparatus constitutes an audiometer of the most exact kind; its action depending upon the number of elements necessary to obtain perceptible sounds. Thus one of the young deaf mutes treated by the microphonograph at the beginning of his treatment required twenty-two elements of the battery in order to perceive sound; after ten months' treatment only two elements were necessary, the auditory nerves and auditory apparatus having been so strongly stimulated to activity by the use of the apparatus. M. Dussaud is now at work on a microphonograph of large dimensions, taking considerable current, and intended to make the voice heard by ten thousand persons. This is intended for the Paris Exhibition of 1900.

PROPOSED TELEPHONE LEGISLATION AT ALBANY.

Three or four new telephone bills have already made their appearance, and a new one is presented by Assemblyman Schneider, of Erie. It is provided that in cities of more than 1,000,000 inhabitants telephone companies shall not charge more than $7 per month for each telephone, or $5 a month each for two telephones. In cities of less than 1,000,000 it fixes the toll at $4 per month for each telephone and 15 cents for every 5 minutes' communication between cities or villages less than 50 miles apart and 50 cents between places more than 50 miles apart. A violation of these rates is made a misdemeanor, punishable by a fine of $100.

ROENTGEN RAYS

THE EVOLUTION OF THE X-RAYS.[1]

BY M. CORNU.

THE past year affords a striking example of the outcome of the accumulated efforts of several generations of natural philosophers, whose starting point was modest enough, but whose final results have assumed exceptional importance. I refer to the discovery of Prof. Röntgen, of which I, as a physicist, feel bound to speak to-day; for these famous X-rays have been to the public, as well as to savants, the scientific event of the year. I will relate their history—an instructive one.

To find the first germ we must go back to the middle of the last century. At that period electrical phenomena excited strong interest; the bold comparison of laboratory experiments with the grandiose manifestations in the clouds, the explanation of thunder and lightning, the invention of the lightning conductor by Franklin, had fired the imagination and spread a taste for electrical experiments. Physics had become a fashionable amusement. People of quality did not disdain to attend the lectures of Abbe Nollet, instructor of physics to the Dauphin, and to follow the demonstrations which the expert experimenter reproduced before their own eyes. Some of the engravings of that time give us glimpses of these gatherings. We see the spruce and coquettish abbes of the court, elegant cavaliers and ladies in grande toilette, crowding round strange looking apparatus, and amusing themselves by drawing sparks from the electrical machine or by producing brilliant brush discharges. The experiment of the brush discharge in vacuo was one of the most remarkable because of its scale and splendor. This brilliant effect was obtained in the "electric egg," a transparent glass globe with two metal rods terminating in knobs, between which the electric discharge took place. The spark was first zigzag, like a lightning flash, then spreading out more and more as the vacuum improved, and, finally, when viewed in the dark, filling the entire globe with a magnificent rose-colored or purple glow. Such was the simple and charming experiment which, after having entertained the dilettanti of physics, has now led to those famous rays which are endowed with such curious properties. But the way was a long one.

For nearly a century nothing new was added to our knowledge of this brilliant phenomenon. It was not until 1843 that Abria, of Bordeaux, while making researches in induction, tried to pass the induced discharge across the "electric egg." He found that at a certain exhaustion the beautiful violet glow, diffused all over the interior of the globe, become stratified; that is to say, divided alternately into bright and dark strata. Furthermore, the positive knob always gave a brush discharge, while the negative knob was surrounded by a dark space. It is this dark space which played an important part later. After Abria, the stratified discharge, excited with more powerful electrical apparatus, was studied in England and Germany by Gassiot, Warren de la Rue, Spottiswoode, Hittorf and Crookes, and the shape of the bulb became definitely that of an elongated hour glass, furnished with two electrodes, which replaced the two rods of the "electric egg." Regular stratification becomes apparent at the degree of vacuum cited by Abria, and with the same characteristics, viz., a brush discharge at the positive electrode, and a black sheath round the negative electrode or cathode.

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[1] Abstract of an address delivered before the French Academy of Sciences.

Needless to say, these experiments were not, as in the last century, simple amusements meant to please the eye. It was hoped by their means to discover the mechanism of the discharge, that is to say, to solve the great problem of the propagation of electricity. But in this respect our hopes were disappointed, and there was a risk that all research in this direction would be abandoned, when Prof. Crookes, guided by theoretical views as to the state of matter in rarefied gases, investigated the behavior of the electric discharge on continuing the rarefaction of the gas in the tube to an extreme degree. He then observed a series of new phenomena. As the vacuum improved, the dark space round the cathode increased in size, driving the stratifications before it, until they vanished one after the other. Finally, the dark space filled the whole tube, the glass of the tube began to fluoresce, especially the part opposite to the cathode. Prof. Crookes saw in this phenomenon the confirmation of his views. He held that it was the molecules of the rarefied gas, repelled by the negative electricity, which bombarded the side of the tube, and that their impact occasioned the glow. He then performed a series of most curious expirements to prove the existence of these projectiles. In one tube he stopped them by means of an internal aluminum screen, and the shadow of the screen was depicted on the end of the tube. In another case he used their impact to turn a little mill. Finally, in a special arrangement, which was afterward termed a focus tube, he directed the convergent fire of this invisible artillery on to a fixed point, an actual focus where refractory bodies, such as rubies and platinum, emitted a brilliant glow.

These brilliant experiments, which Prof. Crookes carried out some twenty years ago, made a great sensation. They were repeated at various meetings, in which many of you have no doubt taken part, and their success recalled the vogue enjoyed a century and a half ago by Abbe Nollet's experimental lessons in physics. But glory is short lived in this world; fashion changes and reputations fade. The Crookes tube soon fell into oblivion, and joined its ancestor, the "electric egg," in the glass showcases of museums. The poor neglected thing meditated for fifteen years on the inconstancy of popular favor, when one fine day it was drawn from its solitude. Hertz, guided by different opinions, took the matter up, and ascertained that the molecular bombardment traversed the aluminum screen, when this latter was not too thick. Physicists, having known for some time that thin layers of silver were opaque to ordinary light, but transparent to ultra-violet rays, saw nothing extraordinary in this. But the phenomenon became interesting from another point of view, when Lenard, making use of this transparency of aluminum, caused the cathode rays, which had until then been confined in a vacuum, to come out from the tube into the air through a small window made of this metal. The radiations, filtered through this remarkable window, excited fluorescence, acted on photographic plates, discharged electrified bodies, and even traversed sheets of black paper. All these properties, which were studied so minutely by Lenard, are precisely those which Röntgen made so famous a few months later. It is only fair to state this, in order not to allow those laborious efforts which are the usual precursors of great discoveries to be hidden from view.

Unfortunately, Lenard's rays apparatus was complex and delicate to handle, and it only gave a small beam of the curious rays. The discovery had, therefore, to be completed by the invention of a more simple apparatus, and, above all, one able to give intense and copious radiation. It was chance, that happy chance which only perspicacious observers know how to profit by, which put into Röntgen's hands the final simple and powerful apparatus. A Crookes tube, inclosed in a cardboard box, was put into action in a dark room, and a fluorescent sheet, which was by chance next to it, glowed. Röntgen noticed this, and immediately concluded that cathode rays from a simple Croopes tube are powerful enough to traverse the glass tube and thick cardboard. Photography through opaque bodies was discovered!

You know the rest. Röntgen soon devised one of the most valuable methods of investigation, to which he drew public attention by means of that somewhat grewsome picture of a transparent hand, of which the bones are visible. Surgery and pathology have been already largely benefited by the new method. Röntgen rays—since they have now received that name—reveal foreign objects in the human body hidden away under the skin, and also show affections of the bones and cartilages. They also enable the diagnosis of pleurisy to be confirmed, as our colleague, M. Bouchard, has recently announced. As the technique becomes perfected the medical applications will become easier and more widespread. Röntgen's discovery has, therefore, been called in to assist in assuaging human ailments. It is another gift to be put to the credit of pure science.

I have already rather tried your patience by speaking of these rays at such length, yet I must add some words about one of their properties which give them considerable theoretical interest. During the last few years much attention has been devoted to the relation between electricity and light. The work of Hertz has proved that electric oscillations can be propagated in air or in vacuo with a speed equal to that of light. Thus electric waves and luminous waves are motions of the same medium. Cathode rays, having the property either of discharging electrified bodies or of themselves assuming a sort of electrical charge which renders them sensible to the action of magnets, add a new link between light and electricity. There is still much which is obscurity, but one feels that physicists are on the eve of making one of those great mechanical syntheses of natural agents, similar to those which we owe to the genius of Fresnel and Ampère.

THE ACTION OF ROENTGEN RAYS ON VISION.

BY FREDERICK S. KOLLE, M. D.

I beg to report that of seven persons with amaurosis, subjected to the Röntgen rays, six observed the Sternschuppenlicht, a peculiar shooting-star light. I have used the German name, as that seems to cover the description or character of the phenomenon. Four of the patients could count the individual stars, ranging between six and thirty-two in number.

The former were not totally blind, that is, they could locate a sixteen-candle-power electric light, with one or both eyes, at variable distances of from three to eight feet. The patient counting thirty-two of these sparklike sensations, using both eyes, could distinguish and locate a lighted lamp at a distance of five feet. The patient who did not respond to the rays had been injured early in life, and both globes had been removed. It is needless to say that none of the patients was enabled to see with the aid of these rays, although by cutting off the rays by the interposition of a steel plate an eighth of an inch thick no such sensation was experienced.

In all of these experiments I used the "radioscope," an instrument devised by me for this work. It consists of the ordinary fluoroscope, with a sheet of aluminum one-twentieth of an inch thick, used in place of the chemical or fluorescent screen; consequently these are not light, but ray effects. I mention this because in all of the recorded experiments the operator obtained considerable if not all light effects by using the bare charged tube, along or in conjunction with the fluoroscope.

From the foregoing I infer that this peculiar sensation depends, as regards its activity, that is, an increase in the number of Schuppen, upon the better or less atrophied or otherwise affected retina. That the lenses are not opaque, or rather impervious, is shown by the same phenomena appearing in the normal eye after a lengthy exposure, attended by headache, supra-orbital, and deep-seated pain in the globes of the eyes.

GOOD READING.

The weekly issue of "The Living Age," bearing date Feb. 13, is the Monthly Supplement number, and including the supplement, contains 96 pages. Among its most striking features are "All Souls' Eve in Lower Brittany," a delightful sketch of the customs and folk-lore of the Breton peasants, translated for "The Living Age" from the French of Anatole le Braz; the first part of "The Land of Suspense," Mrs. Oliphant's latest story of the seen and unseen; a passage from Mrs. Steel's stirring story of the great mutiny, "On the Face of the Waters;" Herbert Spencer on "The Fallacies of Socialism"; a discussion of "Political Ideals and Realties in Spain," by Emilio Castelar, translated for "The Living Age"; and a paper by W. Holman Hunt on "Religion and Art." The "Monthly Supplement," giving Readings from American Magazines, readings from new books, and a list of the books of the month, adds a valuable feature to "The Living Age," which its readers will be quick to appreciate, and with the translations from eminent continental authors, on prominent questions of the day, fairly doubles the value of the magazine which, before these additions were made, was well worth the subscription price of $6.00 a year. The Living Age Company, Boston, are the publishers.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

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[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, MARCH 3, 1897. No. 461.

ELECTRICITY FROM CARBON WITHOUT HEAT.

A HUNDRED years ago, when the steam engine had just begun to assume practical form the world looked to the mechanical and steam engineer for the solution of its great economic problems. "I have what every one of your Majesty's subjects desires—power," James Watt is credited with saying. While that dictum is as true to-day as it ever was, the lapse of time has brought about changes which are based on more than sentiment, and which make themselves felt in the ever present demand for power obtained in a manner more economical than that which the steam engine is able to furnish. Indeed, it may be said that the world has turned from the mechanical to the electrical engineer for the solution of what may be well considered the paramount problem in the scientific and engineering world, the production of electric current direct from carbon without heat. The apparently elementary nature of the problem, paradoxical as it may seem, is what constitutes its greatest difficulty, and it may be safely said that the method which shall finally prove successful will, without doubt, be based upon a principle as simple as that of the dynamo machine itself.

Up to the present time the method pursued to accomplish the desired result has been apparently confined to the devising of some form of primary battery embodying electrolytes acting upon the carbon to effect its oxidization. In the most prominent of these which has thus far been brought forward the action of externally applied heat is also employed to facilitate the electro-chemical action; but other methods without this added, and to that extent wasted, application of external heat, have been suggested, none of which, however, has been pushed to any practical limit. An excellent résumé of the subject is that embodied in the admirable lecture delivered by Mr. Willard E. Case at the last meeting of the New York Electrical Society, in which the lecturer gives the essential features of the devices thus far employed to oxydize carbon without heat in the electric battery. Perhaps the most striking suggestion thrown out by Mr. Case was that in which he draws attention to the processes going on within the animal organism by which the carbon is oxydized by the aid of the haemoglobin of the blood, acting as a carrier of the oxygen. The point insisted upon by Mr. Case and the lesson to be drawn from this process of nature is, that the direction in which to work lies in the suitable preparation of the carbon for the oxydizing material to act upon. Of course it may be possible that a simple and inexpensive process may be devised in the future by which this may be accomplished, but it is this very freedom from any antecedent treatment whatever that gives to coal and other natural fuels the strong position which they now hold. It follows, therefore, that the preparatory process which shall give to coal, or other natural products rich in carbon the property of being oxydized at ordinary temperatures, must be essentially inexpensive, if the application of such material is not to be restricted to comparatively isolated situations. Mr. Case's haemoglobin cell was a beautiful illustration of the principle which he evidently desires to impress upon the workers in this field, namely, that the closer they stick to the processes of nature the nearer they come to the desired goal.

ELECTRIC LIGHTING IN NEW ENGLAND.

THE report of the Board of Gas and Electric Light Commissioners of Massachusetts for 1896, for which we are indebted to Chairman Barker, is as usual, an interesting and important document, easily in the first rank for the real information that it discloses as to the condition of a given industry in a chosen part of the country. The powers and work of this board have been so often referred to in our columns, and so recently, that there is no need now to review that matter, the data under notice being that which results from the active supervision of the board in the exercise of its jurisdiction. It will be remembered that an effort is being made in New York State to create a board having like control over these and other interests. The companies generally are not averse to such control, which operates at least as much for their protection as for their restriction, and the main objection here has been the massing of varied and different interests under the one commission. It is assuredly better to maintain separate boards of control, especially if the vigilance exerted is to be so carefully minute as it is in Massachusetts.

It is one of the signs of improvement of the times that the bad showing of the electric lighting plants in Massachusetts in 1895 was changed in 1896 to the right side of the ledger. In 1895 the net result for the industry as a whole was a deficit of $182,248; for 1896, the net surplus is $34,890. Moreover, the dividends paid out had risen from $487,148 to $544,801. But there is plenty of room for further amelioration. Of the sixty-two companies reported on, only thirty-two declared dividends, the average rate being 5½ per cent. Of the other thirty not paying dividends, nine show deficits. It seems to us that this is most distinctly not a condition of affairs to excite envy or inflame the ardor of those who would "municipalize" the plants. Incidentally, it may be noted that the gas companies operating electrical plants showed a profit on that account of $211,154; and there appear to be some twenty-three such systems. The data of the dynamo capacity in service in lamps shows as follows: Six hundred lamps of 10 candle-power, 836 of 15 candle-power, 414,450 of 16 candle-power, 6 of 4,000 candle-power, 12,113 of 2,000 candle-power, 11,522 of 1,200 candle-power, 160 of 1,600 candle-power, 35 of 1,500 candle-power, and 70 of 800 candle-power. The proportion of double carbon lamps runs very high also, owing to their use for street service, but no data is yet included on the subject of the now popular enclosed arc. Turning to electric power, it is very encouraging to note that just about 14,000 horse-power is supplied by the stations, and that no fewer than twenty-seven of them have power circuits. It is curious to observe that only fifty-four motors are running on arc circuits, a condition which now would probably be paralleled all over the country. The city of Boston has about 1,600 motors on the incandescent circuits, and nearly 700 more on power circuits, and all told, some 6,600 horse-power is daily furnished there by means of electricity.

During the year official reports about action on proposed municipal plants were received by the commission from 210 towns and cities. This betrays a lively public interest in the subject, but 179 of them took no definite steps. One such new plant went into operation during the year, and one town started out on the career of doing a commercial lighting business additional to lighting its streets. There are thirteen municipal electric plants now operating in the State. The places that do the least of it have apparently the lowest rates of taxation, though that may mean nothing.

THE WATT.

THE energy with which electrical engineers attacked the problem of determining the various units required in their daily work, and in conforming them to the universal C. G. S. system, is in striking contrast to the tenacity with which the English-speaking nations still adhere to the old, and in many respects cumbersome, mode of designating and calculating power still in vogue. In the course of an admirable address on the watt and the measurement of power, Mr. W. H. Preece, engineer-in-chief and electrician of the British Postal Telegraphs, places at the disposal of the defenders of the decimal system some excellent fighting material. Regarding the origin of the term horse-power, Mr. Preece recalled the fact that Watt's original determination of this unit gave the figure 22,000 foot-pounds per minute, but being desirous of giving his customers full measure he made the horse-power of his engines equal to 33,000 foot-pounds per minute, and thus established a standard which has ever since been followed, though grounded on no physical basis whatever. In order to show how indefinite the term horse-power, in itself is, Mr. Preece quotes Sir Frederick Bramwell as enumerating no less than five different kinds of horse-power, to which Mr. Preece adds another, the electrical horse-power. These include the various kinds of horse-power, such as the gross indicated, the net indicated, the commercial or nominal, etc., and to this must be added the different values given to the horse-power in different countries. Thus in England the horse-power equals 550 foot-pounds per second; in France 542.47, and in Germany 582.25. When we contemplate these facts one is led to believe with Mr. Preece that the term horse-power, like the horse, has probably seen its best days. As a scientific term, it has been much abused, and as a commercial term its meaning is becoming more and more ambiguous. In order to overcome these difficulties Mr. Preece himself in 1881, at the Paris Congress, proposed to designate as a watt 1,000 joules per second, and in 1883 the term was applied by the late Sir William Siemens to the joule per second. The latter proposal has been generally adopted in electrical work, with a result that the power comparable with the horse-power has become the kilowatt instead of the watt, which it would have been had Mr. Preece's proposal been adopted. We are inclined to agree with Mr. Preece in his belief that the acceptance of his proposal would have hastened the departure of the term horse-power.

Apropos of the increasing popularity of the term watt, Mr. Preece mentions the fact that the motormen of the electric cars at Marseilles, France, are called "wattmen," a by no means inapt designation of those controling the power of the car. Electrical engineers find their power calculations so facilitated by the adoption of the watt that the time cannot be far distant when mechanical engineers will follow in their footsteps. We are well aware of the conservativeness and even prejudices existing towards the abandonment by English-speaking nations of the time-honored units based upon the foot and pound, but if for no other reason the demands of commerce and trade with various foreign nations will force the minority to adopt the units of the majority in self defense. Even now some of the most celebrated engine makers in England have changed over their shop system of measurement entirely to the metric. We believe that a few examples of this kind would do more towards bringing about the desired result than any amount of abstract study and theorizing in our schools and colleges. There is another gain pointed out by Mr. Preece in connection with this matter, and that is that names when well selected, secure precision of language; a watt is a watt and nothing else. Every electrical workman knows, or ought to know, what a volt is, and what an ampere is; and as the watt is the product of these two he gets at once, without further effort of the mind, the idea of the quantities he is handling; and he does not have to ask what sort of a watt or kilowatt is meant.

DURING the late political campaign a certain clergyman in the South declared himself so strongly in favor of the McKinley platform that his congregation could not quite stand it, and he found himself out of a job. It is now stated that, when the new administration comes in, he will be "rewarded," with either the ministry to Greece or the headship of the Smithsonian Institution. If this be true, things are a little out of joint. Our sympathy is with the plucky parson, and would be if he had preached a contrary doctrine, for no one likes to see an honest man suffering for conscience sake. But while we have doubts as to the propriety of the ministry to Greece, we have none about the impropriety of the Smithsonian appointment, should it be in contemplation. That demands a special, trained ability, just as the pulpit does, and never more so than now. If the clergyman wants to stay in politics, the Smithsonian is still less for him, and if he wishes to stick to theology, there are many good and proper positions to which he will be welcomed by men who think as he does on financial issues.

THE telephone has been put to many uses, but we have not heard before of its use in suspending the execution of death sentence. This is reported from Georgia, where, with a margin of about one minute, the Governor called up the sheriff and granted a stay of two hours. The condemned man had already been taken to the scaffold and the rope was around his neck. Before the two hours had run out, the Governor telephoned again to the sheriff that he had granted a further respite of eight days. Just what has happened since we don't know, but probably the Governor at this instant is telephoning a suspension of three months. We do not think the telephone was invented to help vacillating Governors make up their minds slowly.

SINCE the appearance of our Municipal Plant data, last week, the town of Gravesend, Long Island, comes forward to furnish the most horrible example yet of waste of municipal funds on commercial enterprises. John Y. McKane, now in Sing Sing, sold a lot of the town common lands while he was in power, and put the proceeds into a municipal electric light plant costing $120,000. Last Wednesday week an offer was made for its poles, for $2,500, and another offer was made of $15,000 for the whole plant. It ought to fetch that, one would think, but the Brooklyn Edison Company, which wants to buy the 673 poles, says that not more than 250 of them are any good. But for the temporary absence of the originator of the enterprise, under circumstances over which he has no control, he would doubtless be furnishing a cogent array of statistics to show how much money Gravesend was saving by the ownership of a plant.

STAMP collectors in Cuba seem to have a hard time of it, especially if hailing from the United States. Mr. G. W. Scott, of the Havana Electric Light Company, has, it would appear, lately been shut up for two weeks, in a small cell, on meager fare, and without communication, on the charge of "having a set of Cuban Republic stamps in his possession." If there is any other charge it has not been made public, while Mr. Scott denies that he had managed to get a set of the stamps, although he may have tried. This little incident in is keeping with many others that excite American indignation, but in all probability there will be no fighting over it. At least it is to be hoped we won't bombard the insurgents on account of it.

MISCELLANEOUS

ELECTRICITY FROM CARBON WITHOUT HEAT.[1]

BY WILLARD E. CASE.

THE subject has such possibilities, all within reasonable bounds, that I hardly know where to commence or finish. At present we have only crossed the boundary line of that field which I am sure will be productive of tremendous results.

Thermoelectricity has attracted attention for a great many years past, and now and then we have heard of new inventions which led us to think that we were about to solve the problem.

As far back as 1801, Ritter noticed that a current was set up when the junctions of dissimilar metals were heated. And following down to a later date, we find that some thermoelectric batteries were constructed which really produced electrical energy at small cost, and which have been to some extent found practicable. A thermocell was described by the speaker before the Royal Society in 1886, which I will now show you. (Experiment shown.)

It consists of plates of tin and platinum, forming the electrodes, immersed in a solution of chromic chloride. When the cell is heated, the electrolyte becomes active: chlorine, leaving the chromic chloride, temporarily combines with the tin and forms proto-chloride of tin. This chemical action generates electricity, and soon the tin is all converted into chloride and the current ceases. When the cell is cooled this temporary combination of the chlorine and tin is broken up and the chlorine returns to chromium proto-chloride. The tin being set free falls as a metallic precipitate to the bottom of the cell in the form of crystals, ready to renew the operation. If this cell works between 80 and 180 degs. F. or 538 and 638 degs. absolute, the e. m. f. at the higher temperature is about .26 volt, but the possible efficiency is less than 16 per cent., owing to the operation of the second law of thermo dynamics, which provides that in the conversion of heat into work, the efficiency equals the higher temperature minus the lower temperature divided by the higher temperature reckoned from an absolute zero, the latter being minus 273 degs. Cent. So that this cell is a heat engine; a reversible voltaic cell which passes through a complete cycle. It must be heated to operate, and cooled to regenerate itself.

In this connection it may interest you to see in operation a more practical thermo cell which converts heat into electrical energy. This battery is said to consume 2½ cubic feet of gas per hour, and to generate 12½ watts. (The Cox thermo generator was shown in operation, driving a fan.)

In order to make the subject clear to those who are not familiar with it, let me say that all electricity (except that produced by water power or galvanic batteries) is obtained from carbon. That is to say, our electric power of to-day is generated by the combustion of coal under the steam boiler, or by means of the gas engine, and through the intermediary of engines and dynamo, this energy is converted into electricity. Now, we all know that this conversion of the potential energy of coal into heat and then into work, is a most wasteful process, owing to the intervention of the second law of thermo dynamics above referred to, and how to overcome this law and to avoid this waste is the subject under discussion tonight. Practically we only convert a small percentage of the potential energy of the coal into work, a large portion being wasted. It is not so much the inefficiency of the boilers or the steam engine or dynamo, which converts this energy into electricity, as it is the method adopted. When we burn coal under the boiler, we transform the energy of that coal into heat energy, and the moment we do this, we come in conflict, or rather become governed by, the second law of thermo dynamics.

It is an inexorable law of nature that under the conditions in which we live, a great waste must accompany the transformation of heat into any other form of energy. To illustrate, in hot air and gas engines, a cold water jacket is usually employed and to raising its temperature is diverted the larger share of the heat. In the thermopile, the junctures must be cooled by a circulation of air or water, and in Edison's pyromagnetic generator, the iron tubes must be cooled by application of cold air.

In accordance with the second law of thermo dynamics, the heat not lost but which we can utilize in a given case equals the difference between the high and low temperatures used, divided by the low temperature. Now, to express this more simply, there is heat, or an expansive force in everything, down to an absolute zero; but under ordinary conditions, we cannot economically use this heat in any machine below the average normal temperature in which we live. So, when once we set up molecular motion, called heat, we only use it above the normal temperature, up to that point to which we are limited by the destruction of matter. Or, as we might say, to that point at which we burn out our boilers or melt our containing vessels. And this range is but a small fraction of the total range of the heat we have produced. Lodge has shown us that the energy in a pint of boiling water, if it could be all utilized, amounts to more than half a million foot pounds, and even if the water were quite cold, and on the point of freezing, it would still contain energy of 350,000 foot pounds of work, or 1-6 of a horse-power hour in every pint. Now, coal or zinc could be burned to heat this water to a boiling point, in which case only a part of the energy between that point and freezing could be utilized, which is a small portion of the total range between the boiling point and absolute zero. But either material can be oxidized in a galvanic battery without heat and waste, and electricity produced. If we burn the coal, as Lodge has suggested, the highest temperature commonly available is that of the furnace; hence the heat should be supplied to the working substance in the cylinder at a furnace temperature. This condition is roughly satisfied in internal combustion engines, though they have many defects at present. This furnace temperature is about 2,000 degrees above absolute zero, or 1,500 degs. Fahr., and if in this engine we could cool down to 600 degrees above zero, or 110 degs. Fahr., we could have a possible efficiency of 70 per cent. of the whole,

$$\frac{2{,}000 - 600}{2{,}000} = .70,$$

that is, 70 per cent., less the friction of the machine and the loss in the conversion into electrical energy, which would bring it down to something like a possible 50 per cent. or 60 per cent. The steam engine does not even approach this. Its theoretical efficiency at 300 pounds steam pressure is 33 per cent., but in actual operation this is reduced to 25 per cent. Gas engines, internal combustion engines come nearer this ideal. In fact, Prof. Thurston states that a cannon when being fired has an efficiency of 50 per cent.[2]

Let it be understood that this is a law of nature; it is inevitable under the conditions in which we live. No cunningly devised furnace or feed-water heater, or cut-off, or triple-expansion apparatus, or pyro-generator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted, over and above that which we must of necessity lose.

Now, the question which we naturally ask is: How are we to convert this potential energy of the carbon into electricity with the least loss?

If the boiler, steam engine and dynamo are not available for our use economically, how shall we do it? We know that the voltaic battery does not act through the transformation of heat into electricity; it produces electrical energy direct. The zinc is oxidized and the potential energy of that zinc is converted directly into electrical energy, without the production of heat. The second law of thermo-dynamics is thus avoided as no heat appears. But, the cost of this zinc and the chemicals employed to oxidize it, are so expensive that we cannot afford to use them. The cheapest materials which present themselves at present to our notice are coal or carbon and the oxygen of the air. And if we could convert the energy of the coal into electrical energy direct and cheaply, we could do away with our steam motors, in time, provided the apparatus was simple and practical. Now, there is no known reason why a cheap substance may not yet be found which will act on coal and develop electrical currents in place of heat, but the general tendency of late, has been to discard this method and to attempt to find some stable electrolyte or bath, which will act as a carrier of the oxygen of the air, conveying it to the carbon and oxidizing it, as zinc is oxidized in a battery, producing electricity. This electrical energy would be the equivalent of the heat energy that would be developed by the combustion of the coal in the ordinary way.

Of course, in the construction of such a cell we must be governed by the experience which we have had with the galvanic battery in which the elements of electromotive force, internal resistance, etc., are involved and by which consequently the output of the cell is governed; such a cell must produce a large amount of energy, be simply and easily cleaned or recharged, in order to be practical. It must be as durable and as simple to use and handle as the steam boiler and dynamo are to-day.

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[1] A lecture delivered before the N. Y. Electrical Society, Feb. 24.

[2] Science, Oct. 3, 1891.

It may be of interest to give you a comparative illustration of what the energy of coal does to-day, through the use of the steam engine, and what it would do provided we could oxidize it in a battery without heat. The average of large electric light plants, requires 4 pounds of coal for every horse-power hour of electricity delivered from the dynamos to the line. That is to say, four large stations show a consumption of 4.2 lbs. per horse-power hour; 49 stations, 4.6 per horse-power hour; and 32 small stations, 12 pounds per horse-power hour. Theoretically, .175 pound of coal will yield one-horse-power hour, or, allowing for ash, .185 pound, and of zinc, one pound used in a battery produces one horse-power hour under a potential of 2 volts, including the loss in internal resistance. The cubes of these materials represent the weights required by each to produce one electrical horse-power hour. (Experiment shown.)

Of course the subject of electricity direct from carbon has been considered from many points of view. Some have attempted to obtain cheap electricity by using the oxygen of the air to oxidize various substances; others have attempted to oxidize coal with the oxygen of the air without heat, and others have attempted to oxidize coal by the oxygen of the air with the application of external heat. The evolution of this subject is most interesting. We will, therefore, study the question from that point of view, and examine some of the most important batteries which have been constructed. We will do so chronologically. Of course, lack of time will compel me to avoid reference to many well conceived inventions.

Passing over the carbon-consuming cells of Jablochkoff, Bard, Crumm, Edison, Wright and Thompson, I will first describe the cell invented by C. S. Bradley in co-operation with Professor F. B. Crocker, which was mentioned in the discussion of a paper read by the speaker on "Electricity from Carbon Without Heat," in 1888, before the American Institute of Electrical Engineers.

Mr. Bradley described fully the action of fused salts on coal and stated that the oxygen of the air was absolutely necessary for the purpose of cheap oxidation, or, to use his own language: "The cell consisted of fused sodium manganate and putting a blast of air through it and by that means supplying it with oxygen and allowing it to act on the coal which is put in another part of the vessel, a little over one volt was obtained."

The cell consists of an iron vessel 2½ inches in diameter and 6 inches deep, which is placed inside of a retort and heated by a gas flame to nearly a red heat. The electrolyte of the cell is caustic soda, to which peroxide of manganese is added, forming sodium manganate. In this cell is immersed the electrode of carbon which acts as the positive pole, and when the circuit is closed, you will see that we will have an electromotive force of about 1 volt, with a current of 3 amperes. (Experiment shown.)

The next cell to which I will ask your attention is that described by W. W. Jacques in "Harper's New Monthly Magazine" in December, 1896, which is another illustration of the same principle involved in the Bradley cell, with a few practical modifications. It, like the other cell, consists of an iron vessel, which is the negative electrode, containing fused caustic soda, minus the peroxide of manganese, into which is plunged the positive coal or carbon. The oxygen is supplied by a blast of air as in the cell before described, and an e. m. f. of about 1 volt is said to be obtained. The difference between these two cells, which I particularly desire you to notice, and the only practical difference between them, is the addition of peroxide of manganese to the bath of the Bradley cell, and, although I have described them chronologically, I will first show the Jacques cell and then by simply adding peroxide of manganese to it, we will have the Bradley cell. We will then be enabled to get their comparative e. m. f. and current in the same cell. But I may say in passing that experience with these cells before you leads me to believe that the theory of their action is not by any means well understood. It is most uncertain and erratic, and seems to be more so before than after the addition of the manganese peroxide. For instance, its e. m. f. seems to depend upon its temperature. If water is present when the caustic soda is first used, a reverse current becomes manifest. When air is blown through the electrolyte the e. m. f. is increased. Sometimes only .3 of a volt is obtained; sometimes about 1½ volts. But the greatest amount of current is apparent when the carbon is immersed in the bath.

When the carbon rod is drawn up along the inside of the vessel the highest e. m. f. is obtained, and when this carbon electrode is replaced by another having none of the fused electrolyte on it, and brought in contact with the exterior of the vessel, at different points where the temperature varies, no appreciable e. m. f. is obtained. This would indicate that as we drew the carbon up out of the bath against the side of the vessel, we approach a point where the critical temperature exists and we get the highest e. m. f.

If a nickel crucible be used as suggested by Bradley some years ago, the e. m. f. is brought up to what is considered the theoretical, as you will see. This little nickel crucible contains fused caustic soda and carbon electrode, the same as in the Jacques cell. When heat is applied, you will notice that the voltage goes up to 1.16, then begins to fall and at a critical temperature above a red heat, it drops to .3 volt, a most interesting fact, and on cooling, the voltage goes up again to 1.16, and drops again when the caustic soda solidifies. You will observe that the voltage is above the theoretical. (Experiment shown.) Many other peculiar actions will be noticed if the carbon rod is replaced by an iron one. With this form of cell it is claimed that as high as 85 per cent. of the energy of the carbon consumed is converted into electrical energy. The following results of tests of the Jacques cell taken from the article referred to and from the Engineering Magazine of July, 1896, may be of interest. Electricity obtained from 1 lb. of coal (of which 0.4 lb. was consumed in the pots and 0.6 lb. was burned on the grate) equaled 1,336 watt hours, or 32 per cent. of that theoretically obtainable.

Another cell reported in the public prints to have been built and operated by Jacques, consisted of 100 iron cells 1½ inches in diameter and 12 inches deep which gave an e. m. f. of about 90 volts and 16 amperes, supplying thirty 16-candle power incandescent lamps for a little over 18 hours. In this experiment it is said that about 8 pounds of carbon were consumed in the cells. This, it was stated, gave an efficiency of over 90 per cent., which, of course, did not include the power to operate the air-pump and the coal consumed in heating the cells. But my experience with the cells before you leads me to doubt the correctness of these computations.

It has been suggested that carbon-consuming batteries would be too bulky and occupy too much space as compared with that occupied by the present central station for a given output. I find, however, that the Edison station at Duane street has a capacity of 28,000 electric horse-power. The cubical capacity of the building is in round numbers, 900,000 cubic feet. The same building crowded with Jacques cells, assuming that they would perform the work claimed for them and leaving aside the question of the difficulty of their operation, properly distributed, would have an output of 60,000 horse-power. This estimate is necessarily theoretical and based entirely upon statements made by Mr. Jacques, namely, that a furnace containing cells occupying a cubical space of 600 feet has a capacity of 40 electrical horse-power. You will thus see that this ratio is in the proportion of 28 to 60 in favor of the battery. It has been stated that the e. m. f. of the carbon-consuming cells is so low that they would be of no practical value. I think our experience with the storage battery in central stations refutes this idea; at least for potentials up to 250 volts and by means of rotary transformers the current can, if necessary, be converted into any form and pressure.

These cells, if correct in theory, can be heated without infringing on the second law of thermo-dynamics, as the law does not apply so long as the oxidization of the carbon itself does not produce heat, but electricity. For, as we have said, there is heat in the electrolytes and all matter down to an absolute zero, and the electrolyte in the practical operation of these cells, is simply heated to permit the chemical affinities acting. We are governed here, as elsewhere, by the laws of evolution, and I think that this question will be solved only through many attempts and many failures. I believe that we must look at this subject from a different point. In the first place, can we not learn a lesson from nature? We certainly have a most wonderful example of the conversion of potential energy of carbon direct into work in the animal economy, which is developed at the expense of the oxidization of the material supplied by the food, with an efficiency twice as economical as in the case of the steam engine. One-fifth of the potential energy is converted into work; four-fifths is converted into heat. But we must remember that the human body must be able to exist in the arctic regions as well as in the tropics, that the engine-room must always be kept warm, and to insure this average temperature in all parts of the earth and under all conditions, the four-fifths of what apparently is waste energy is necessary to maintain the race.

A day's work of muscular toil is laid down by the authorities at about 1,084,950 foot pounds. The normal daily expenditure in heat cannot be so readily determined; it is estimated at 6,148,000 foot pounds; that is, between one-fifth and one-sixth of the potential energy of the food is expended as mechanical labor; the remaining four-fifths or five-sixths leaves the body in the form of heat. Of course eventually the work goes into heat and is dissipated.

In the human economy the oxygen of the air is taken up by the blood in the lungs. It is carried through the arteries and attacks the tissues, giving up its oxygen and so oxidizing them, and thus producing heat; and when work is done, the equivalent of the heat disappears as work, and when the work is not done, the temperature rises, perspiration and evaporation takes place, and the temperature is kept at its normal condition, through this safety-valve. In other words, expressed electrically, there is local action as in a battery. I am aware that the question of the cause of muscular contraction is in dispute but it is generally admitted that the muscular force must be derived from chemical energy.[3]

Observe, in the first place, that nature prepares the food which it consumes to perform its functions. The food is taken into the stomach and digested. A great part of it is useless. the best part is selected and is transformed into a condition in which it can be easily oxidized at a low temperature, the blood acting as the carrier of the oxygen. Does this not give us a hint that we should follow this course likewise, and prepare the material for our carbon-consuming batteries? The oxygen of the air, we always have with us; so have we many carriers of oxygen, but an attempt so far as I know, has not yet been made along this line which I suggest, except that illuminating and other gases have been used.

A cell which I will soon show you, is one described by me in a paper read before the American Institute of Electrical Engineers in 1887. It consists of two electrodes, one of carbon, surrounded by powdered carbon, in a porous cup, and one of platinum, both being immersed in an electrolyte of sulphuric acid in a glass jar about one inch in diameter and six inches in height. Into this electrolyte when we introduce chlorate of potash we form peroxide of chlorine, which is a very unstable gas and decomposes in the presence of carbon; its oxygen attacking the carbon, oxidizes it without heat, the chlorine being set free at the platinum pole, electricity is generated with an electromotive force of 1.3 volt, varying with the amount of oxidizing agent present and with the kind of carbon used. Or, we can place these two electrodes in a vessel containing water, generating this gas outside the cell and pass it over into the cell containing the electrodes, in whch case the cell will operate the same as before; its internal resistance being regulated by the amount of sulphuric acid we may wish to add to the water.

You will notice that when the electrodes are immersed in the sulphuric acid, that only a slight e. m. f. is indicated, due to the combination; on the addition of chlorate of potash, the e. m. f. is about 1.3 volts per cell and the current about .4 of an ampere. To show you that the action is strong and the oxidization of carbon rapid, I will connect the cell with this little electric bell, which will give you an idea of its strength. (Experiment shown.)

We have been taught to believe that the e. m. f., due to the oxidation of carbon, is about 1.05 volts. This value has been arrived at by assuming Andrews' determination, that the oxidization of one pound of carbon to CO_2 equals 14,544 B. T. U.; or that one gramme equals 24,944 foot pounds. This determination was only approximate, and further, it was a determination made at a very high temperature. Now you have seen that the oxidation of carbon in this cell without heat has produced 1.3 volts, and would produce even more if we chose to concentrate the peroxide of chlorine present, which is rather a dangerous operation, as the gas is an explosive one under some conditions. So it would apparently appear that there are more foot pounds of energy in a pound of carbon than shown by Andrews, unless the additional energy in this instance comes from the peroxide of chlorine.

It might be thought that the high e. m. f. obtained in this cell is due to the action of the nascent chlorine on the platinum, but careful measurements have determined the contrary.

We have here, therefore, a cell in which carbon is oxidized without the application of heat and at normal temperatures; a cell in which oxygen in unstable composition is readily given up to the carbon and the product of the oxidization is carbonic acid gas, as proved by analysis. I think we have, therefore, the right to assume that a large percentage of the potential energy of the carbon is converted into electrical energy. The point I wish to make in this connection is: We have in this cell, conditions which are analogous to those taking place in the human system, at least to the extent that carbon is and can be oxidized at the normal temperatures under which we live, and its potential energy converted into electricity.

We have in the blood of the human economy a carrier of oxygen, called haemoglobin; it absorbs its oxygen through the lungs, each gramme taking up 1.34 c. cm. of oxygen; this oxygen is in such unstable condition that it can be extracted from the blood by means of a vacuum and by means of most reducing agents; yet it has the power to oxidize carbon and hydrocarbons as the body provides them, without external heat.

We have in this test-tube, water containing haemoglobin in solution. You will see that by transmitted light, it is of the color of arterial blood, as it is fully oxidized, and when a reducing agent is added to it, and the air excluded, you will see that it becomes the color of veinous blood, and when the air is again admitted, it takes up the oxygen and becomes arterial in color. This game can be played, of give and take and oxidizing and de-oxidizing as many times as we like. Even carbon reduces it and gives an e. m. f. (Experiment shown.)

What I want to express to you is this: In this battery which I have just shown you, carbon is completely oxidized at normal temperature by oxygen which is held in loose combination. So it is done in the human body, and we know that to be a very efficient machine. Therefore I see no reason to think that it is necessary for us to use high temperatures. Keep without the second law of thermo-dynamics; search for a suitable carrier of oxygen or some cheap source of oxygen supply and hydrogen or carbon; or a carbon compound easily oxidized.

Does it not seem logical that by following along this line and by preparing the material to be consumed, as nature does in the human body, we may yet be able to reach the desired end with economy? Is it not probable, judging from human experience, that within the wide range of materials, some cheap means can be found? I believe it is. Like all good things in nature, it will come through many trials and failures. The struggle for existence will perfect it, but there is no known law which indicates that we are dealing with the impossible.

SOME RECENT DEVELOPMENTS IN COPPER MANUFACTURE.

BY HAROLD P. BROWN.

In these days of keen business competition, makers of electrical apparatus and machinery are quick to seize upon each advance in the arts which will reduce the cost of material or increase the daily output of their shops. And the alert engineers in our large electric power houses are always ready to adopt improvements which will effect a saving of power. Both of these classes will, therefore, be glad to learn of a discovery in metal handling which will reduce cost and save time and power.

It has been considered impossible to obtain solid castings of copper without mixing with it some other material. And it is well known that even one-half of one per cent. of alloy is enough to reduce the electrical conductivity of the casting to one quarter that of pure copper. Many processes of mixing or tempering this metal have been invented but their product has not up to this time been able to show the physical properties of rolled or drop-forged copper.

Some months ago in a new type of rail bond I used strips of rolled copper with cast copper terminals. These castings were made for me by a firm which claimed extraordinary things for their product. I therefore, expected very little from the metal, and in making tests was greatly surprised to find that a piece of this metal with but ⅝ of a square inch section, could transmit 1,500 amperes for twenty minutes without excessive heating. A calculation based on this performance indicated a conductivity of at least 90 per cent. that of the best rolled copper.

As I had never before found cast copper with more than 40 per cent. conductivity, I decided to make a thorough and complete series of tests so as to ascertain the facts concerning this metal, which is called MB copper. A chemical test suggested by Mr. Edison showed that these castings had less impurity than was contained in some sheet or rolled metal sold as pure electric copper.

To exactly determine the relative conductivity, I ordered a pattern made from which I obtained castings of the best commercial copper and of the MB metal. These castings were carefully finished so as to present for testing a cylinder 25 inches long and 0.8 inch in diameter; a terminal was left at each end, about 2¼ in. by 2¼ in. by 1 in. As a basis for comparison I had an exactly similar bar turned up from the best rolled Lake Superior copper. The completed bars were magnificent pieces of metal, without an apparent flaw. The difference in shrinkage of the two castings and a slight variation in the size of the terminals made it impossible to exactly obtain the comparative weight. The terminals of the rolled bar measured 2 in. by 2 7-16 in. by 1 in. and its weight was 7 lbs. 6 oz.

The commercial cast bar was a popular process, "Tempered" copper with terminals 2 1-16 in. by 2⅛ by 1 in.; its weight was 6 lbs. 9 oz. The MB bar's terminals measured 2 in. by 2 3-16 in. by 1 in., and its weight was 7 lbs. 1 oz. Each of the cast bars gave a clear musical tone when suspended and struck; the MB bar, though the heavier, gave the higher tone. Of course the rolled bar was without resonance. The commercial cast bar had accidentally been turned 0.002 of an inch too small, but the other two measured exactly 0.8 of an inch, thus having a section of practically one-half a square inch.

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[3] Proceedings Royal Society, March 12, 1895.

I decided to test the electrical drop in two feet of each bar and its temperature at from 100 to 1,500 amperes, the latter being three times the proper current for that section of copper. In order to prevent any rise of temperature from the contacts at terminals, each terminal was amalgamated by the Edison process and coated with the Edison flexible solder; there was, therefore, no appreciable drop at these contacts. In amalgamating the commercial copper bar by the Edison process, fumes were given off with an odor of zinc, and a black precipitate was formed. This was washed off and the process repeated several times until the surfaces remained bright. Both of the other bars yielded instantly to the process without fumes or precipitate.

Mr. Edison states that this is a keen test of the purity of copper and so it proved, for the analyses subsequently made for me by Ledoux & Co. showed the commercial casting to have 99.15 per cent. of copper; the rolled bar 99.83 per cent. and the MB 99.85 per cent. In spite of the different characteristics of these bars, the variation in composition is less than seven-tenths of one per cent.

From tests of similar samples, the tensile strength of the commercial cast copper was 19,000 lbs. to the square inch, while the MB was 30,000 lbs., which is practically the same as rolled copper. The cables used for connections were 500,000 cm. with triple braided insulation. When heavy currents were used the bare ends of the cables near the bar connections were cooled with wet waste. The observed temperature of the bars was, therefore, not due to any outside cause. The instruments used were all made by Weston and comprised a shunt ammeter reading up to 1,500 amperes; a millivoltmeter reading 0.0002 per degree up to 0.01 volt; another reading 0.002 per degree up to 0.1 volt and a third reading 0.01 per degree up to 1.5 volts. In each case the same voltmeter terminals were used; these were clamped upon amalgamated spots on the bars just 24 inches apart. A special dynamo driven by Edison motors was used; its field was excited from the Edison mains; by using a rheostat and a bank of lamps, the amount of current generated could be accurately adjusted.

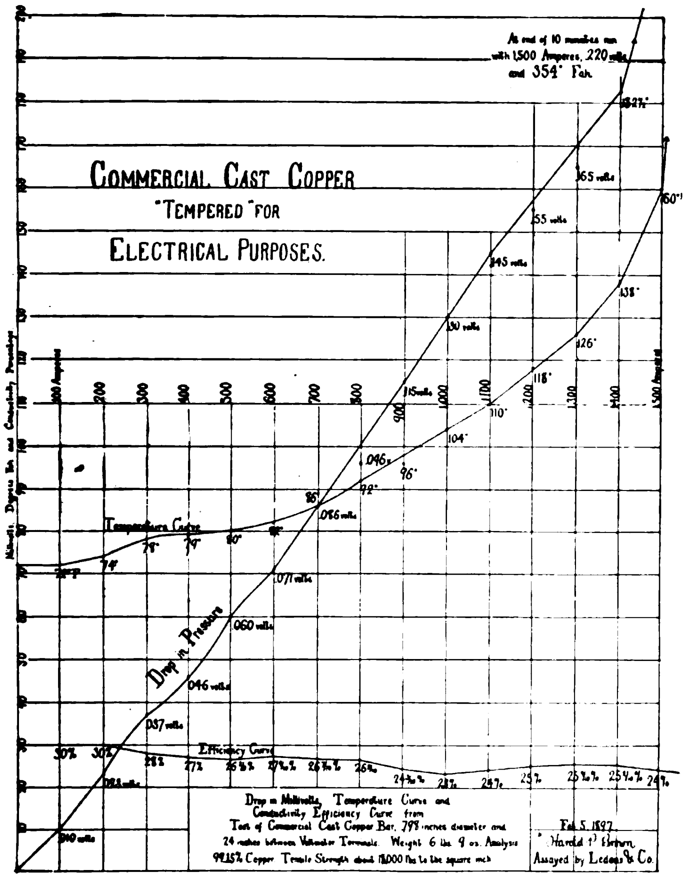


FIG. 1.

The first readings were taken at 100 amperes after about one minute's run; the current was then increased 100 amperes and a second reading taken, and so on until 1,500 amperes was reached. This amount of current was continued for ten minutes and increase of the temperature and drop noted. The bars were then disconnected and laid upon a wooden floor and their rates of cooling noted. Since the copper resistance tables are either calculated for a constant temperature or were compiled years ago from data based on impure copper, I decided to use as a base of comparison, the drop of the rolled copper bar at each 100 amperes. Since the performance of the MB copper came so close to this standard, I repeated the tests on each and found the readings accurately recorded.

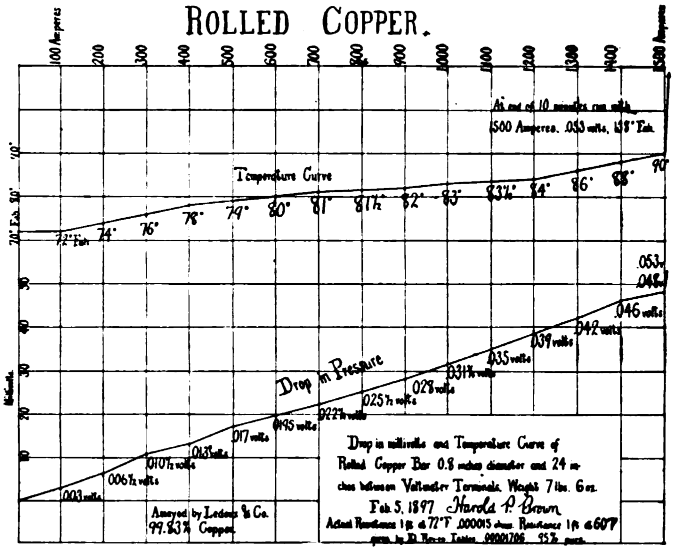


FIG. 2.

The accompanying curves will show the behavior of the three metals under exactly the same set of conditions. The commercial cast copper, Fig. 1, averaged less than 28% conductivity, and before the end of the run scorched the wood on which it rested and the cotton covering of the thermometer bulb, as it reached 354 degs. Fahr. and 0.22 of a volt drop. Before the test the color of this piece was fine and closely resembled that of the other bars; after the test the bar was a mass of red and silver colored spots and had lost nearly all its resonance. At the end of the run it had expanded from increase of temperature ⅛ of an inch in 24 inches and 0.002 of an inch in diameter.

Allowance should be made for its difference in size. It required two hours and twenty minutes to cool to the temperature of the room. The rolled copper showed a conductivity far greater than called for by the tables ordinarily used. Its actual resistance per foot at 72 deg. Fahr. was 0.000015 ohm. In the table published by the London Electrical Review, the resistance of a piece of copper, 95 per cent. pure, one foot long with a section of one-half a square inch, is said to be 0.00001706 at 60 deg. Fahr. Without reducing to the same temperature, the latter resistance is 13 7-10 per cent. greater than the resistance observed.

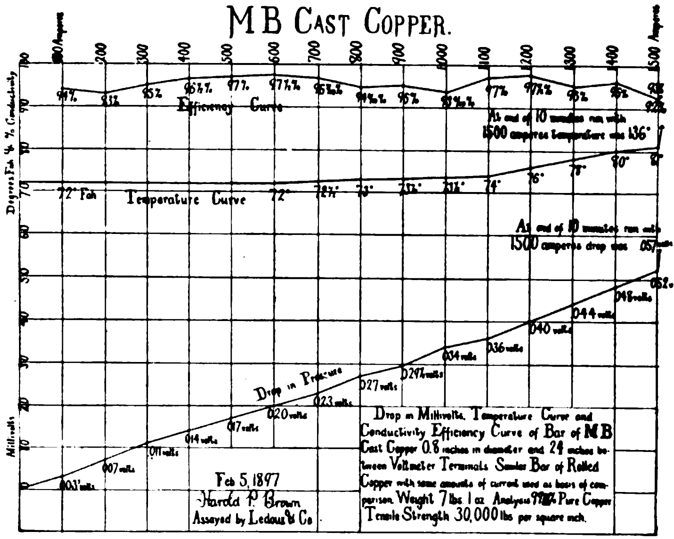


FIG. 3.

The tables based on the Matthiessen standard of conductivity also show greater resistance; it is therefore wise to use an actual measurement of modern rolled copper as a standard of resistance for cast copper.

The rolled copper bar at the end of the ten minutes run with 1,500 amperes, reached 138 deg. Fahr. and 0.053 volt. It had then increased one-eighth of an inch in 24 inches as did the other, but the diameter increased 0.0005 instead of 0.002 of an inch. It required one hour and twenty-three minutes to cool. See Fig. 2.

The performance of the MB copper was a surprise and remains a puzzle. In the test it kept 8 to 10 degrees cooler than the rolled bar up to a load of 1,400 amperes. At the end of the ten minutes run with 1,500 amperes it reached 136 deg. Fahr and 0.056 volt. Its increase of size was the same as that of the rolled bar. It required one hour and thirty-nine minutes to cool. See Fig. 3.

The varying temperature of the two bars evidently accounts for the up and down movement of the efficiency curve, between 94 per cent. and 97½ per cent. If in the tests the temperature of the bars should be kept at 72 degrees by allowing time for cooling after each reading, it is my opinion that this curve would be practically a straight line at 95 or 96%.

I need not say that this conductivity is marvelous and opens an entirely new field for dynamo and motor construction and for switch board work, where a large saving can be effected by using it in place of rolled or drop-forged copper, both of which will warp or twist when heated, while the finished cast metal retains its shape. I know of large multipolar dynamos upon which castings of low conductivity have been used for field coil connectors, etc.; on account of the unsuspectedly high resistance of these contacts, the calculations concerning compounding have been upset and the dynamos have been failures. Another surprising quality of these MB castings lies in their elasticity. I have fastened in a vice one end of a casting 1 inch wide and ⅜ of an inch thick; the other end, 12 inches distant from the point of support, was bent one inch out of its position but sprung back when released. I have driven through a ⅞ inch hole in a hardened steel plate, a plug of MB metal 57-64 of an inch in diameter. This required as many hammer blows on the fifth trial as it did the first.

In another experiment I drove into an opening 1 9-16 inches wide between heavy steel rails, a plug of MB copper cut in two pieces lengthwise, the sum of whose widths was 1 19-32 inches, thus compressing the metal 1-32 of an inch. A current of 1,500 amperes was then passed through the junction whose section was ⅜ of a square inch, and a drop of 0.018 volt was indicated from rail to rail through the two copper pieces in series. The rails were then separated 1-32 of an inch more, but the drop remained the same, showing that the copper had resumed its previous width. An analysis of another sample of this MB copper gave the following results:

Copper	99.870	per cent.	Bismuth,	None,
Silver	.034	"	Lead,	None,
Iron	.011	"	Cobalt,	Trace,
Arsenic	.002	"	Sulphur,	None,
Zinc	.013	"	Oxygen,	(by difference)
Tin	None.			.068. 0/0.

This analysis is verified by others made by such experts as Ledoux & Co., Booth, Garrett & Blair, Prof. Frank X. Moerk, and others, and shows exactly the same results as the best Lake Superior copper. It is evident that no alloy has been used. And yet the process has increased the electrical conductivity and the tensile strength; has given a certain amount of elasticity and decided resonance; has increased the density and changed the structure of the metal.

On presenting this matter to Mr. Edison he accounted for the evident change in the structure of the metal by the theory that the shape of the crystals has been altered so that their lines are parallel, and that the molecules are thus brought closer together and into more intimate contact with each other.

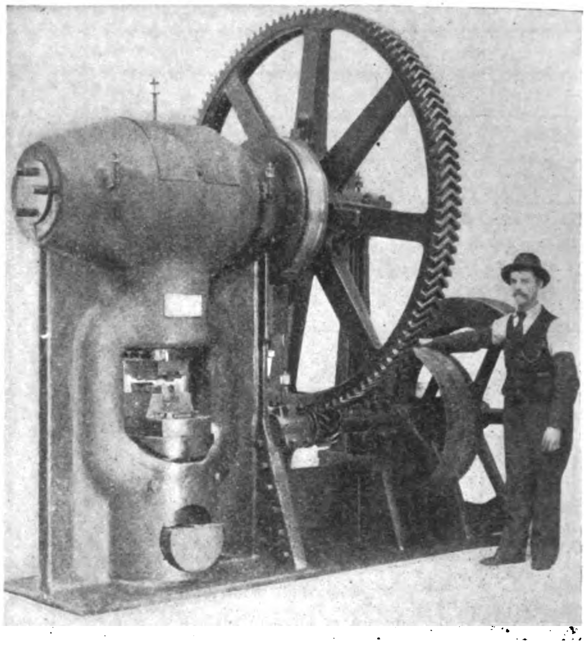
The fact that MB copper can also be rolled or forged adds new interest to its development. As its tensile strength exceeds that of ordinary copper wire, it is certainly worth while to make wire from it in order to determine its strength and conductivity. If it is possible by this process to make as large an increase in the conductivity of wire as it has made in conductivity of cast copper, it will revolutionize dynamo and motor building, and every electric light and railway company will save money by using it to replace its present line wire. And if the tensile strength of the wire is increased by the process, poles can be set further apart and the wire will be less likely to decrease its diameter during winter. This metal is well worth the attention of all electrical engineers who appreciate the value of high conductivity.

It is understood that Mr. Edison is interested in the development of the process and that the MB copper will be manufactured under his supervision at the celebrated Menlo Park **Works.**

MECHANICAL

OTTUMWA IRON WORKS' NEW PRESS.

THE press we illustrate is something new in this line and is designed for use where extra heavy pressure is required. It weighs 24,000 pounds, has a steel shaft 11½ inches in diameter. Its frame is made of one casting, in which the shaft is supported by a bearing at each end. This double bearing for the shaft greatly increases the crushing power of the press. The adjustment is by a wedge which is moved back and forth under the anvil, or die support, by means of a screw. This allows the die to be raised or lowered while the press is in operation, and secures a very fine and accurately determined amount of adjustment. Its strength is largely increased and rendered noiseless by the use of a spiral gear and pinion. The gear wheel is 82 inches in diameter, working in a pinion of 7¼ inches.



PRESS MADE BY OTTUMWA IRON WORKS.

The press has been developed in the shops of the Ottumwa Iron works, for the purpose of doing a class of work that they were unable to get a tool of the kind to do. It is especially valuable in doing such work as cold forging steel articles, or shaping forks or spoons, or bringing steel pieces to a uniform thickness. Tool steel blocks, 1 inch square by 1½ inch, and varying in thickness 1-16 inch, by being pressed through this press once, will be brought to a uniform thickness to within less than 1-1,000 inch. This is a great deal cheaper than milling them, and quite as accurate. The press is built by the Ottumwa Iron Works, Ottumwa, Pa.

SIDE CRANK MEDIUM SPEED ENGINE OF THE BALL ENGINE CO., ERIE, PA.

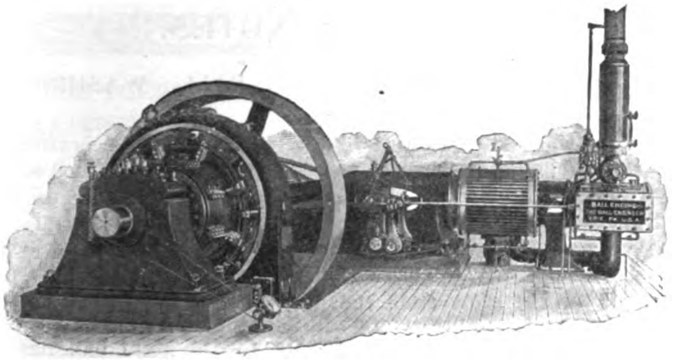
THE accompanying engraving represents the new side crank medium speed engine just brought out by the Ball Engine Company, of Erie, Pa., and designed particularly for railroad work. Keeping in view the extremely severe condition of electric railway service, all the parts of this engine are unusually liberal, and every possible refinement in adjustment and manipulation has been incorporated.

The bed is symmetrical and contemplates provision for every strain that may be put upon the engine in service, and is an exceptionally excellent example of mechanical designing and rigidity. Towards the upper end the bed becomes a round circular column, having on two sides of the finished surface the crosshead guide surfaces, which are bored coincident with the boring and facing for the reception of the cylinders. The two sides are pierced with elliptical openings, making easy access to the crosshead or upper end of connecting rod.

The crosshead is of the double-plate pocket type, used by many makers of Corliss engines, and is provided with taper shoes to compensate for any wear that may occur against the guides, the shoes being of cast iron and running surfaces spotted with genuine babbit metal, the area of which is very liberal.

The introduction of the shaft into the engine is accomplished by arranging the shaft boxes in a large jaw cutting into the bed deep enough to bring the center of the shaft in a plane with the center line of engine, finished spots being provided to meet corresponding finished surfaces upon the cast iron boxes. The shaft boxes are adjustable by means of screws.

The crank shaft is one solid piece of 40-carbon open-hearth forged steel from end to end, and ground to a perfectly round, smooth running surface. Surrounding the crank throw is a disc carrying sufficient amount of counter-weight to give a running balance to the crank and to the reciprocating parts, so there is no vibration to be communicated to the frame and other working parts of the engine. The connecting rod is of forged steel, hammered down from a solid bloom, with both ends cut out to receive the crank and crosshead boxes. The adjustments can be made by hand with a great degree of accuracy.



THE NEW TYPE OF ERIE BALL ENGINE.

The high pressure valve is of the double-face telescopic type, receiving the boiler pressure on the inside, there being a sufficient amount of unbalanced area on the faces so that the force of the steam on the inside forces the two faces apart, causing each to rub against the seat with a sufficient force to keep the surfaces polished and steam tight through the entire life of the engine. The low pressure valve is of the common letter D type, with improved construction and proportion; is provided with a round relief area upon its back, operating against the chest cover, thus having a large, well-proportioned valve that runs with the greatest ease, yet follows up its wear without attention from the outside.

The outboard bearing has the same form of boxes and adjustments as the main bearing, and as a very liberal amount of metal is employed, makes a strong and substantial support to the outer end of the shaft. The material used in the piston rods, valve stems, rocker shafts, and crank pins is the best crucible steel, which, on account of its hardness and strength, gives the greatest possible amount of wear.

The governor, which in the engine shown is in the fly wheel, is quiet in operation, quick in action, perfect in regulation, and is especially adapted to the sudden shocks of railway service.

LITERATURE

COIL AND CURRENT. By Henry Frith and W. S. Rawson. London and New York: Ward, Lock & Tyler. Cloth. 294 pages. Freely illustrated. Price $1.25.

This is an excellent work, of the popular class, and gives an admirable idea of all the great triumphs and advances in electricity made since the beginning of the art and more particularly during the present century. It gives first a brief review of the history of electricity, and then takes up in succession the telegraph, the electric light, the electric motor, and the electric railway, space being also given liberally to the telephone, welding, plating, deposition and the miscellaneous uses of electricity. Each part is carefully yet lightly handled, and the technical information is interspersed with a multitude of stories, old and new. The book is thoroughly abreast of the latest work, and while it necessarily contains some historical cuts of familiar aspect, it is brightened up by a large number of new and graphic illustrations. In some sections the variety of new illustrative material is quite pleasing. The book is well printed and appears in a stout, decorative binding.

LETTERS TO THE EDITOR

MR. WINCHESTER ON MUNICIPAL PLANTS.

I DESIRE to express my sincere thanks to you for the high though undeserved compliments paid me in your editorial comment upon the subject of municipal ownership of electric lighting plants in your issue of February 17.

It would have been more pleasing to me, however, to have noted an intention in your editorial and selected articles to treat the subject with impartiality which was apparently lacking, as evidenced by the spirit of your comments upon my report and the array of articles descriptive only of unfavorable extremes and exceptional conditions without throwing any light upon existing successful municipal plants which it would seem should have been included to faithfully carry out an intention to be impartial. The fact that there are no successful municipal plants in existence cannot be offered as a reason why they were omitted, as your fund of data upon the subject must demonstrate. You know and so do I, as well as any one else who has investigated these plants, that there are many such in highly successful operation to-day.

You implied that my report presented a poor case as an argument in favor of municipal ownership. Perhaps you are right; I never was good at an argument, but have always had the greatest respect for facts. The list of plants contained in my report was made up of the good and the bad without partiality and a careful study of it does not bear out your statement, but clearly shows a majority of plants which cannot be distorted so as to represent anything but successful institutions as tax reducers. My report was the result of many months of investigation and hard study with this one end in view, to get at the actual facts.

The time given by you to analyze the report probably consumed a matter of a few hours, considering the many other matters which demand your attention. Had you taken more time I doubt not in your desire to be fair, that your criticisms would have been more substantial.

As to being a champion of municipal ownership of electric light plants, I can hardly accept such a high sounding title in the sense it was bestowed, and must modify it by saying that I only champion that side of the question in instances where municipal plants can be a benefit to the people who want them.

I regret that you represented me as being so narrow as to believe that men of one section are more honest than those of another, to which reasoning you implied that I attributed the success of our South Norwalk municipal plant. I said nothing which could be so construed. As a matter of fact our citizens are largely composed of New York City business men, including myself. Nor did I say or imply that I was not in favor of municipal plants for large cities, but I do adhere to the belief that any city, large or small, already possessed of well managed private electric light plants which are conducted on broad principles, fair and satisfactory to the people, supplying excellent service at low rates, of such character as are found in New York City and most of the other large cities, are not in need of municipal plants.

The municipal plant has a broad field of its own to fill without conflicting with the vested rights (so called) of private corporations that recognize their worth. Vested rights in public matters are the property of the people who it should be understood can give or recall them at will, and are never the unconditional property of individuals.

The field of the municipal plant is to afford relief to places which are burdened with cheap plants owned by speculative private corporations which in return for valuable franchises often given them gratuitously by municipalities in good faith, supply miserable service at maximum rates, making the public pay not only the cost of the production and a fair profit, but also for the losses due to poor construction, uneconomical machinery and bad management.

The success of the South Norwalk municipal plant should in justice be credited to my two brother commissioners, Mr. Joseph A. Volk, a keen, practical business man of experience, and Col. Leslie Smith, an honorably retired officer of the United States Army, a man of method and discipline. Both men are the embodiment of honesty, and the citizens by whom they have been repeatedly elected and re-elected to public positions of trust and importance, have the most implicit faith in them. Their interest in the success of the plant placed in their charge could not be exceeded if it was their own personal property and it is my pleasant privilege to be their associate.

All must bend to the power of the public, which is deliberate and slow, but sure in action; and the unwise electric light corporations that have misused public confidence can but trace the blame to themselves for the advent of the municipal plant, to-day nearly 400 strong in this country, and in a state of incubation in about 300 more cities and towns.

Let me ask how in justice can such figures as you publish from the Utica report be accepted as reliable? Do they not show how readily anything derogatory to the municipal plants is swallowed even by a journal as broad and intelligent as The Electrical Engineer? The data in that report is most incomplete. Nothing is said as to the number of lamps furnished by the plants quoted, and the candle power per lamp, price of coal, whether or not the plants are exclusively engaged in arc lighting, or, in fact, any information which would account for the extreme variations in cost per lamp hour, or candle power ratings for one cent as given—just figure some of those rates backward and note the unheard of phenomenal yearly results. The size of the plant and its various physical conditions, make all the difference in the world. A large number of lights cost less to produce pro rata than do a small number, as we all know; therefore without fuller explanation the Utica report cannot be justly considered as a criterion of true facts. Had that same report been made in favor of the municipal side, how quickly the minor failings that I have been able to note casually would have been jumped on and perhaps many others which my comprehension has been too dull to grasp.

I can speak personally in stating that the figures relating to the South Norwalk municipal plant as given in the Utica report are wrong and show evidence of careless, mistaken, or intended distortion so as to make the municipal side appear to a disadvantage. As a matter of fact, the correct South Norwalk figures including interest, depreciation and all operating, expenses, are, cost per lamp per hour, .0265 cents, candle power per hour for one cent 453, instead of .0571 cents per hour in the former case and 280 candle power per one cent per hour in the latter, as the Utica report states. Who made the report anyhow?

I for one would be pleased to see this question treated without partiality for once. All that is asked is justice. If the municipal plant is wrong let its opponents prove their statements by facts that will stand investigation, and not by assertions, assumptions, extremes and distortions. While this sort of ammunition is being used, the popular municipal "fad" is capturing city after city. If it is wrong, it must be crushed by just condemnation, but if it is right, no power can impede its advancement.

Again thanking you for the high esteem in which you hold me, which is most bountifully reciprocated, I am ever yours for progress,

ALBERT E. WINCHESTER,
Electric Light Commissioner.

South Norwalk, Conn., February 20, 1897.

PROF. THOMSON AND THE ENCLOSED ARC LAMP.

As the enclosed arc has taken a clearly defined position in the art of electric lighting of to-day, it is interesting to note the appreciation by scientists in the early days of commercial arc lighting of what we know to-day to be its essentials. The articles which have appeared in The Electrical Engineer by Prof. Marks are interesting as showing the development of this improvement, and from these articles it is quite evident that the utility of the enclosed arc depends solely upon the capacity of the apparatus to slowly replace the effects produced by air, the change being gradual and capable only of maintaining life and clearness to the enclosed atmosphere in which the arc is maintained, without the rapid consumption which is the result of unlimited quantities of air being supplied to the electrodes.

This then is the secret of success of the enclosed arc, and while these features have been, by the articles referred to, accredited to recent date, they were as a matter of fact fully known, illustrated, and described by Prof. Elihu Thomson in 1879, and also known to others at that time to be his invention. Among the evidence of this was a most complete specification for an application for letters patent prepared in February, 1879, in the handwriting of Prof. Edwin J. Houston, and signed by both Profs. Thomson and Houston, which became evidence in an interference proceeding between Prof. Thomson and myself upon the question of priority of invention of another matter. In this writing is described the advantage of excluding almost all fresh air from the enclosing globe to reduce the consumption of the electrodes and increase the longevity of the arc from a pair of carbons. Furthermore, means are shown and described to insure the very slow and gradual supply of air and escape of products of combustion so necessary to avoid blackening and bursting of the globe. In addition to this, the lamps are shown as arranged for constant potential circuits.

While all this may be deemed as too ancient to be considered more than as historical, nevertheless, it shows how possible it is for an inventor of the character of skill possessed by Prof. Thomson to foresee the necessities likely to arise in the future. This evidence, it seems to me, shows Prof. Thomson to be the first to devise and suggest the essentials for successful working of the enclosed arc.

R. M. HUNTER.

Philadelphia, Pa.

NEWS AND NOTES.

ELECTRICITY AT THE INAUGURAL BALL, WASHINGTON.

Having abandoned the elaborate plan of street decorating by illuminated arches, the committees in charge turned all their energies practically to the beautifying of the inaugural ball room. The streets and squares will nevertheless be equal to the occasion, Pennsylvania avenue, with its score of reviewing stands, several having the length of a whole block, will receive the glow from the firework display, and many beams from electric projectors will lend their peculiar charm. The Pension Building, the chosen place for the great ball, has been equipped with three covered approaches 15 feet in width, each having a covered carriage siding 75 feet long. On entering the main hall one can scarcely believe it to be the same building, the covering and decorative effects have been so thoroughly carried out. The colors are universally white and yellow in draperies, making the ball room an easy one to light up. The lighting is effected from almost every side. The main floor is bordered by 150 two-column in two tiers, the capital of each column mounting a cluster of sixteen 8 candle-power lamps, arranged in sunbursts and wired in multiple directly to 110 volt mains on the three-wire system. The use of nails or screws was prohibited, and all the clusters were attached to the columns by wooden strips and iron bands. These 2,232 lamps are fed from six temporary cables, three making the rounds of the hall on the main floor and three on the ceiling of the first gallery, tappings being made at each column. The electrical contractor fortunately had the use of a steel rail running around all four sides of the building on both gallery and main floor, which is used as a trolley conveyance for moving heavy articles, this rail furnishing all the support that could be wished for, as the cables are conveniently suspended by wooden blocks and insulators. Above the double tier of incandescent clusters a "necklace" of arc lights is strung around the building wired in series. Series arc lamps also furnish light temporarily located on the numerous stairways which lead from the main floor to the two promenade galleries from which a grand view of the hall can be had. Above the arcs and in the center of the hall three wooden-ribbed domes are suspended, each thirty-five feet in diameter, lined with white and yellow cheese cloth, and having a fall of white cheese cloth in all directions skillfully caught back, concealing the tremendous iron girder roof. Each dome is outlined by 115 lights. The domes are suspended from the roof by four ropes each, the ends of the ropes branching out to three ends, thus giving the frail ribbed dome twelve points of support around the base. Twenty-five hundred 6 candle-power lamps are wired through the palms and floral decorations, and 500 in addition go to outline an American flag over the entrance, and an eagle and shield with the names of McKinley and Hobart, over the band stand, which is situated midway in the hall. A golden gate forms a striking decoration at the farther end of the hall, both band stand and arch having clusters of incandescent lamps; the effect is very brilliant. A decorated fountain makes a center piece for the main floor. The cost of the electric work, including the supply of current, also gas turned down low, is $4,670. The electric work was carried out by John R. Galloway, contractor, of Washington, D. C. An illuminated canvas on the roof displays the number of the carriage called, in figures several feet in height. Among the non-electrical things of interest is the temporary kitchen adjoining the building, which is seventy-five feet in length, and equipped with every convenience of modern design. N. M. H.

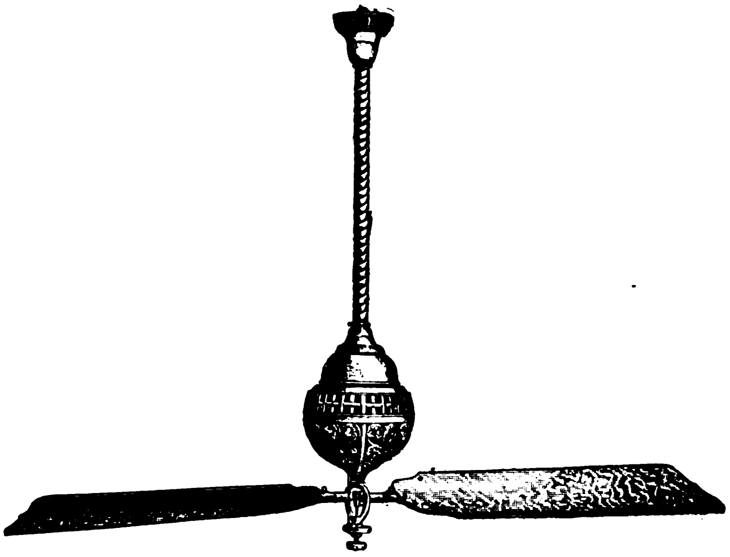
THE COX LABORATORY, at St. Albans, England, has, we regret to learn by cable, been destroyed by fire. The details of the event are not given, but it is hoped that no delay will be caused in the manufacture and delivery of the Cox thermo-generators, for which a large demand has already sprung up.

CASSIER'S MAGAZINE for March prints in handsome form the complete revised text of Mr. Tesla's poetic speech on Electricity, delivered at the Buffalo banquet last January. It is accompanied by some admirable pictures of the work at Niagara.

POWER TRANSMISSION

THE TUERK ALTERNATE CURRENT CEILING FAN.

WITH the approaching summer season we may look for the ever increasing demand for that now indispensable adjunct to comfort, the electric fan. Where the spaces to be ventilated are large the ceiling fan has been found exceedingly useful, and among those who have devoted their attention to this particular class of work are the Hunter Fan and Motor Company, of Fulton, N. Y., who are now bringing out their 1897 type of Tuerk alternating ceiling fan, which enjoyed such well-merited popularity during the last summer season. The new fan is shown in Fig. 1. The 1897 model's new features consist first of a switching device which greatly facilitates the control of the fan; to this has been added an enlarged oil chamber, so that one filling is quite sufficient to carry the motor through a whole season or longer, if desired; and besides this, a number of improvements have been introduced in the construction of the outfit which will be appreciated by users.



THE TUERK ALTERNATING CURRENT CEILING FAN.

Our engraving, Fig. 2, shows the highly ingenious mechanical arrangement for reducing the speed and transmitting the power from the motor to the fan blades. As will be seen, the new switch is operated in connection with the blade adjuster, the upper wheel operating the switch, while the lower wheel adjusts the blades, which may be done while the fan is in motion.

It will be noted that the transmitting gear consists of a shaft with a beveled transmitter wheel. The case inclosing the motor carries the fan and intermediate bevel wheels faced with leather. These wheels engage interiorly with the pulley and exteriorly with the inner face of the case; with this arrangement, the case rotates around the motor, but at a much lower speed. The transmitting wheels are mounted in swinging frames hinged to the stationary support which carries the motor case, and the weight of the fans and outer case is utilized to produce and maintain the frictional contact of the wheels that support the case and fans. Thus the friction is always the same, and any wear on either pulley wheels or case is automatically taken up, and the fan speed is thus always at a fixed ratio to that of the motor.

It will readily be seen that by this construction the friction on all the journals is reduced to a minimum, there being no cramping strain, all shafts being perfectly balanced and stepped with a single hardened steel ball, supported by a hardened steel screw. Means are provided for circulating the oil, and all shafts are set vertically so that the oil cannot run to waste. Means are also provided for carrying the motor case in a vertical position in the outer revolving case, by providing the case with a tubular stem, in which the armature shaft is journaled and the outer case is provided with a tubular shank, which revolves along the stem, while the armature shaft revolves within it. The letters B, C, D, D, Fig. 2, show the oil reservoir.

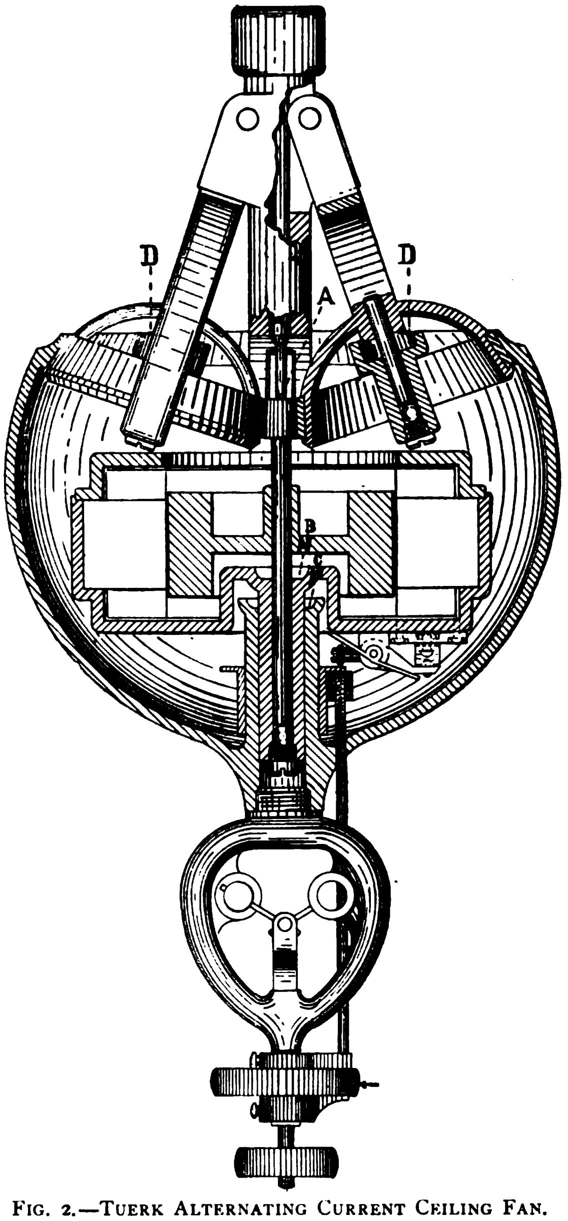


FIG. 2.—TUERK ALTERNATING CURRENT CEILING FAN.

The new Tuerk ceiling fans operate on any of the standard alternating systems and at different voltages ranging from 50 to 120 volts. The actual energy consumed by these motors is from 120 to 140 watts depending wholly upon the angle of the blades, which are adjustable and can be set at any angle desired. The fans are finished in Bower-Barff, bronze, ivory and gold, full nickel and polished cast brass.

The selling agency for the Hunter Fan and Motor Company for the entire East will be under the management of E. B. Latham & Co., 136 Liberty street, New York.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEBRUARY 23, 1897.

Alarms and Signals:—

ANNUNCIATOR. A. R. Miranda, Boston, Mass., 577,532. Filed Nov. 17, 1896.

Intended for use in barbers' establishments, to announce automatically the abandonment of a chair by a customer.

ELECTRIC SIGNAL FOR HIGHWAY CROSSINGS. W. W. Alexander and M. C. Gillham, Kansas City, Mo., 577,635. Filed March 23, 1896.

System for single track railways whereby a train approaching a crossing from either direction causes an alarm to sound and to cease directly it has passed the crossing.

Batteries, Secondary:—

SECONDARY BATTERY. H. G. Morris, Philadelphia, Pa., 577,771. Filed Sept. 5, 1895.

A cell having supports therein below the liquid level, a battery plate consisting of sections connected together by necks, the upper section being in the form of a beam from which the other sections are suspended, the beam section being part of the active plate within the liquid and resting upon the supports within the cell.

Connectors, Conduits and Insulators:—

ELECTRICAL INSULATOR. T. W. Young, Washington, D. C., 577,704. Filed Sept. 23, 1895.

A conductor of electricity in combination with an electric heater arranged in proximity to a support of the conductor and a hood for shedding water away from the electric heater.

Distribution:—

ELECTRIC TRANSFORMER. L. Gutmann, Peoria, Ill., 577,480. Filed April 25, 1896.

An element plate for electric transformers, consisting of the combination of two punchings, each having two limbs at an angle to one another, and a recess in one or both of them, and a third punching adapted to be retained in two oppositely located recesses of the two punchings named first.

ELECTRIC TRANSFORMER. L. Gutmann, Peoria, Ill., 577,742. Filed April 25, 1896.

An electric transformer element combining two U-shaped pieces of magnetic material, whose butting joints form the letter Z.

DEVICE FOR CONTROLLING LIGHT EFFECTS. H. V. Arnold, New York, 577,816. Filed Feb. 24, 1896.

Means for controlling the different colored media used in so-called "light-effects."

Dynamos and Motors:—

ALTERNATING CURRENT MOTOR. L. Gutmann, Pittsburg, Pa., 577,427. Filed Feb. 4, 1891.

Consists of a field magnet, an armature whose windings are subdivided into coils, contact terminals for the subdivided windings and a brush adapted to rest permanently on one armature-terminal and temporarily on the others.

Electro-Metallurgy:—

ELECTRIC FURNACE. F. J. Patten, New York, 577,493. Filed Aug. 1, 1896.

A central carbon core constitutes one electrode of the furnace, having numerous pencils of carbon radiating from it through the mixture to be fused, the outer extremities being connected to independent leads whereby they can be given current simultaneously or separately at will.

PROCESS OF AND APPARATUS FOR TREATING ARSENIC ORES. G. M. Westman, New York, 577,802. Filed July 8, 1895.

Consists in melting the ore by means of an electric current, one of the electrodes in the circuit being a stratum of lead, beneath the ore, with which the precious metals unite while molten, and, second, condensing the arsenical vapors given off from the ore while melted, simultaneously with the precipitation and union of the precious metals with the lead.

Lamps and Appurtenances:—

FILAMENT FOR ELECTRIC LAMPS. J. H. Douglas-Willan and F. E. W. Bowen, London, England, 577,499. Filed Aug. 3, 1896.

A process of treating filaments consisting in rendering them incandescent in the presence of a compound containing boron, carbon and oxygen.

ELECTRIC ARC LAMP. G. M. Lane, Asbury Park, N. J., 577,760. Filed Jan. 4, 1896.

Cut-out for arc lamps.

Measurement:

VOLTMETER. P. Brandt, Berlin, Germany, 577,678. Filed Aug. 6, 1896.

A core for solenoids, comprising a soft iron sleeve, and a bundle or cluster of wires contained therein.

Miscellaneous:—

PROCESS OF MANUFACTURING OZONE AND BY-PRODUCTS. G. J. Andersson and J. C. Dittrich, Brooklyn, N. Y., 577,523. Filed Dec. 12, 1894.

Consists in first freeing the air from carbon dioxid and then drying it, then ozonizing the oxygen of the air into ozone and ozonizing simultaneously the nitrogen of the same into nitrous oxids by electrical currents of high tension in an ozone generator and then separating the nitrous oxids from the ozone by absorbing them in suitable liquids.

APPARATUS FOR PRODUCING OZONE. E. Andreoli, London, England, 577,636. Filed Aug. 12, 1896.

Details of construction.

ELECTRIC ELEVATOR. J. P. Casey, Philadelphia, Pa., 577,644. Filed June 13, 1893.

Automatic means for shutting off the current when the lifting cable is impaired.

APPARATUS FOR PRODUCING ELECTRIC CURRENTS OF HIGH FREQUENCY. N. Tesla, New York, 577,670. Filed Sept. 3, 1896.

For description see page 239.

MANUFACTURE OF ELECTRICAL CONDENSERS, COILS, ETC. N. Tesla, New York, 577,671. Filed Nov. 5, 1896.

Exhausts the air from the insulation while hot, and then admits compressed air after the material begins to cool and solidify.

TOY. L. A. Eberhardt, New York, 577,730. Filed July 9, 1896.

Composed of a base-plate, a superposed horseshoe magnet and a metallic object adapted to be moved along the base-plate and between the magnet shanks.

SAFETY DEVICE FOR ELEVATORS. W. Ehrhardt, Union, Hudson County, N. J., 577,649. Filed Jan. 4, 1895.

Locking devices on the door of shaft whereby the door is held locked until released by a contact device on the car.

COMBINED CHECK-RECEPTACLE AND CASH DRAWER. A. R. Miranda, Boston, Mass., 577,533. Filed Nov. 27, 1896.

Details of construction.

Railways and Appliances:—

ELECTRIC RAILWAY SYSTEM. C. F. De Redon, New York, 577,450. Filed Sept. 5, 1895.

Includes a circuit closer comprising a permanent magnet adapted to be attracted by a part carried by the car, a lever on which the magnet is placed, a contact plate carried by the plate and having connection with the current carrying wires.

ELECTRO-PNEUMATIC BRAKE. F. Chapsal, Paris, France, 577,526. Filed Sept. 26, 1896.

Combines a pneumatic brake system, an electrically operated brake valve therefor, comprising an oscillating electromagnet, a single line wire leading thereto, and means for sending reverse currents over the wire, and valves operated by the oscillation of the magnet.

TROLLEY FOR ELECTRIC RAILWAYS. H. N. Gale, Bristol, Conn., 577,741. Filed Oct. 16, 1896.

The wheel is mounted so as to permit of a lateral motion.

ELECTRIC AND GRAVITY PLEASURE RAILWAY. J. A. Griffiths, Philadelphia, Pa., 577,550. Filed April 3, 1896.

Comprises a car provided with a downwardly projecting feeder-arm, a trough arranged along the course below the surface and a feeder wire arranged in the trough only at the upwardly inclined portions of the course.

Switches, Cut-Outs, Etc.

AUTOMATIC CIRCUIT BREAKER. G. F. Packard, Fort Wayne, Ind., 577,447. Filed Sept. 22, 1986.

Employs a weighted drop-armature adapted to break the circuit upon a predetermined increase of the current in the main circuit.

ELECTRIC CUT-OUT. J. F. McElroy, Albany, N. Y., 577,822. Filed Oct. 20, 1894.

Consists of a porcelain block, a curved grooved channel-way therein, a curved fuse-wire placed in the channel-way, suitably connected with a flexible covering over the channel.

Telegraphs:

SUBMARINE TELEGRAPHY. A. Muirhead, London, England, 577,534. Filed Nov. 18, 1895.

Method of transmitting impulses by means of perforations in strips of paper.

TELEGRAPH TRANSMITTER. H. A. Taylor, London, England, 577,540. Filed Nov. 18, 1895.

Similar to above.

PERSONAL

MR. A. D. WIKE, secretary of the Marietta, Pa., Electric Light Company, and prominently connected with other Marietta enterprises, died on February 24 of pneumonia, at the age of 52.

MR. D. PADDOCK, assistant electrician of the "Big Four" Railroad, has resigned in order to engage in electrical work in Chicago.

MR. H. T. SIMPSON has been appointed superintendent of telegraph on the Chesapeake & Ohio Railroad to succeed the late M. B. Leonard.

MR. G. H. LEWARS, assistant treasurer of the Westinghouse Electric and Manufacturing Company, and formerly in a like capacity with the Sawyer-Man Company, has resigned in order to accept the position of general manager with the Curtis Publishing Company, of Philadelphia, which issues the popular Ladies' Home Journal.

T. A. EDISON, JR., has been in Texas recently making arrangements for the introduction of his father's phonoplex on the Santa Fé Railroad system.

DR. S. S. WHEELER, president of the Crocker-Wheeler Electric Company, leaves for Bermuda to-day, and will be gone about three weeks.

MR. C. S. KNIGHT, Mr. J. J. Wood and Mr. W. J. Buckley, of the Fort Wayne Electric Corporation, have been making a study of all the new work at Niagara Falls the last week.

MR. CHARLES A. VALLETTE, cashier of the Missouri Electric Light and Power Company, St. Louis, and secretary and treasurer of the Edwardsville (Ill.) Electric Light and Power Company, was a Chicago visitor last week and made a call at the office of The Electrical Engineer. He reports the outlook good for larger business.

THE STOCK MARKET

WAITING BUT HOPEFUL.

The course of industrial and financial events appears to be steadily for the better. The improvement in the value of securities is not large, but it seems to be secure. An opinion appears to be current that a marked gain will follow the inauguration of Mr. McKinley, but there is no solid reason offered for this, as the controlling conditions remain unchanged. The boom that comes in the spring may, however, hasten its arrival, especially as the balance of trade still runs strongly in our favor.

On the stock market, the talk is bullish in many directions, but there is no great activity. Of Western Union during the week, 5,699 shares were sold, opening at 82¼ and closing at 83½. General Electric on sales of 11,190 shares advanced from 34½ to 35. In Boston, American Bell held its own, and looks good for 230. The general status of local lighting and railway stocks and bonds has also improved and there is a brisker inquiry. The public is slowly but steadily absorbing good bonds.

LEGAL NOTES

TELEGRAPHIC MISDEMEANORS.

The U. S. House of Representatives Committee on the Judiciary has favorably reported a bill which makes it a misdemeanor for any person to transmit by any telegraph or telephone company any dispatch from any State or Territory relating to lotteries, poolselling, bookmaking, or gambling.

DAMAGES FOR TELEGRAPHER'S BULLS.

The Kentucky Court of Appeals, in an opinion by Judge Guffy, delivered against the Western Union, holds that telegraph companies are liable for damages for mistakes in unrepeated messages, notwithstanding the waiver of damages printed on the backs of the company's blanks.

MARSDEN J. PERRY AS UNITED TELEGRAPH CO.'S RECEIVER.

At Boston, on February 24, in the United States Circuit Court a hearing was given in the United Telegraph Company receivership case, resulting in the removal of H. J. Pettingill as receiver and the appointment instead of Marsden J. Perry of Providence, R. I. The change in the receivership was made on the petition of the defendants, who claimed that Mr. Pettingill, being superintendent of the Postal Telegraph Company, a competitor, was hostile to their interests.

Judge Colt, in making the order, said that he made the change as it was the ordinary procedure when one of the parties objected to the receiver. An order of notice was issued, returnable on March 9, when a further hearing on the injunction will be held. Mr. Perry was given five days in which to file a bond of $20,000.

PLAN FOR THE BETTER LOCATION OF KEY HOLES.

The New York Aldermanic Committee on Streets gave a public hearing last week on the subject of illuminated house numbers. Mrs. Helen N. Gaillard, of Brooklyn, exhibited for the enlightenment of the committee members a portion of a hall door, to which was attached an electric appliance, by means of which the numbers on a frosted glass plate let into the door were illuminated. The light came from a tiny incandescent lamp, the current for which was supplied by a small two-cell battery. Mrs. Gaillard said that the contrivance could be applied to keyholes as well as to numbers. The committee will report at the next meeting of the Aldermen.

BOARD OF CONTROL. Senator Stranahan has introduced in the State Senate a bill extending the life of the New York Board of Electrical Control for one year from November 1, the salary of the commissioners to be $5,000.

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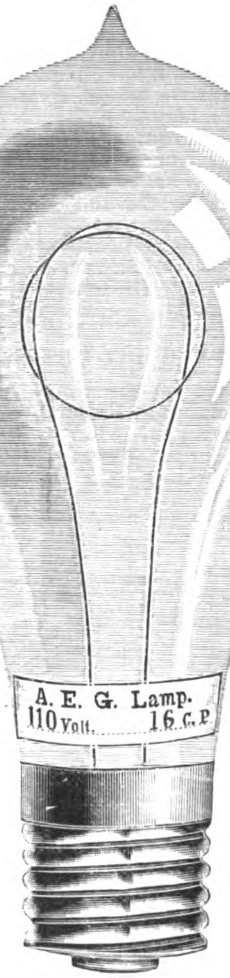
TRADE NOTES & NOVELTIES

THE A. E. G. INCANDESCENT LAMP.

THE cut herewith is the same size as the standard 16 candle-power lamp made by the Allgemeine Elektricitats Gesellschaft of Berlin, Germany, for the American market. This concern, which is the largest in Europe, first started as a lamp factory alone. This was back in 1883, and the success that this line of their goods obtained was an entering wedge for the enormous volume and variety of business that they are now doing in all quarters of the globe.

Until now the demand for their lamps in Europe, and, in fact, the whole Eastern hemisphere, has been so great that the total product was absorbed there. Recently, however, their factories have been enlarged, and they are now placing their goods on the market in this country, being convinced that their superior quality will make them exceedingly popular.


A. E. G. Lamp.
110 Volt. 16 C.P.

STANDARD A. E. G. LAMP.

The lamp filaments are made by a secret process which insures exceptional durability and maintenance of candle power. Numerous tests that have been made justify them in giving a guarantee of an average life of 800 hours for the standard 16 candle-power lamps and even this is far below the results obtained.

The lamp is very graceful and has several mechanical features which will commend themselves to the practical man. The bases are made of spun brass and porcelain, and are secured to the lamps themselves by a very small quantity of special cement, which is almost perfectly moisture proof. Twisting off of the bases is unknown.

Messrs. Machado & Roller, 203 Broadway, New York City, have been appointed the sole agents for the United States for these lamps and will gladly send their lamp book and prices to interested parties, a category which includes every lamp consumer in the United States.

THE INCANDESCENT LAMP SITUATION.

With reference to the information on this subject in our pages last week, we are in receipt of the subjoined confirmatory data from the Westinghouse Electric and Manufacturing Company, or, rather, its alter ego, the Sawyer-Man Co., which conducts that part of its business:

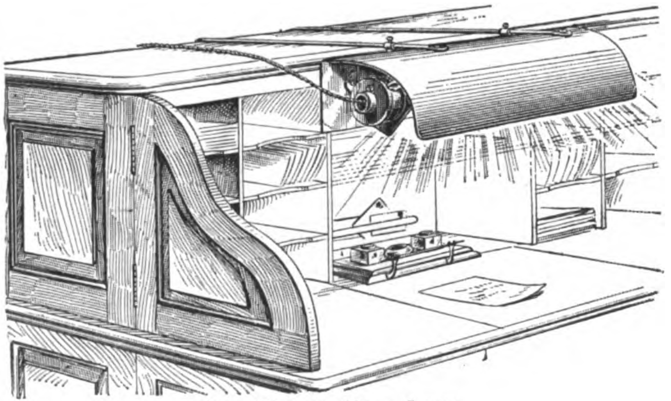
The Westinghouse Company is the owner of a large number of patents relating to incandescent lamps and the processes of manufacturing them.

The following companies have been granted licenses by the Westinghouse Company, and are now operating under these patents, viz.: Bryan-Marsh Company, the Perkins Electric Switch Manufacturing Company, the Columbia Incandescent Lamp Company, the Buckeye Electric Company, the Sunbeam Incandescent Lamp Company, the Adams-Bagnall Electric Company, General Electric Company, New York and Ohio Company.

It is further understood that the Westinghouse Company is prepared to grant licenses upon equitable terms to other reputable manufacturers of incandescent lamps, and that several are now negotiating for them. Newspaper statements have appeared from time to time to the effect that a pool has been formed among certain lamp manufacturers. The officials of both the Westinghouse and Sawyer-Man Companies state that they are not members of any such pool, but are continuing the independent manufacture and sale of incandescent electric lamps. Other rumors to the effect that the Westinghouse Company has gone entirely out of the incandescent lamp business are denied by the officials. This rumor may have arisen from the fact that the Westinghouse Company does not itself manufacture incandescent lamps, having about a year ago reorganized the Sawyer-Man Company, one of its controlled companies and transferred its incandescent lamp business to that company.

THE DAYLIGHT DESK LAMP.

E. J. WARING, 136 Liberty street, New York, is enjoying great success with his "Daylight" electric desk lamp, of which the accompanying cut will give the reader a good idea. This electric desk lamp is constructed upon scientific principles, and is of value to those who are compelled to do night or dark desk work. The light is soft and abundant, and so well distributed as to leave no shadows or dark corners on the desk; yet the lamp itself is entirely shaded from the eyes. Furthermore, it does not heat the head. In appearance it is ornamental and attractive, and in no way interferes with the opening or closing of a "roll top" desk. With upright mountings it is well suited to "flat top" desks or "library tables," being especially suitable for a library or reading lamp.



The Waring Desk Lamp.

Catalogue and price list will be cheerfully mailed to any address on application.

A BIG SHELBY INCANDESCENT LAMP DEAL CLOSED IN THE WEST.

Jas. C. Wormley & Co., whose general offices are in the Marquette Building, Chicago, closed a deal some time ago with the Shelby Electric Company, of Shelby, Ohio, whereby they are to have the sole agency for the Shelby tipless lamp in Cook County, Illinois, and Minnesota. We understand that the contract was made some time ago, but only recently became public.

It is Mr. Wormley's intention to carry a large stock of the Shelby lamps in Chicago as well as in St. Paul, where his company has a well established agency. Mr. Wormley has been connected with the incandescent lamp business for several years and is one of the largest exclusive dealers in that line in the United States.

Mr. Wormley was up to the time that the Universal Electric Company's factory was destroyed by fire, their sole agent for the West, and it was with that lamp that he built up his reputation with the trade. Since the Universal was burned out of existence he has had several different factories manufacture for him. As Mr. Joseph Hardwick, formerly superintendent of the Universal factory, is now connected with the Shelby Electric Company, he feels that he is in a position once more to hand his old customers a lamp manufactured after his own ideas.

In addition to the Shelby agency, Jas. C. Wormley & Co., will continue to market the Wormley lamp in all territory. This lamp is made up in lower efficiency than the Shelby lamp, running from 3 to 4 watts per candle power, but has a double coiled filament (showing 2 turns). It may be said since they commenced advertising this lamp at a discount that it has become very popular, both in the East and West.

THE CHICAGO SCHOOL OF ELECTRICITY.

Messrs. W. Clyde Jones, A. Scheible and E. J. Swartout, a special committee of the Chicago Electrical Association, have investigated the Chicago School of Electricity, and report favorably upon its aims and work.

BRYANT CATALOGUE SUPPLEMENT.

The Electric Appliance Company have just prepared a supplement to the Bryant catalogue of electrical specialties, showing a line of the best electric light specialties that have been brought out during the past year. The supplement is also supplied with a special trade discount sheet giving trade prices on the goods listed. The Bryant specialties have a great reputation, and anything new brought out by this company is always received with considerable interest. The Electric Appliance Company would be glad to send one of these catalogues with discount sheet to the trade, on application.

THE JUNGFRAU ELECTRIC RAILWAY.

M. Guyer-Zeller, chairman of the Jungfrau Electric Railway Syndicate, Zurich, informs us that it is proposed to finance the undertaking before Easter, and one-quarter of the whole capital is to be reserved for English and American subscribers. The prospectus of the company, giving details of the technical and financial considerations, has been issued in the English language. Our readers will recall the description of this remarkable undertaking appearing in our issue of Nov. 18, 1896. The lowest section of the road as far as the Eiger glacier is to be completed during the coming summer.

ELECTRIC MINE HAULAGE PLANT AT MOON RUN, PA.

The Moon Run Coal Company, of Moon Run, Pa., is about to install an electric haulage plant in its colliery, and to this end has contracted with the General Electric Company for electrical equipment, sufficient to operate a mine road with over three and one-half miles of tracks. The generating station will consist of one 165 k. w., 250-volt generator, directly connected to a Harrisburg Ideal Engine 18½ inches by 16 inches. These with the switchboard will be set up in the present power house, which at present contains an air compressor plant for the operation of certain pick machines. The inside haulage will be handled by one 10-ton mining locomotive, equipped with 40 horse-power motors. This will haul 40 loaded cars per trip, each loaded car weighing about two and a half tons. There will be over three and one-half miles of trolley wire in the mines, with the necessary feeders.

It is worthy of note that electricity was not adopted by the Moon Run Coal Company before it had made a more than careful investigation of the merits of all other systems of mechanical haulage, cable, compressed air and steam. The economical showing exemplified by the results obtained in the many other mines now using the General Electric Company's system of electric haulage, proved conclusively the advantage which would accrue to the Moon Run Colliery by the introduction of electricity.

BUILDINGS FOR SALE.—Some four years ago, the Berlin Iron Bridge Company, of East Berlin, Conn., designed and built a stove works at Sioux City, Iowa. Owing to the failure of the company, they have been obliged to take back the foundry building, mounting shop, and general machine shop, and now offer these buildings, which were of the best iron construction, for sale at a bargain. The buildings are not second hand, except the fact that they have been put up once, as they were never used. Here is an opportunity for any company contemplating new construction to examine into the matter, as the price at which these buildings are offered is much below the present market value of all classes of structural material. See their ad. in another column.

ADVERTISERS' HINTS

THE INTERIOR CONDUIT AND INSULATION COMPANY, announce that their new styles of fan motors are now ready.

THE GLOBE ELECTRIC HEATING COMPANY, 141 North 12th street, Philadelphia, are again advertising their heaters which they are so successfully manufacturing for a large variety of uses.

THE GOODYEAR VULCANITE COMPANY, 353 Broadway, New York, are supplying hard rubber goods for electrical and mechanical purposes, including phonograph tubes, hook insulators, magnet heads, battery cells, sounder covers, etc.

A. L. BOGART, 22 Union Square, New York, are making the Bartholdi automatic gas lighter which they claim to be the smallest in use. This is but one article in a long line.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY state they have constructed 26,000 horsepower in oil-insulated transformers at potentials ranging from 5,000 to 50,000 volts.

THE STANDARD AIR-BRAKE COMPANY, 100 Broadway, New York, guarantee to control any car by means of their apparatus on any grade up to 13½ per cent., and for even steeper grades they have special equipments to meet the most extraordinary difficulties.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, have just issued a supplement to the Bryant catalogue which they will send on application with a special trade discount sheet.

THE BALL ENGINE COMPANY, Erie, Pa., publish a list of medals awarded to them for the excellence of their automatic engines.

EDWARDS & CO., 144th street and Fourth avenue, New York, say the "Eco" buzzers and bells never work out of adjustment. They are provided with platinized contacts and are dust and bug proof.

MACHADO & ROLLER, 203 Broadway, New York, are the sole American agents for the "A. E. G." incandescent lamps.

WM. SMITH HORRY, Sault Ste. Marie, Mich., and Ontario, will undertake the design of electrical machinery of all kinds.

THE McFELL ELECTRIC COMPANY, Marquette Building, Chicago, Ill., are now the Western agents for Whitman & Couch, the importers of the Ericsson Swedish Microphone.

EDWARD M. BENTLEY, Temple Court, New York, will be glad to correspond with those who may desire the services of an expert in patent cases.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., have secured the order for the entire engine equipment of the new station of the Scranton Illuminating, Heat and Power Company, consisting of five cross compound engines and one simple engine.

BROWNLEE & CO., Detroit, Mich., advertise "a perfect pole" for which they claim strength, durability and economy.

THE WARD LEONARD ELECTRIC COMPANY, Hoboken, N. J., will this week introduce their automatic under and over load circuit breaker which they state is a strictly high grade article with a capacity of 30 amperes. The price during March is $7.50 net.

THE HUNTER FAN AND MOTOR COMPANY, Fulton, N. Y., are now ready with the '97 patterns of the Tuerk alternating current ceiling Fan made for from 50 to 120 volts and finished in various styles.

THE WALKER COMPANY, Cleveland, Ohio, advocate the use of their trolley which cannot leave the wire, and with which a switch may be dispensed with.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., are offering an iron building for sale at a bargain. It is adapted for a foundry, machine shop and, with very slight alterations, for a cow barn.

THE H. B. CAMP CO., Aultman, Ohio, say they are quite able to convince interested parties of the superiority of their vitrified clay conduits for underground wiring.

THOS. MUIR & SON, 31 Larned street, W., Detroit, Mich., have brought out a new automatic motor starter for 110, 220 and 500 volts circuits. Among its good points may be noted its simplicity, reliability and safety, only one being required to control a 500-volt current.

THE AUTOMATIC CIRCUIT BREAKER COMPANY, Newaygo, Mich., guarantee their circuit breakers to operate perfectly or no pay.

THE AUTOMATIC SWITCH COMPANY, Equitable Building, Baltimore, Md., are now ready to furnish the latest type of the Whittingham automatic motor starter for pump elevator and other motors, and also their quick acting switch. They say they prevent accidents and save money.

UEHLING STEINBART & CO., LTD., 60 Mulberry street, Newark, N. J., say that thousands of tons of fuel now wasted by bad firing, can be saved by the use of the gas composimeter which indicates and records continuously the percentage of carbon dioxide in the chimney gases, making an autographic record of the condition of the fire. Write them for details.

THE MENOMINEE ELECTRIC AND MACHINE COMPANY, Menominee, Mich., make a specialty of fan motors.

CARLISLE & FINCH are manufacturing search lights for a variety of uses.

THE AHLM-EDWARDS ELECTRIC COMPANY, Medina, Ohio, build their motors with adjustable bases which adapts them for fastening to ceilings and walls where floor space is at a premium.

NEW YORK NOTES.

THE BERGMANN LONG-LIFE ARC LAMPS are the subject of a handsome catalogue just issued by the General Incandescent Arc Light Company, 572-578 First avenue, New York City. The styles for 1897 are illustrated and described and prices are quoted. These enclosed arc lamps are shown up in careful detail, and many valuable points are given as to their use by lighting companies and purchasers. Some data is also given as to "Sun-Schmelzer-Nuernberg" carbons for direct current enclosed arc lamps. The company are manufacturers of various styles of arc lamps, blade switches, switchboards, etc., and stand ready to undertake general and experimental work of all kinds. A view of the fine factory is shown on the last page.

MR. M. R. RODRIGUES, 17-19 Whipple street, Brooklyn, manufacturing electrician, is in the market for a quantity of small steel castings, and will be glad to hear from any foundry making a specialty of them.

A. L. BOGART, 22 Union Square, New York, will soon issue a new and complete catalogue of his electric gas lighting attachments. It will dwell especially on the attachments as applied to the Welsbach light. The catalogue will be the first of its kind ever issued and, as stated by Mr. Bogart, will be of great value to those interested.

MR. L. J. McPARLIN, a lawyer of Lockport, N. Y., has secured the signatures of 150 firms and individuals to a 5 years' contract for telephone service, at $30 a year for business places and $24 for residences. The new company propose to issue about $8,000 of bonds, for ten years, at 6 per cent., and will be glad to hear of parties who will place this amount for them.

THE ELECTRICAL MERCANTILE AGENCY, of 318 Broadway, New York, has issued a very neat slip pad calendar for 1897 to its friends and patrons, who find it quite an ornament for their desks. The agency has published also a neat little brochure describing the features of its admirable work for the protection of credit and the sifting out of irresponsible parties.

THE PELTON WATER WHEEL COMPANY, San Francisco and New York, have recently shipped a number of wheels to Japan; also three wheel plants to the Island of Java, East Indies, including pipe lines and all appliances. The former were chiefly for electric lighting, and the latter for running the machinery of sugar, tea and coffee plantations, as well as for furnishing light. The company are using as a very interesting letter circular a picture of the surveying work being done by one of their engineers and a gang of native assistants, for a large power station in the Malay Peninsula, not far from Singapore. This plant will furnish power and light for several large towns, over transmission lines.

JOHN SIMMONS COMPANY, 106 Centre street, New York, are pushing the sale of their two specialties, the Excelsior railway bracket, one of the best brackets now on the market suitable for trolley roads, etc., and their Hercules switchboard. Business is brisk in all their departments. John Simmons Company carry an immense stock constantly on hand of wrought iron pipe fittings, valves and supplies for steam, gas water and electrical engineering.

KEUFFEL & ESSER COMPANY, 127 Fulton street, New York, report a good trade for their drawing materials, etc. The electrical industries make up a good share of the trade controlled by this firm, and the renewed activity is causing plenty of work to be put on tracing paper, at least.

FRED'K RECKENZAUN, 44 Pine street, New York, consulting and contracting engineer, installed the storage battery fire alarm plant for the city of Rochester, N. Y., the largest of its kind in the country. Mr. Reckenzaun is ready to undertake other installations of this character.

M. E. SANGER & CO., 36 Cortlandt street, New York, are manufacturing intricate and special devices for a number of electrical companies. They do also experimental and model work, and will be glad to hear from any parties desiring such work.

THE AMERICAN ENGINE CO., Bound Brook, N. J., have just secured the order for the entire engine equipment of the new station of the Scranton Illuminating, Heat and Power Company, to be built on the site of the old station recently destroyed by fire. The equipment will consist of six American-Ball engines, five of which will be compound and one simple. Direct connected generators will be used on four of these engines, and the station will be modern in all its appointments.

THE STANDARD AIR-BRAKE COMPANIY has secured the services of Mr. Herbert B. Taylor, at present with the Consolidated Traction Company, as chief assistant in the electrical department to Mr. F. Ubelacker. Mr. Taylor has handed in his resignation and will enter the service of the Standard Air-Brake Company on March 1.

NEW ENGLAND NOTES

BIBBER, WHITE & CO., of Boston, are the manufacturers of the Boston transformer, whose economy is in keeping with the saving principles that are well recognized at the Hub, and exemplifies New England thrift. The company will be glad to receive and answer inquiries on the subject.

THE SWETT & LEWIS COMPANY, successors to G. A. Frei & Co., of 17 Bromfield street, Boston, manufacturers of X-ray supplies, have just moved to 11 Bromfield street, the old quarters being too small to accommodate the ever increasing business. They have more than doubled their space, as well as force of employés. All their tubes are made in their own laboratories by skillful glass-blowers. The fluoroscopes are neatly gotten up, and the screens coated by a process entirely their own. Besides a laboratory and office, they have fitted up a large dark room for photographic purposes, also an operating room, so that a physician can bring in a patient, and have a radiograph taken in entire privacy. We understand that they are soon to bring out a new style of tube, which will have many points of excellence.

WATER WHEEL GOVERNORS FOR MINNEAPOLIS.—The Lombard Water Wheel Governor Company, of Boston, have closed a contract with the St. Anthony Falls Water Power Company, of Minneapolis, for seven governors for the new plant which they are building. These seven governors are to regulate four water wheels each, or 28 water wheels in all, aggregating 10,000 horse-power. The style of governor to be employed in this plant is designated by the manufacturers as Type C. During the past year the Lombard Company have with this governor regulated over 40,000 horse-power of water wheels, in the United States. On account of the magnitude of the Minneapolis plant, the question of governors was very carefully looked into before the above order was placed.

WESTERN NOTES

TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., have issued a very striking list of their sales of multipolar and bipolar machines sold during 1896. This apparatus was installed all over the country in large and small plants, and for a great variety of purposes. They will be glad to receive inquiries as to any projected new work.

MR. G. D. STURTEVANT, of the Adams-Bagnall Electric Co., Cleveland, paid a visit to Chicago recently and had his headquarters at their branch office. He was taken good care of there by Mr. J. G. Pomeroy. Mr. Sturtevant was fortunate enough to secure an order recently from the city of Newark, Ohio, for 100 of their differential arc lamps.

THE METROPOLITAN ELECTRIC COMPANY of Chicago have taken the agency of the Reynolds self-insulating bug cut-out, and have a stock of these on hand, from which they can make prompt shipments. This cut-out is a new one which has some very desirable features. It consists of two pieces of porcelain so recessed and put together as to entirely cover and connect the fuse wire and connections. It is neat and compact in form, and the size is only about ¾ inch in diameter by 1½ inch long. This, with the other desirable features, makes it a cut-out which will fill many requirements of the wiring trade.

H. M. UNDERWOOD & CO., 204 Dearborn street, Chicago, have been appointed general Western agents for the sale of the Adjustable Shade Holder, manufactured by the Housatonic Company, of Wellingford, Conn., who are to be congratulated on having secured the services of so able a representative as Mr. Underwood, who is most energetic and has a large acquaintance amongst the electrical trade in the West.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, which is the new style of the Card Electric Motor and Dynamo Company, as noted in our columns last week, is making some important changes in the handling of its Eastern business. This part will be in the hands of the Bullock Electric Company, which will control the sales east of the Alleghanies, and which opens offices this week in the new St. Paul Building, Broadway and Ann streets. Preparations have been made to handle business double that of last year.

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Vol. XXIII. MARCH 10, 1897. No. 462.

ELECTRIC LIGHTING

THE BOWLING GREEN STORAGE BATTERY STATION OF THE NEW YORK EDISON CO.

THE Edison Electric Illuminating Co., of New York, was from the very beginning of its existence, a pioneer in low tension central station distribution, and since 1882 has led the way in the adoption of most of the methods and apparatus which have served to keep this system of distribution so well abreast of the times.

Ever on the alert to call to its aid the latest advances in the art the company long since undertook an investigation into the advisability of adding storage batteries to the existing system, with the result, that a battery was installed in the company's Fifty-third street station. This was in 1890, and the experience gained since then led to the installation of a battery of greatly increased size in the new Twelfth street station, which went into operation during the past year.

Up to this period these batteries had been employed only as auxiliaries to the stations in which they were installed, but the distribution of load on the company's extended system had become such, that it was found that advantages in several directions would accrue by the use of storage batteries used as independent distributors, fed at a distance by current from one of the existing stations of the company.

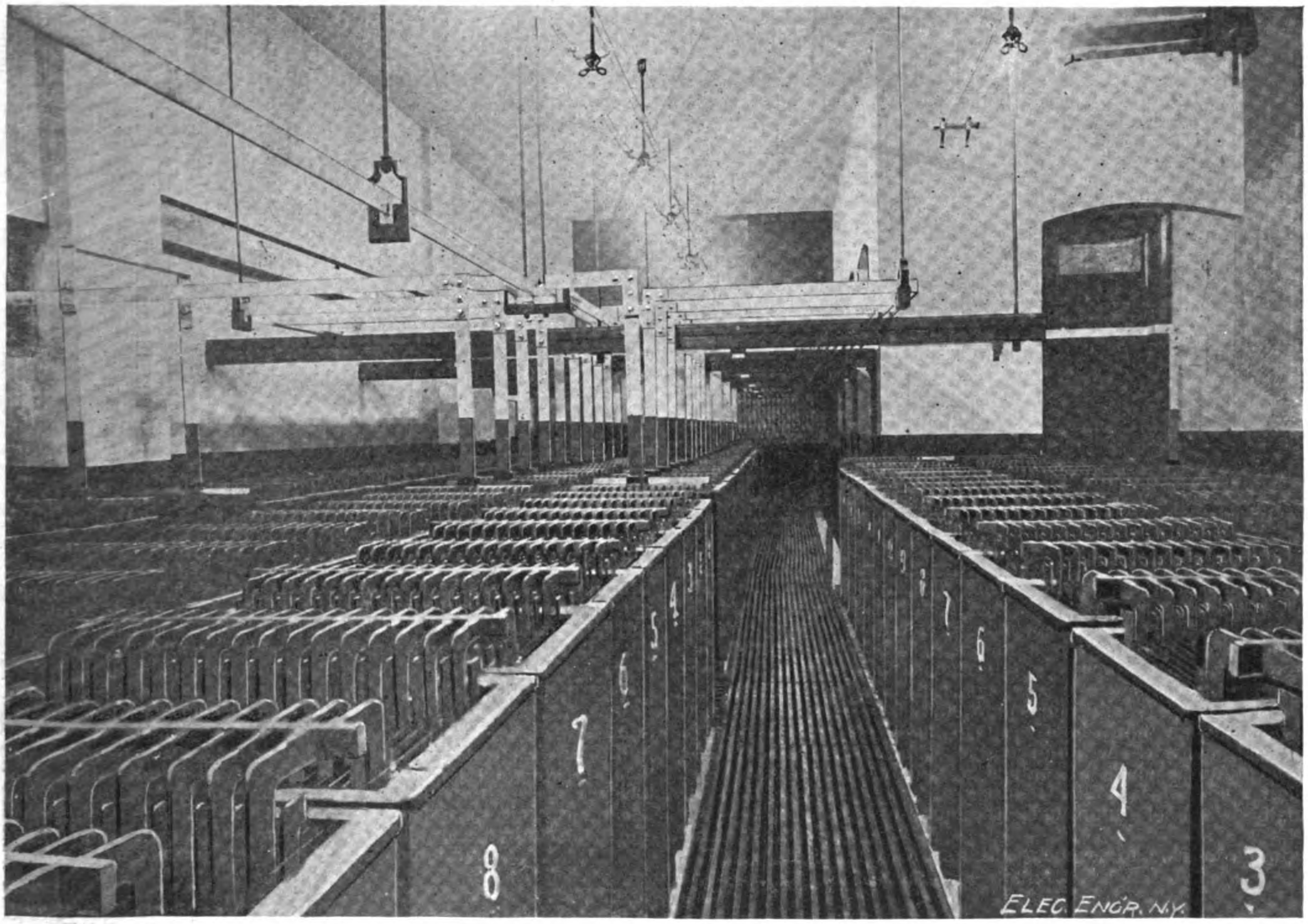


FIG. 1.—BATTERY ROOM, BOWLING GREEN SUB-STATION, EDISON ELECTRIC ILLUMINATING CO., NEW YORK.

Such a storage battery sub-station has now gone into operation, located in the Bowling Green Building, situated close to the southern tip of Manhattan Island.

THE OBJECT OF THE BATTERY STATION.

Before entering into a detailed description of this most interesting installation it may be well to give a short account of the objects for which the battery has been installed and the work it accomplishes.

The new battery plant takes the place of the annex dynamo station formerly situated in the Produce Exchange, and supplies current to a small feeder system, re-enforcing the supply of current from the great Duane street station to the lower part of the district. It furnishes an auxiliary supply of current direct from the battery, enabling the feeders extended as tie feeders into the Bowling Green Building, to be used as distributing feeders to the system from both the Duane street station and the Bowling Green Building. While acting as an auxiliary supply to the general system it also takes care of the distribution of current to the extensive installation of the Bowling Green Building itself.

The supply of current to charge the battery is taken from the Duane street station, about a mile distant, over four-tie feeders, equipped with controllable disconnective switch boxes on the Bowker-Van Vleck system. This enables them to be used as tie feeders by disconnecting them from the general system during the hours of light load, and as distributing feeders during the hours of maximum load, when they feed current into the system from each end. A considerable saving is thus effected in the investment which would be required for costly feeders to supply the maximum load to a distant part of the system.

This installation of an auxiliary source of current supply in

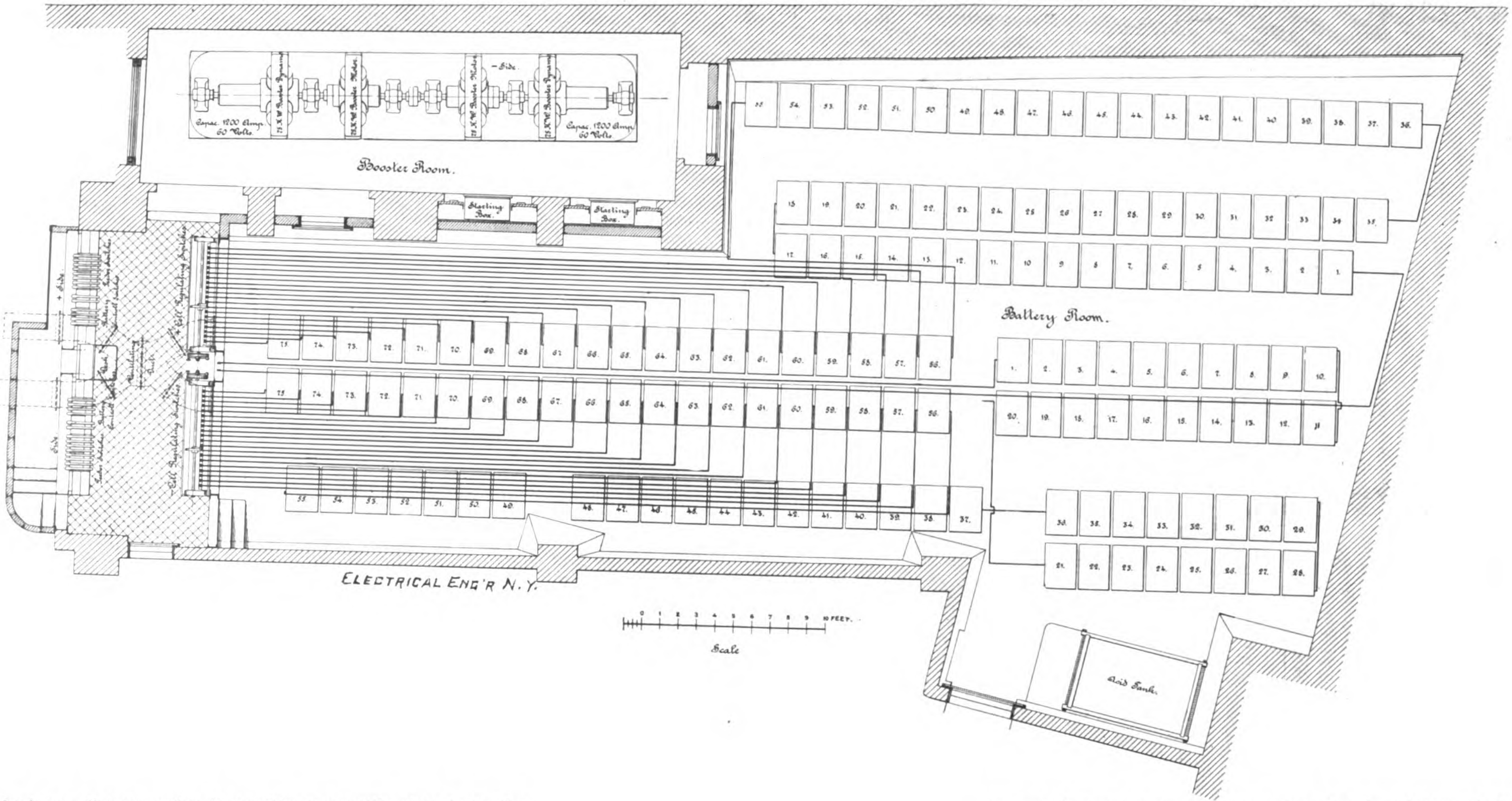


FIG. 2.—BATTERY, BOOSTER AND OPERATING ROOM, BOWLING GREEN STORAGE BATTERY STATION, EDISON ELECTRIC ILLUMINATING CO., NEW YORK.—PLAN VIEW.

the lower district makes it possible to actually shut down the Duane street station as a generating station during the hours of minimum load, the supply of current to the district below Eighth street being derived from the storage battery plants at Bowling Green and at the Twelfth street station, supplemented, if desired, by the supply of current from the Twenty-sixth street station over the tie lines to the Twelfth street station, whence the current is distributed through boosters, raising it to the required potential, over the tie feeders to the Duane street station switchboard.

By the shutting down of the Duane street station during one watch, while the load is very light in the downtown district, it is expected to effect considerable economy in operation, while providing adequate supply of current from several independent sources.

With this brief account of the raison d'etre of the new battery station, we may now proceed to the description of the station itself, which is noteworthy in more than one particular, representing, as it does, the latest practice in this field.

THE BATTERY ROOM.

The battery room, which is shown in Fig. 1, is located in the sub-basement of the Bowling Green Building, and, due to the fact that the floor of the room is below the water line, an extensive scheme of water-proofing was necessary, and was carried out as follows. See Fig. 4. A layer of concrete, 18 inches thick, was first laid over the entire area, and covered with several layers of pitch and felt. This material was carried out as follows. See Fig. 4. A layer of concrete, 18 this layer of water-proofing, on the floor, were then laid a series of vitrified hollow tiles for conducting the feeder cables under the floor, where they enter at the front of the room, to the rear cable vault under the controlling room, the ducts sloping downward to the rear cable vault. Above these ducts was placed another layer of pitched felt to further prevent any water from rising through the floor, and also, to preclude the possibility of acidulated water finding its way downward into the ducts from the floor above. Another layer of concrete 12 inches thick was then placed above the ducts, and the floor was then covered over with a white vitrified tile, which was found not to be affected by acid and which forms the floor proper of the battery room. This construction is shown in the sectional view, Fig. 5. The water-proofing on the side-walls is retained in place by a wainscoting of slate, securely fastened to the brick walls at the top and imbedded into the concrete at the floor level.

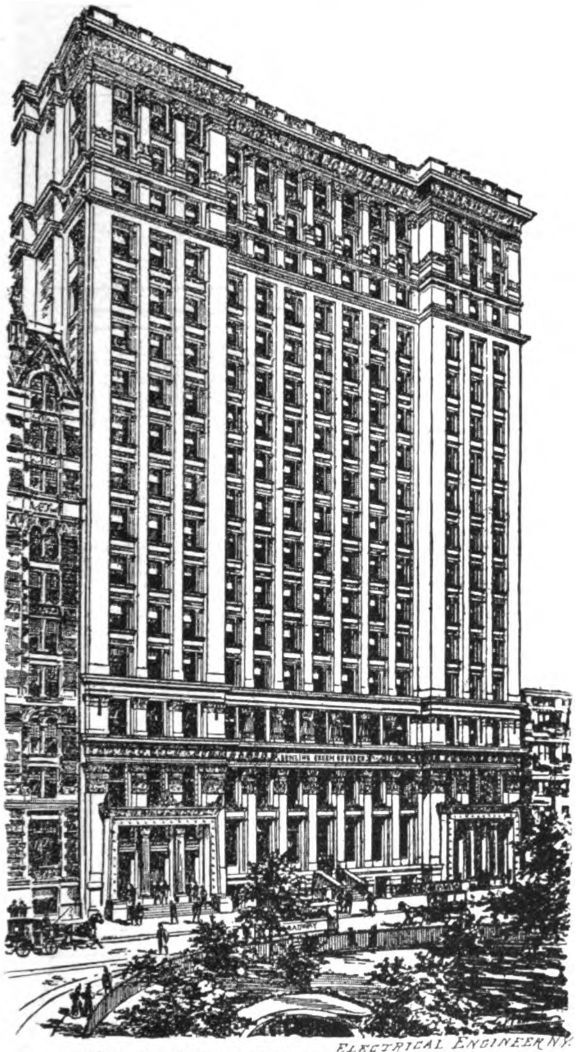

ELECTRICAL ENGINEER N.Y.

FIG. 3.—THE BOWLING GREEN BUILDING.

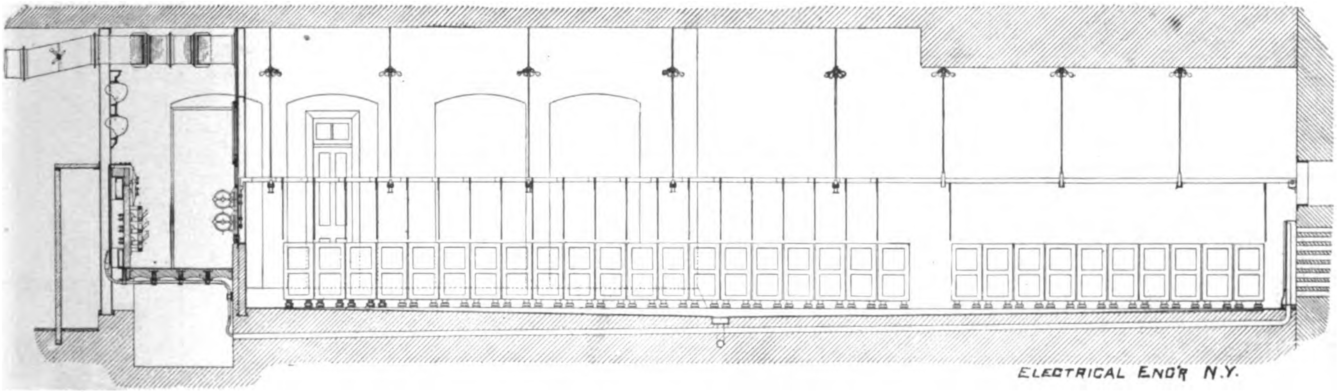


FIG. 5.—BATTERY AND OPERATING ROOM, BOWLING GREEN STORAGE BATTERY STATION. SECTIONAL SIDE VIEW.

It was considered necessary to thoroughly protect the two building columns, which project into the battery room at the south wall, and the base of each column was, therefore, in addition to the usual water-proofing, incased in a boxing of sheet lead one-quarter inch thick. This construction is shown in Fig. 4. Longitudinal drains through the battery room form depressions in the aisles between the battery cells and drain into small cesspools, constructed entirely of lead, which discharge into a 4-inch lead drain pipe, embedded in the floor.

THE BATTERY.

The battery proper consists of 150 cells, manufactured by the Electric Storage Battery Co., of Philadelphia. There are 75 cells on each side of the three-wire system, and each cell contains 14 "Manchester" positive and 15 "chloride" negative plates.

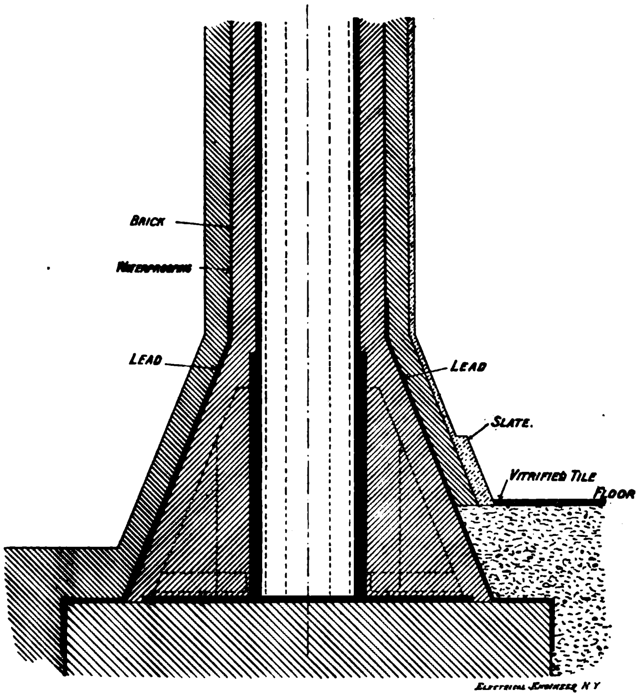


FIG. 4.—SECTION THROUGH BASE OF BUILDING COLUMN.

The guaranteed rate of discharge for one hour is 2,000 amperes per side; for three hours, 1,000 amperes per side, and for ten hours, 400 per side. The normal rate of charge is about 400 amperes per side.

There are 20 regulating cells at the end of the positive and negative sides of the battery series, each of which is separately connected to a block on the regulating switches, shown in detail in Fig. 7. Two regulating switches are connected in multiple on both the positive and negative sides, to permit of a discharge at two potentials, or to enable the battery to be charged and discharged at the same time. This arrangement is shown in Fig. 11. Each cell measures 40¾ inches in height, 21½ inches wide and 30½ inches long. The containing tank is made of poplar, and is lined with lead. Each tank is supported on four special petticoat porcelain insulators, resting on 6-inch vitrified tile.

Provision has been made in the arrangement of the cells to permit of the installation of a duplicate battery which can be placed over the present outfit.

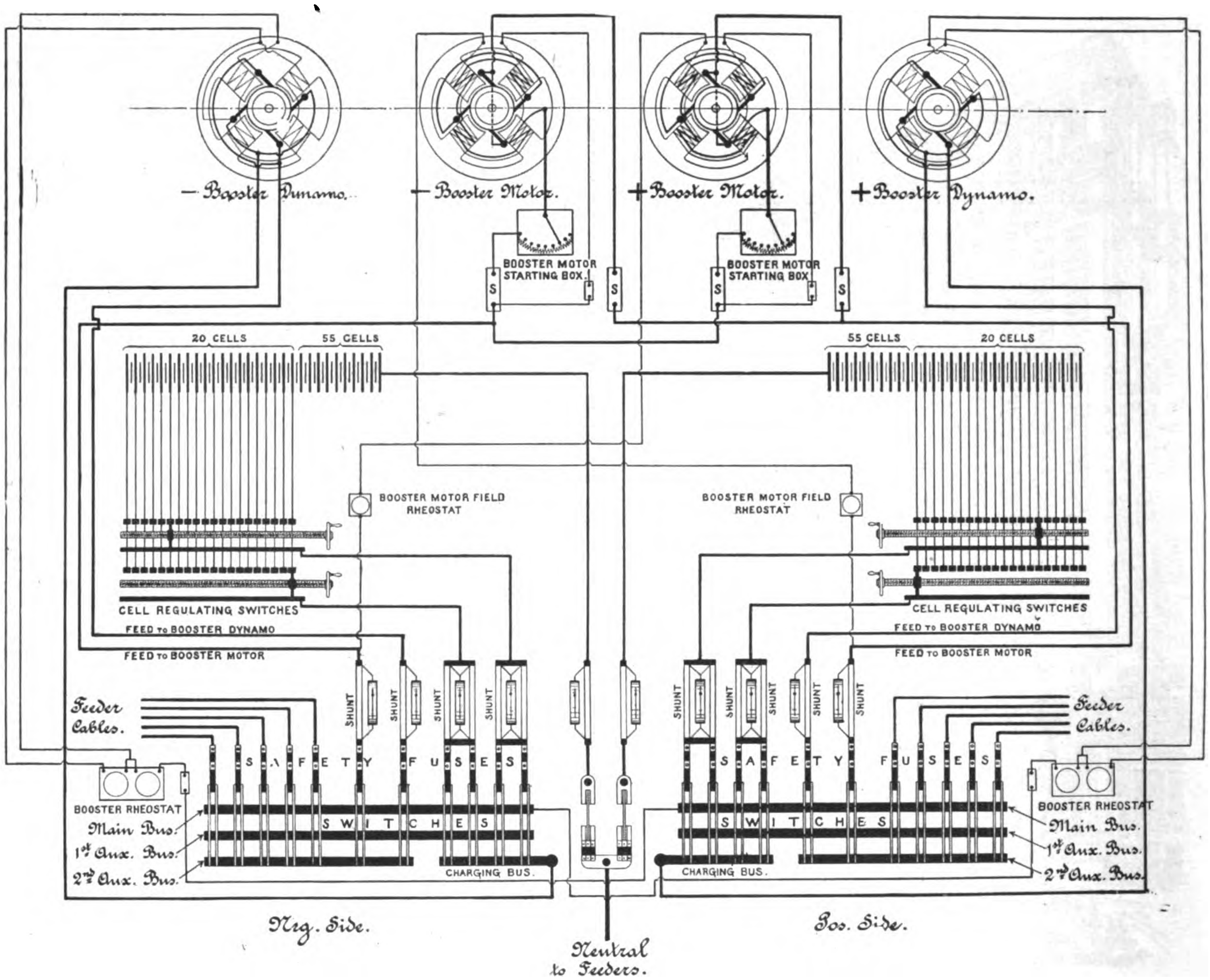


Fig. 6.—Battery, Booster and Feeder Connections, Bowling Green Storage Battery Station.

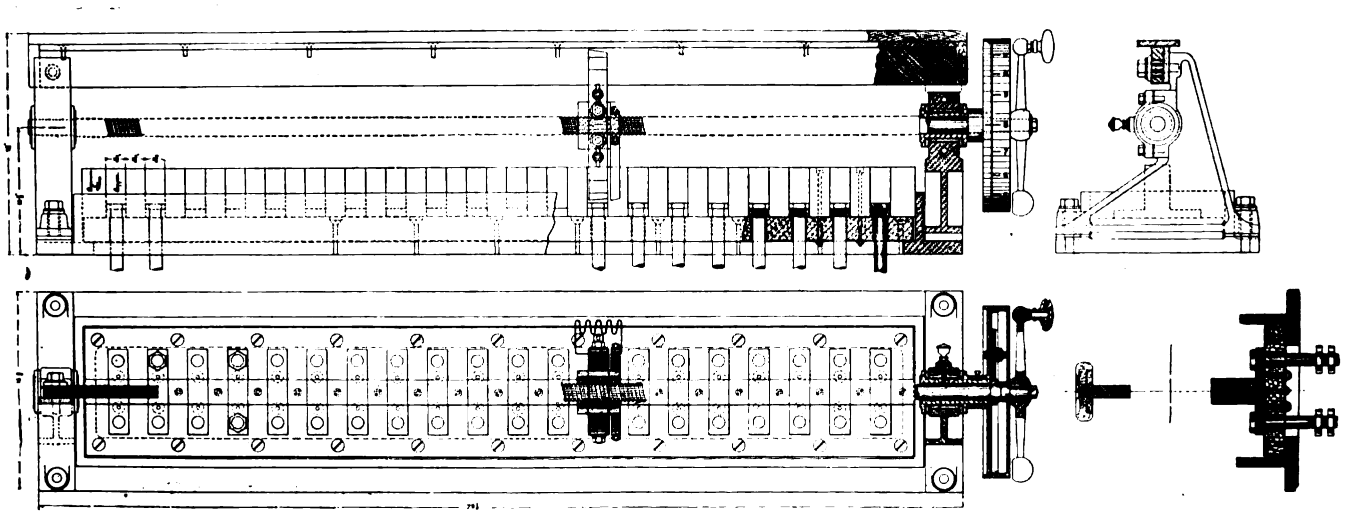


Fig. 7.—Cell-Regulating Switch, Bowling Green Storage Battery Station, New York.

The conductors between each set of cells and between the regulating cells and the cell regulating switches are all made of copper bars three inches wide by one-half inch thick. The area of all the joints is 18 square inches, and each connection is made by two seven-eighth-inch bolts, in preference to the common practice of employing a larger number of smaller bolts. These copper strips are supported on porcelain insulators, resting in hangers, or on horizontal iron beams extending across the room, as shown in the perspective view of the battery room, Fig. 1. The result has been a very symmetrical and substantial arrangement.

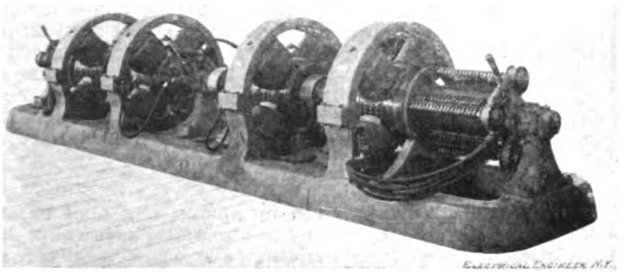


FIG. 8.—BOOSTER IN BOWLING GREEN STORAGE BATTERY STATION.

THE BOOSTER.

In one corner, at the north side, is a space partitioned off from the battery room which contains the booster outfit, with the necessary starting mechanism. The booster illustrated in Fig. 8 and shown on the plan, Fig. 2, is used to raise the e. m. f. of the charging current from the potential of current supplied to the installation to that required for charging the battery. The booster can be used also to raise the e. m. f. of discharge for feeding some distant point of the outside system at a higher initial pressure than would normally be required.

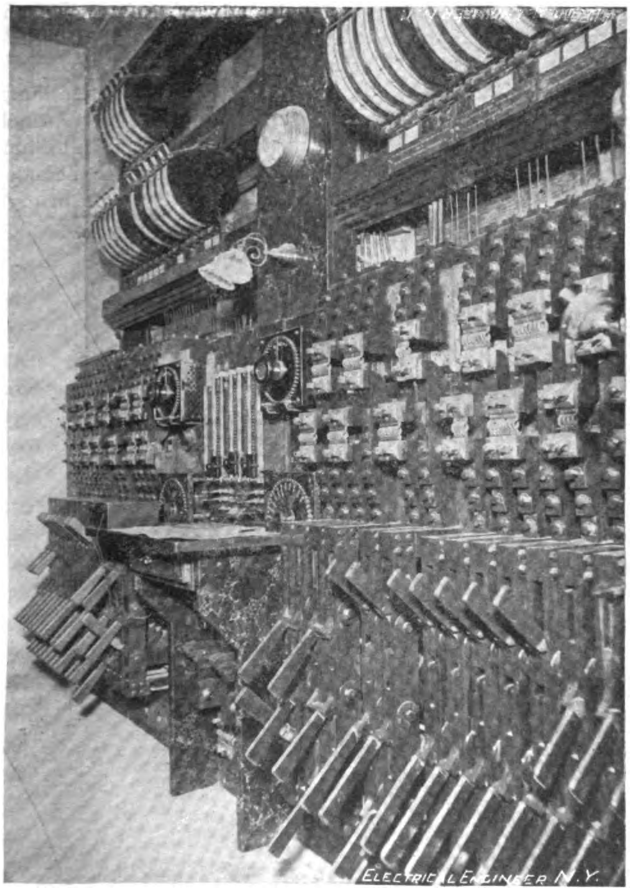


FIG. 9.—BATTERY, BOOSTER AND FEEDER SWITCHING AND INDICATING APPARATUS.

The booster outfit, built by the General Electric Co., consists of one positive and one negative dynamo, at each end of a common shaft, each capable of raising the e. m. f. of 1,200 amperes 60 volts. These boosting dynamos are driven by two 75 k. w., 240 volts, compound wound motors placed between the two dynamos, and so connected that either or both motors can be used at pleasure.

THE CONTROLLING ROOM.

At the rear of the battery room and adjoining the booster room is the controlling room, which contains, on the front wall, the four cell regulating switches, and on the rear wall the battery, booster and feeder switching and indicating apparatus.

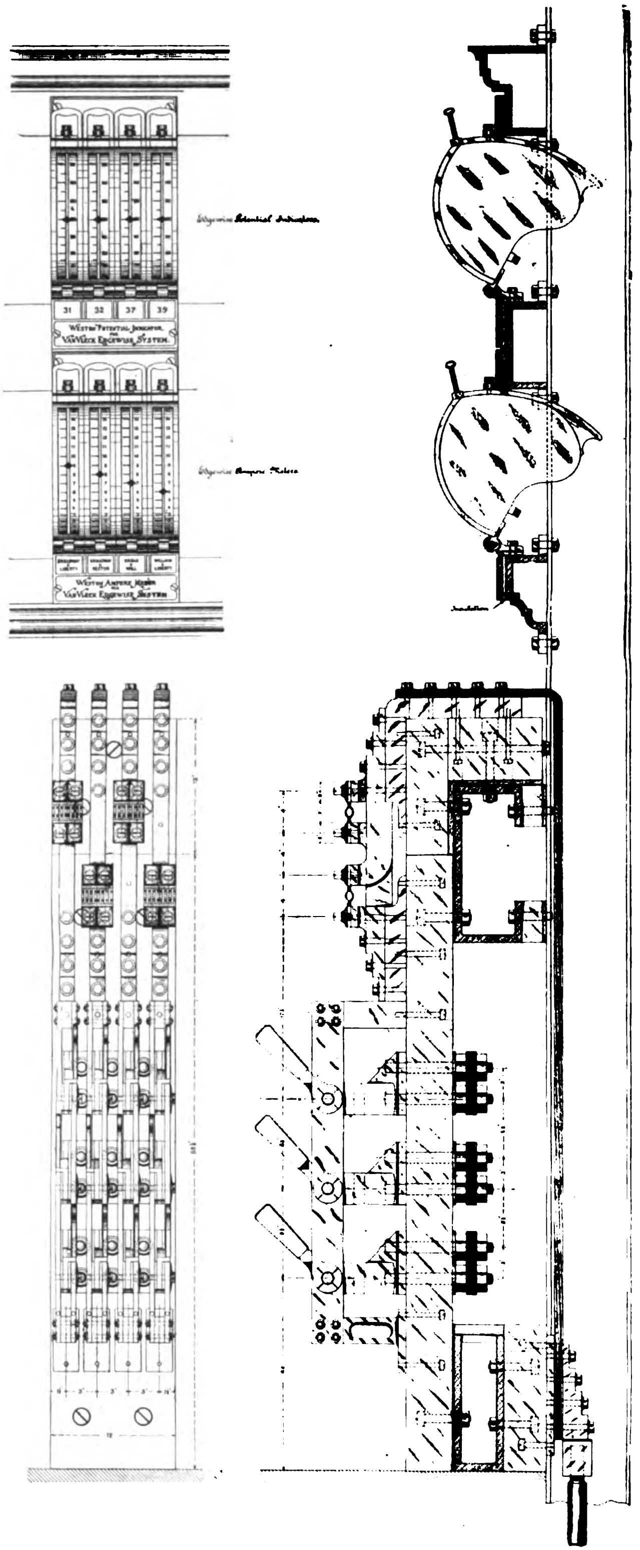


FIG. 10.—EDGEWISE FEEDER SWITCH AND INDICATING APPARATUS. FRONT AND SECTIONAL VIEW.

The general scheme of the battery, feeder and booster connections is shown in the diagram, Fig. 6, from which it will be seen that three main busses are employed, any one of which can be used to supply either the booster motors, the booster dynamos or any of the feeders, while the battery at the same time can be discharged on to either one of two busses, which arrangements permit of great flexibility in the operating of the plant. The cell regulating switches, of which there are four, embody several novel features, chief of which might be mentioned the movable dial adjacent to the operating handle, which indicates to the operator the particular end cell used on the charge or discharge. These dials are shown in the perspective, Fig. 11, and in the diagram, Fig. 7. Each regulating switch is of ample capacity to carry 1,500 amperes.

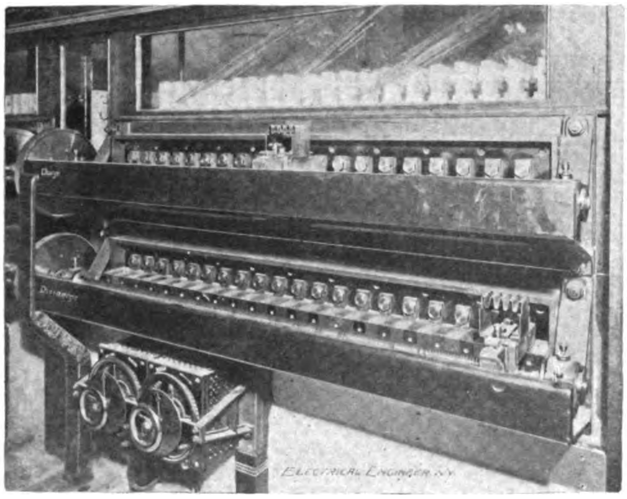


Fig. 11.—Cell Regulating Switches.

All of the positive and negative feeder, motor, booster and battery charge and discharge switches, with the volt and ampere indicating apparatus, located on the rear partition, are constructed on the Van Vleck edgewise system, which has resulted in a considerable saving of space, making the switchboard proper only 12 feet long, including the space required for a central desk. A front view and section of the apparatus for four 1,000 ampere feeders, occupying a width of 12 inches, is illustrated in Fig. 10, the switches and other apparatus for the attery and booster outfit, being exactly similar to the feeder apparatus. The engraving, Fig. 9, gives a clear view of the entire board. All of the circuits from the switches, with the exception of the feeder circuits, are provided with separate standardized copper shunts for the Weston ampere meters; while for the feeder circuits a portion of the cable has been used for this purpose. The connections between the switches and the feeder ends in the vault and to the booster outfit have been made with rubber-covered lead encased cable run through the tile ducts in the floor.

In addition to the feeder and battery controlling apparatus there is employed additional apparatus for the measuring of the potential at the feeder ends and of the battery cells and for the operating of the controllable junction boxes inserted in the trunk feeders running to the Duane street station, permiting the trunk feeders to be connected or disconnected at will from the underground street mains directly from the operating room. A general plan of the arrangement of cells, booster room, operating room, etc., is shown in Fig. 6. This shows the connection between the cells and connections from the end cells to the cell regulating switches.

VENTILATION.

The battery room is ventilated by means of a duct passing overhead through the operating room and discharging into the main smoke flue of the building. The ventilation through this duct can be assisted, when necessary, by means of a fan placed in the duct and operated by a one-quarter horse power motor external to the duct.

Though this battery station has been in operation barely a month, the results already obtained with it more than bear out the anticipations of the company, and it will very likely lead to the installation of other similar equipment as the demand for current in the outlying districts increases.

THE MACINTIRE ENCLOSED ARC LAMP.

In a brief note in our issue of February 24 we drew attention to the new departure in enclosed arc lamps effected by the International Arc Lamp Company, whose offices and works are situated at the corner of Houston and Mercer streets, New York.

The first installation of these lamps has been placed in the restaurant of J. Kamsler, at 713 Broadway, New York, and their appearance and effect are admirably shown in the accompanying engraving, Fig. 1.

As will be seen, the lighting is done by six Macintire lamps attached to the ceiling and projecting downward only 19 inches, of which 3 inches are taken up by the canopy. The bulb enclosing the arc is shaded from below by a regular incandescent lamp shade, while surrounding the bulb is a ring of crystal prisms carried by an ornamental canopy. The lamps take 80 volts and are run from the Edison mains. The resistance in circuit with each lamp is mounted on the switchboard and does not encumber the lamp as is usually the case. The entire effect of these lamps is highly artistic.

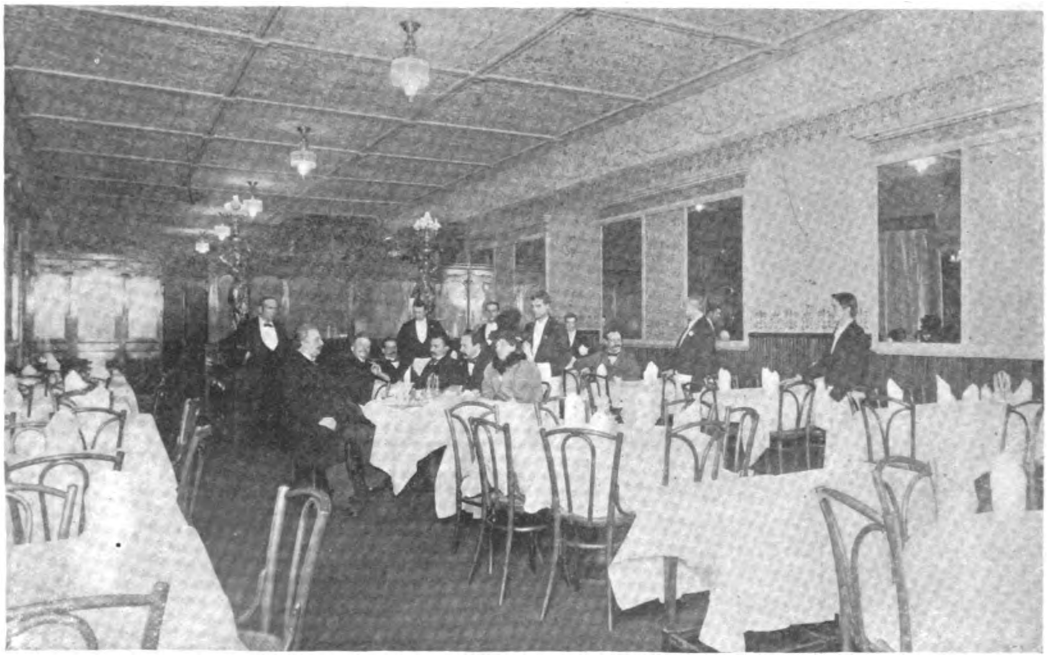
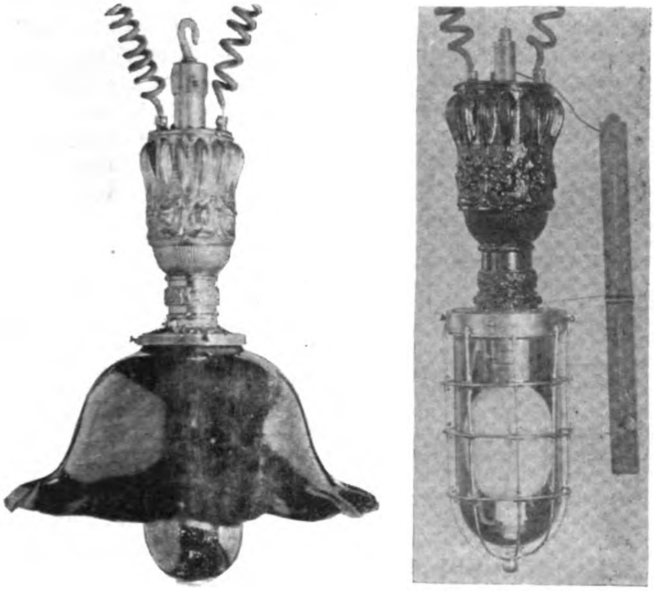


Fig. 1.—Macintire Enclosed Arc Lamp in New York Restaurant.

A good idea of the construction of the lamp will be had from the engraving, Fig. 2, which shows one style in an enlarged view, intended for interior illumination. The short length of the lamp adapts it particularly for the illumination of apartments, stores, etc., and especially for ship and marine lighting, where there is very little head room. The marine type of lamp is shown in Fig. 3, and, as will be seen, it occupies scarcely more space than an incandescent lamp. The bulb is protected by a grating and the lamp can be easily shifted from one position to another when necessary.



FIGS. 2 AND 3.—MACINTIRE ENCLOSED ARC LAMPS.

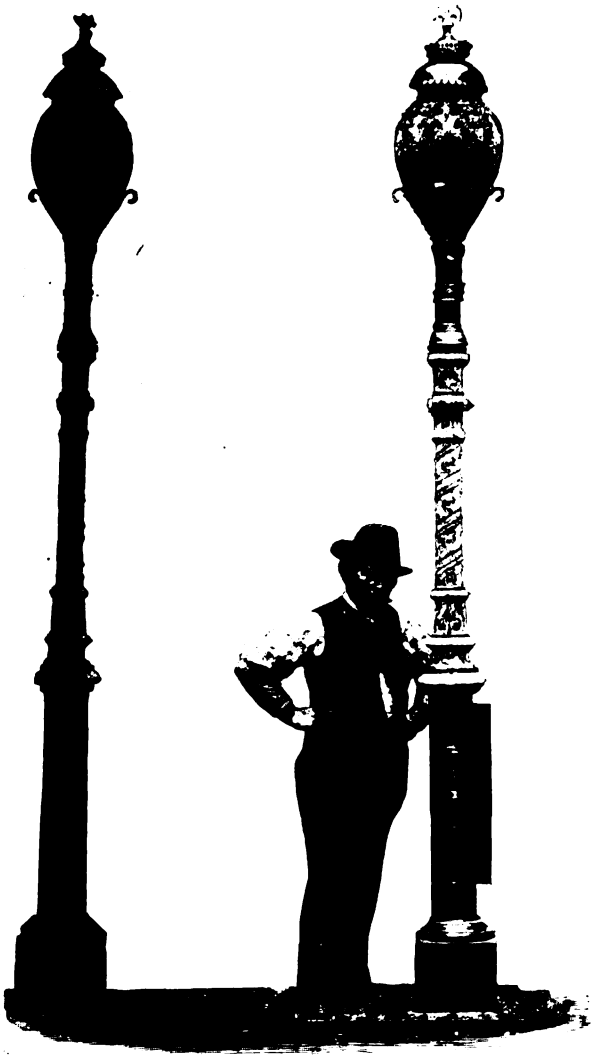


FIG. 4.—MACINTIRE STREET ARC LAMP POST.

In addition to the lamps for interior illumination, Mr. G. R. Macintire, the inventor, has designed a special type to be used in connection with a street lamp post. This is shown in the engraving, Fig. 4. The lamp is mounted on the top of the post, but the lamp mechanism is placed in the lower section near the ground and can be got at by opening a cover in the post, as shown in the post at the right. A slender rod connects the mechanism with the carbons in the bulb and regulates their position with the greatest nicety. Several of these highly ornamental Macintire lamp posts have been installed in this city. They lend themselves particularly to the illumination of the entrances of stores and public buildings, and for street illumination generally. There is little doubt that they will meet with appreciation by the lighting fraternity.

MISCELLANEOUS

FOREIGN DUTIES ON ELECTRIC MACHINERY AND LAMPS.

THE following statement, showing the rates of import duty leviable on dynamo-electric machinery and electric lamps in the principal European countries, has recently been prepared:

Countries and Tariff Classification.	Rates of Duty—United States Equivalents.
Austria-Hungary:	
Dynamo-electric machines	$1.23 per cwt.
Electric lamps	$12.37 per cwt.
Belgium:	
Dynamo-electric machinery—	
The duties are assimilated to those on machines and machinery of all kinds which are—	
Machinery of cast iron	19¼ cents per cwt.
Machinery of wrought iron or steel	39 cents per cwt.
Machinery of copper or other metal	$1.18 per cwt.
Electric lamps	10 per cent. ad valorem.
Bulgaria	10½ per cent. ad valorem.
Denmark:	
Dynamo-electric machines	57 cents per cwt.
France:	
Dynamo-electric machines weighing—	
5,000 kilograms and more, containing at least 50 per cent. of cast iron	$1.18 per cwt.
5,000 kilograms and more containing less than 50 per cent. of cast iron	$1.99 per cwt.
From 2,000 to 5,000 kilograms, containing at least 50 per cent. of cast iron	$1.78 per cwt.
From 2,000 to 5,000 kilograms, containing less than 50 per cent of cast iron	$1.99 per cwt.
From 1,000 to 2,000 kilograms	Do.
From 50 to 1,000 kilograms	$2.96 per cwt.
From 10 to 50 kilograms	$7.91 per cwt.
Conductors for dynamo-electric machines and detached pieces, such as metal coils, surrounded by insulated copper, worked parts of copper weighing less than 1 kilogram, numbered and marked, fitted together or not for electric machines weighing—	
More than 2,000 kilograms	$3.47 per cwt.
From 1,000 to 2,000 kilograms	$3.95 per cwt.
From 200 to 1,000 kilograms	$4.44 per cwt.
From 1 to 200 kilograms	$5.94 per cwt.
Less than 1 kilogram	$7.42 per cwt.
Electric lamps—	
Incandescent lamps of glass—	
With their mountings	$34.60 per cwt.
Not with mountings	$69.22 per cwt.
Arc lamp (regulators)	$5.94 per cwt.

Germany:	
Dynamo-electric machines (so far as they can not be described as "Lokomotiven" or "Lokomobilen")—	
Preponderating material being of cast iron	37 cents per cwt.
Preponderating material being of wrought iron	62 cents per cwt.
Preponderating material being of other common metal	98½ cents per cwt.
Electric lamps—	
Incandescent lamps of glass in conjunction with other materials so far as the same can not be classed as hardwares, etc., with the exception of cases in which platinum wire is used	$2.96 per cwt.
Electric arc lamps and other electric lamps	According to material of which composed.
Greece:	
Dynamo-electric machines	Free.
Electric lamps—	
If of glass	$7.69 per cwt.
If of plain porcelain	$3.89 per cwt.
If of porcelain, inlaid, colored, or gilt	$15.57 per cwt.
Holland:	
Dynamo-electric machinery	Free.
Electric lamps and appliances for electric lighting not forming part of the machinery	5 per cent ad valorem.
Italy:	
Dynamo-electric machines—	
Weighing up to 1,000 kilograms	$2.47 per cwt.
Weighing more than 1,000 kilograms	$1.58 per cwt.
Detached part of dynamo-electric machines	$2.47 per cwt.
Electric lamps—	
Of bronze, brass, steel, or iron	$2.96 per cwt.
Norway:	
Dynamo-electric machines	Free.
Electric lamps—	
Portugal:	
Electric apparatus and machinery for whatever purpose	30 per cent. ad valorem.
Electric lamps—	
Roumania:	
Dynamo-electric machinery	Free.
Electric lamps	$4.94½ per cwt.
Russia:	
Dynamo-electric machines of all kinds	$3.34 per cwt.
Electric lamps	$14.34 per cwt.
Spain:	
Dynamo-electric machines	$1.82 per cwt.
Electric lamps, chargeable as ordinary lamps, according to material of which composed, as follows—	
Of copper	$12.17 per cwt.
Of cast iron	84 cents to $1.73 per cwt.
Of wrought iron	$2.96 to $3.57 per cwt.
Of tin plate	$4.95 per cwt.
Of other common metals	$3.71 to $4.44 per cwt.
Of glass and crystal	$4.95 to $10.88 per cwt.
Of earthenware	$3.71 to $11.84 per cwt.
Of porcelain	$5.19 to $11.06 per cwt.
Sweden:	
Dynamo-electric machinery	10 per cent. ad valorem.
Electric lamps	$20.60 per cwt.
Switzerland:	
Dynamo-electric machines	39 cents per cwt.
Electric lamps	59 cents per cwt.
Turkey	8 per cent. ad valorem.

BUFFALO proposes to have a special Niagara power celebration next August at the time of the Grand Army of the Republic Encampment. Mr. C. R. Huntley has hold of the electric end of it, and it is said that Mr. Tesla will probably furnish some original ideas for interesting electrical effects that will render the occasion memorable.

THE HÆMOGLOBIN CARBON CELL.

BY WILLARD E. CASE.

IN order to correct any false impression which may have arisen in consequence of the sensational articles which have appeared in the daily newspapers, I desire to say that the haemoglobin experiment, shown by me in the lecture delivered before the New York Electrical Society,[1] was simply done for the purpose of showing that blood absorbed oxygen and gave it up to reducing agents; then on exposure to air it would absorb more oxygen and give it up again, and so on. I did not have a haemoglobin cell present, as some of the sensational newspapers said. During the discussion I was asked by one of the members if haemoglobin would give a current, and I answered yes, as I had before determined. So I placed a piece of platinum and a piece of carbon as electrodes in the haemoglobin solution and showed the audience that the voltmeter was affected. Now, we all know that two dissimilar substances give an electromotive force, even in water, and I might say even in pure water. In this experiment there might have been some iron in the carbon. It will be borne in mind that it was during the discussion that this came out at the request of one of the members, though I had known the facts before, but preferred to say nothing about them, as I did not wish to be placed in the light of bringing out a new cell before I had more fully investigated it.

Immediately following the lecture, however, I set about to make a test, the results of which were as follows: (1) Carbon stick and platinum in the haemoglobin solution gave .06 volt. (2) Took the stick out and exposed it to air, and then tried again and got .07 volt. (3) Added potassium hydrate solution, and the highest e. m. f. obtained was .08 volt. (4) Platinum and animal charcoal gave 0.12 volt. (5) The potassium hydrate solution alone gives only about .01 to .02 volt.

This shows that the haemoglobin does act as a carrier of oxygen and oxidizes the carbon. Bubbling air through does not help the process; that is, the haemoglobin is so fully oxidized that an excess of air is of no value. Of course, when the haemoglobin becomes reduced, then it will absorb more oxygen from the air. With different forms of carbon we get different voltages. This haemoglobin solution, however, would not be of any practical use, as it decays in two or three days.

What I said in my lecture I adhere to and believe I can maintain, but I cannot be held responsible for the writings of unscientific reporters of the daily press.

ELECTRICITY AND ELECTRICAL ENGINEERING IN CHINA AND JAPAN.

BY R. VAN BERGEN.

THE building of the electric street railroad in Shanghai marks the inauguration of a new era for China. Her conservatism and reactionary principles have been steadily undermined for the past half century, but the spirit of self-preservation now impels her on the march to progress. The Japan-Chinese war woke up the sleepy mandarins, who had been taught that China was the Middle Kingdom and that all nations were naturally tributary to her; but Li Hung Chang's trip around the world has given the impetus necessary to open up immense natural resources and to inaugurate improvements.

Since his sojourn in the United States, the writer has been asked frequently about the opportunities in China and Japan for electrical engineers and for the sale of electrical apparatus. As to the last named country, the chances for both are exceedingly slim, and it would be wrong to advise a young man to go to the Mikado's Empire for the purpose of bettering his condition. Japan is still adhering to her old plan of sending out bright, industrious, young men to learn practically, as well as theoretically, whatever new discoveries are made. Scientific books as well as periodicals find earnest readers, and her colleges and universities are fully up to the times. She is gradually discharging such of the few foreign employés as are left, and wholly declines engaging any one but natives, except in very exceptional cases. After Americans had introduced electric lights and the telephone in Tokyo, native engineers have established similar plants in the large cities of the Empire, and, although the result was not always satisfactory in the beginning, they have overcome all difficulties, and now furnish a highly satisfactory service. While the Japanese decline to employ foreigners, they have also prohibited the use of foreign capital. Under the present treaty, foreigners cannot own real estate, except in the few square rods of the foreign concessions in the open ports, nor can they own shares in a Japanese enterprise. Even Japanese bonds are inalienable to foreigners. Hence the opportunities to invest capital are exceedingly slim. The above, strictly correct statement, will demonstrate satisfactorily that Japan offers no opportunity either for ambitious young men or for the trade.

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[1] The Elec. Eng., March 3.

It is quite another case in China. As is well-known, the Emperor is a mere figurehead, the real power being pretty evenly divided between Li Hung Chang, the Viceroy of Pe-chili, and Chang Chih Tung, the Viceroy of Hupeh. Some five years ago these rivals agreed that it was time to start improvements, but Li Hung Chang favored the introduction of foreign capital, whereas Chang Chih Tung believed in imitating the example of Japan. The latter, therefore, was sent to Nanking, and spent enormous sums of money in establishing railroad shops at Hankow, without any results. Li Hung Chang, upon his return, succeeded in convincing the privy council, not only of the immediate necessity of beginning improvements, but of enlisting foreign capital to carry them out. This capital is furnished, probably by Russian financiers, who keep an eye on future acquisition of territory. But the skill and ingenuity employed is American.

It is impossible to form a conception of the immensity of the Empire and of its resources, and since word has gone forth that improvements must be made, the anti-foreign feeling, always induced by the mandarins, is rapidly subsiding, if it has not wholly disappeared. The government is taking the initiative in introducing improvements. The palace of the late Empress Dowager was furnished with electric lights prior to her death, and it is rumored that the Yellow City, the residence of the Solitary Man, will soon be likewise provided. Li Hung Chang distinctly favors Americans. Aside from the goodwill he experienced here, he was acute enough to see that our inventions were the best, the ability of our engineers the greatest. And it must not be forgotten that for many years he has been on most intimate terms with a United States Consul of Tientsin, who resigned this office to accept the position of tutor to Li's favorite son, and who still occupies a position in Li's household.

There is, therefore, no small opening for American ingenuity and enterprise in China, and still it would scarcely be advisable to proceed there on speculation, unless one were provided with solid letters of introduction, and with the means to live, at least for a year. The passage to China is expensive, notwithstanding the number of steamboat lines plying between the Pacific coast and Shanghai.

That city is in reality a republic, the government being conducted by the municipal council, which is largely English. It is, however, the port where the first stop is made, and in the summer season, that is from March to October, steamers leave for Tientsin almost daily. This last named city, the residence of Li Hung Chang, is also the seat of government, so far as concessions or appointments are concerned, and as Li is easily accessible, and perfectly willing to listen to and entertain suggestions, the difficulty is fairly overcome when Tientsin is reached.

China, being a silver country, the cost of living is very moderate, hotels charging about $3 a day Mexican. Such is the rate in the Astor House in Tientsin, and in the Hotel des Colonies in Shanghai. But the best way by far would be to communicate by letter, either direct to Li Hung Chang, whose secretary and interpreter is sure to attend to the matter, or through the intervention of the United States Consul, or some American business house. Of the latter, the China and Japan Trading Company, whose headquarters are in this city, is the oldest and most influential. The time is propitious because, although England is alive to every commercial enterprise and her business houses have agents in every open port of China, the intended improvements are as yet only conceptions, although a beginning will be made shortly. The building of the railroad between Te-tschau and Pekin, a distance of 700 miles, will begin on the 13th of this month. The construction is in charge of American engineers. Other improvements, such as the building of the electric road between Shanghai and Woosung, a distance of 12 miles, will be initiated this year.

SUBWAY EXPLOSION IN BOSTON.

Owing to a bad leakage of gas into one of the subway excavations in Boston last week, a serious explosion occurred at the corner of Tremont and Boylston streets on March 4 about midday. No authentic explanation is given of the explosion, but it is said that it may have been due to the sparking of one of the street car motors that pass every second; but it was far more likely due to the dropping of a lighted match or cigar or cigarette. Complaints had been made during the morning of the gas leak, and just before the explosion people had been telephoning to the gas company. Be this as it may, one of the passing cars was blown in two, other adjacent vehicles were damaged, six people were killed outright and fifty were injured. Windows and stores in the vicinity were badly shattered, and it is feared that some of the foundations were shaken.

LETTERS TO THE EDITOR

POWER PLANT ENGINEERING ON STEAM RAILROADS.

I NOTICE in your issue of Feb. 24 a short article on "Electric Locomotion in New England," which contains some remarks made by the president of the N. Y., N. H. & H. R. R. before the Connecticut Legislature, opposing a proposed competing electric line.

That the N. Y., N. H. & H. R. R. Company are "deep" in the transition work of converting a great system from steam to electricity is apparent to all competent electrical engineers, and the railway company will find themselves "deeper" yet, unless they change their methods. It is also apparent that much of their work is in truth "experimental." It does seem to an outside engineer that a powerful corporation, which can command, if it will, the best electrical and steam engineering talent in the world should actually retard the progress of the larger and more important electric railway work, while professing to advance it. In many ways the Nantasket construction is very crude compared with overhead construction of five years ago. The engineers of the railway company have claimed that the overhead trolley is not satisfactory for heavy loads and high speeds, judging from their Nantasket experience. It will, I think, be admitted by all competent engineers that this is largely due to the faulty construction and that it is possible to operate, at as high a rate of speed and with as heavy loads, by means of a properly constructed overhead trolley system.

These railway engineers then advocated a third rail and installed a considerable length of it, but they have it alive continuously for its entire length, a source of leakage in bad weather and a danger at all times.

Moreover, in their power stations this railway company have installed the tubular or older form of boiler in numerous small units, instead of rapid steaming modern safety boilers, in a few large units, and operating at a high pressure. Modern engineering skill and observation has long ago proved the economy and wisdom of the latter type and yet, even in the latest station of the N. Y., N. H. & H. R. R. Company, now being completed at New Britain, the boiler plant is to consist of ten comparatively small units! Furthermore, the same company are installing in their new passenger depots this same tubular boiler for heat and power, instead of safety sectional boilers, although scarcely a day passes without a fatal explosion of one or more tubular boilers occurring in some part of the country.

These points of retrogression can be multiplied, but I do not wish to take up your valuable space with further criticism of the engineering skill of President Clark's advisers. I will conclude with the hope, which must be shared by many other and more competent engineers than myself, that the N. Y., N. H. & H. R. R. Company may speedily awake to the fact that they are behind the times and should "hustle," not only to keep up with the procession, but to be at the head of it.

"ELECTRICAL ENGINEER."

New York, Feb. 27, 1897.

MENTAL ACTION AND THE ETHER.

In regard to the subject matter of your editorial on Prof. Crookes and brain waves, it is very improbable, as I pointed out long ago, that brain action is unaccompanied by wave disturbances in the ether. It is only a question as to their intensity and capability of awakening thought in a recipient brain. This, as I understand it, is the real question at issue; not whether there be brain waves, but whether they be capable of accounting for the phenomena of telepathy. I still see no reason to change my opinion as to the possibility of this action.

EDWIN J. HOUSTON.

Philadelphia, March 3, 1897.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription
United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, MARCH 10, 1897. No. 462.

" ACCIDENTS. "

EVER since electrical distribution on a large scale came into vogue a noteworthy proportion of the loss of life and property which has followed its introduction has been ascribed to "accident," that conscience-easing term which has been so much abused in the past. That there may be accidents in the true sense of the word, we do not propose to deny, but the time has gone by when the destruction of an entire central station ought to be ascribable to any cause short of an earthquake. And yet an "accident" due to gross carelessness initially, is given as the cause for the total destruction by fire of the Mount Vernon street power house of the Philadelphia Traction Company.

According to newspaper reports the primary cause of the "accident" which led to the destruction of the station was the fouling of the chain of a traveling crane with one of the running dynamos. We can very well see how such an accident, or rather such gross carelessness, might have been followed by the wrecking of the machine interfered with, but we confess our inability to conceive the combination of circumstances which led to the disaster that followed. Given that the dynamo in question had been short circuited, the safety devices provided for just such emergencies ought to have been adequate to take care of the abnormal load. If it be argued that it was not a case of inoperativeness of safety devices, but the throwing around of molten metal on the oil-soaked floors that resulted in the conflagration, then still less does this constitute, in our estimation, a valid excuse. The management of a central station which allows oil to accumulate on its wooden floors in these days of cheap concentrated lye, is either incompetent or worse. Besides, a wooden floor is bad engineering, to begin with. It is just such incidents as these that are apt to set at naught all the ingenuity and care bestowed on his work by the electrical engineer. We trust that for the benefit of the entire fraternity the Philadelphia disaster may be thoroughly investigated, and the blame fastened where it belongs.

Another so-called "accident," which resulted in fearful loss of life, was the gas explosion over the new Boston subway last week. This is asserted to have been caused by ignition, due to a spark from an electric car passing over the subway; but it is evident that a lighted cigar stump might be equally accountable for the result. Granted that it was due to an electric spark, the fact that a leakage of gas had been detected some time before the accident, and the gas company urgently notified of the fact, makes it unfair to lay the blame in any way upon electricity, which is now the general practice when no other cause can be readily assigned to account for mysterious fires and explosions, such as the one referred to. We hope that Mayor Quincy will carry out his proposed idea of instituting a rigid investigation of this deplorable "accident."

A GENERAL LAMP TESTING BUREAU.

A SHORT time ago in commenting upon the steps which had been taken in Germany towards the establishment of a bureau for testing incandescent lamps, organized for the benefit of central stations and other consumers of lamps, we drew attention to the advisability of establishing a similar bureau in the United States, where such an institution would evidently be of far-reaching importance, in view of the enormous development which electric lighting has attained in this country. A proposition of this nature seems so natural that it is strange some action has not been taken before this in the matter; but we are glad to know that active plans are under way, looking towards the establishment of such a bureau, and that President Nicholls, of the National Electric Light Association, has taken up the matter with characteristic energy. In his third interim report to the National Electric Light Association, which we print on another page, will be found the preliminary plan for such a bureau, which ought to command the immediate attention of all users of incandescent lamps. The plan being merely tentative, the actual tests to which lamps should conform are not given, but these will not be difficult to fix when the time for actual consummation of the plan arrives. In looking over the plan we notice that the manufacturer is subjected to penalties for deficiency in the quality of his products, which is quite proper; but no provision is made for compensating the manufacturer for qualities in his lamp exceeding the required standards. In this respect the present plan differs from the German, in which the manufacturer receives a bonus commensurate with the excess above the standard. Whether or not such a bonus is expedient is a matter which may well be open to debate, but it seems to us that it would be an eminently fair arrangement, and we see no way in which it could work any hardship, as the consumer would in every such case be getting the full value of his money. It is not generally known, but we understand that a bureau of this nature is now in actual operation, carried on by a certain number of central stations in the United States, and that its work has proved eminently satisfactory to all concerned, including both the manufacturer and the user. We can see where great benefits will accrue to the entire art from the work of such a bureau established by the National Electric Light Association, and trust that no efforts will be spared to bring about its early establishment.

CONDUIT TRACTION IN NEW YORK.

THE Metropolitan Traction Company has now confirmed the announcement of its decision to adopt electricity on several of its lines. Out of 165 miles of road it will have 43 operated electrically, and the method will be, as stated, that of the underground conduit. Mr. J. D. Crimmins, speaking for the company, says that the cost of running a car one mile, including everything but the fixed charges on the investment is, with electricity, 9 to 9½ cents; with compressed air, 12 to 14 cents, and with the cable about 18 cents. He intimated, therefore, that even the present cable systems of the company would have to go. A curious misapprehension appears to exist in some quarters as to the effect of the underground system on adjacent gas and water pipes. Because, such pipes sometimes go, with badly handled trolley systems, it is inferred that the results must be inevitable, and worse, when both wires are under the surface and near the pipes. The public is already learning, however, that from the very nature of things the underground system is safe company for the neighboring pipes. It may be expected that in its new work the Metropolitan Company will improve upon its Lenox avenue line. Repairs have been quite frequent and costly. Moreover, it may be expected that no further trial will be made of brick paving around the tracks. The condition of this paving on the Lenox avenue line, although the road is still so new, is pitiable. It may fairly be described as a sad ruin.

WITH THE opening of spring weather, the bicyclists are beginning to make their appearance in great numbers and it is noticeable that a good many of them appear to be furnished with electric lamps. The old oil lamp is still far from satisfactory, and there would seem to be a good market here for electricians to work up, especially for those who are in touch, as many of them are, with the bicycle trade. Some of the lamps on the market this season strike one as practical and successful.

ROENTGEN RAYS

THE EFFECT OF X-RAYS ON THE HAIR.

BY FREDERICK S. KOLLE, M. D.

DAILY, the reports of the pathological conditions caused by exposure to the Röntgen rays, meet the eye; in fact, there is much smoke and but little fire. The usual reports refer to dermatitis, an inflammatory condition of the skin, resembling sunburn, which is readily overcome by judicious treatment, but differing somewhat in its stubborn nature to be influenced by such remedies as readily bring about a recovery of a dermatitis when due to other causes.

Another peculiar result is the falling out of the hair about the face or head, when exposed to the rays. I wish to present a typical case of the latter, which is not only of interest, but of considerable value to the radiographer, who may at any time be threatened with legal proceedings to recover damages for such injuries, which are but temporary and where recovery is complete.

The patient was a boy thirteen years of age. Through my earnest wish, expressed to his parents, I was permitted to make a radiogram of his entire body, on my assuring them that no harm would come to him. The same boy had sat for some of the pictures exhibited by me at the National Electrical Exhibition in New York in May, 1896. He came to my laboratory during the week of Oct. 19 to 24, 1896, and on Oct. 21 I made a radiogram of his head. The exposure was one of forty minutes, made in the usual way, with a Thomson double focus tube. The distance between the tube and skull was about 18 inches, as I passed an 18-inch desk rule between the tube and head at the time with perfect ease. He slept during the entire time of the exposure, and I had to tap him on the head to arouse him, and he was surprised to find that the whole time had flown by. This was the only radiogram made that day, and as I obtained such a good result, it was not necessary to make another of the skull.

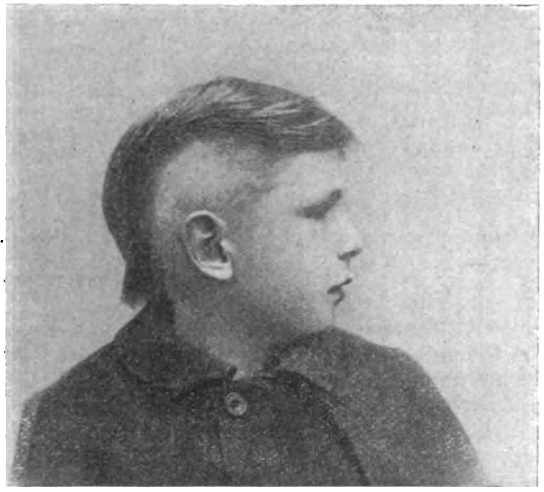


FIG. 1.—APPEARANCE OF BOY, NOV. 9, 1896.

The radiogram of the entire body was completed in the four sections necessary, and my little friend disappeared, until, on Nov. 9, when he came to my office and showed me his head, where, to my great displeasure I saw a large area of hair missing from the side of the head exposed to the vacuum tube, as shown by the illustration, Fig. 1, which is a reproduction of a photograph made on that day.

The boy gave no history of pain, itching or other signs of inflammation. All he knew is that, on the night previous the hair had suddenly fallen out. The depilated area corresponds to the side of the head exposed to the tube, and as another such case had been reported in Chicago, I came to the conclusion that this was a similar case; that the depilatory cause was none other than this unknown force, emanating from a charged vacuum tube. A peculiar fact to be noted is that the hair all fell out at once. The integument or scalp appeared bald, somewhat elevated and slightly œdematous. There was no redness; sensibility was not impaired, the bald patch was regular, and scaling was absent.

His hair was cut, and stimulating and hygienic treatment was at once commenced. The œdema, or watery condition disappeared in a few days and fine, downy hairs began to show themselves. These were again cut when they had reached a length of one-eighth of an inch.

It seems to me that it would be well to treat the area exposed to the rays at once after long exposure, say 35 to 40 minutes, at least, hygienically, with the hope of stimulating the nerve or follicle to nourish its individual hair, whatever the cause of the alopecia or baldness may be. The head should be washed once a week for a time and thoroughly dried and daily a non-irritating oil should be used containing tincture of nux vomica, half a drachm to the ounce, or tincture of cantharides, one drachm to two ounces of the oil, adding a little oil of lavendula, to cover the oily odor. Soap should, by all means, be avoided, unless the hair is thoroughly dried after its use and the above oil used.

This treatment was continued quite regularly up to the present time. The new hair, having been cut three times, was allowed to grow thereafter, and is now (March 2) about three-fourths of an inch long, as shown in Fig. 2. The new hair is of a somewhat lighter color than the hair of the head not affected, owing to a lack of pigment; but I notice that it is daily growing darker, being most marked about the roots of the hair. The shaft of the individual and new hair is not as strong as the old hair, but I find here and there strong hair interspersed about the area of new growth.

I beg to demonstrate by describing this case that the nerves of the follicles and the minute blood-vessels supplying the hair are not destroyed by the rays as has been supposed heretofore, and therein the action of the rays differ from the depilatory action of the direct electrical current, where the entire follicle is destroyed. The same treatment, as is herein described, can be employed in the treatment of alopecia about the face, where the hair has fallen out as a result of exposure to the X-rays usually occurring to the operator himself.

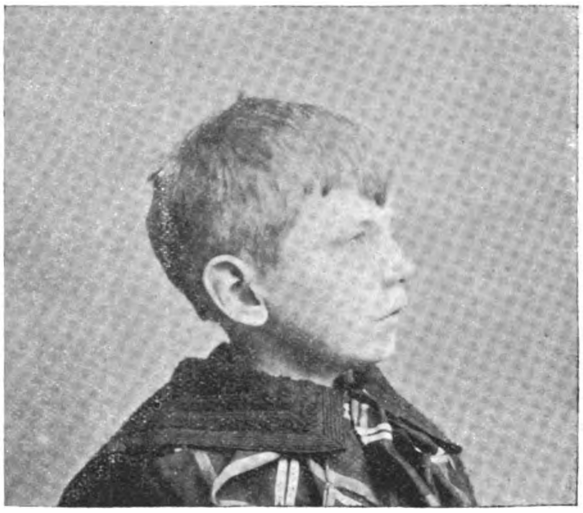


FIG. 2.—APPEARANCE OF BOY, MARCH 2, 1897.

I may here mention that, although I have made over thirty radiograms of the human head, where the exposures varied from 32 to 60 minutes, no symptoms of baldness resulted, as in this case, although the age and the fineness of the boy's hair may have been an important factor in bringing about the result shown.

LENARD AND ROENTGEN RAYS.

BY EDWARD P. THOMPSON.

THE contents of a communication received by the writer from Dr. Philip Lenard of Heidelberg, may be of interest as shedding some light on the relations between Lenard and Röntgen rays. The communication was called forth by my treatment of the external radiations from a discharge tube (Crookes tube), and especially my discussion of his own researches, which were originally published in several foreign proceedings of societies, and in foreign languages, some of them being published by Berlin Akad. Jan. 15, '93, Wied. Ann. Jan. '94, Vol. LVI, p. 225. Wied. Ann. Vol. LI., p. 259, and papers and articles of 1895 and 1896. Translations of these and other papers, discussions of Lenard's results by other investigators, and Lenard's latest theories, were considered in my own language under about twenty headings, setting forth in a classified manner the various facts, principles, and theories relating to external cathode (or Lenard) rays, in the book, "Röntgen Rays, and Phenomena of the Anode and Cathode."

Dr. Lenard, in stating that "We agree in all you have said on my experiments in the text of your book," discloses succinctly his present valued opinions on three points in this English letter. One of his remarks seems to indicate that he does not agree in all points with Prof. Röntgen.

In my book, I stated: "A remarkable occurrence was the accomplishment of the discharge at a much greater distance than that at which phosphorescence was exhibited. See also experiments of Röntgen, who suggested that Lenard had to do with X-rays in his experiment, but thought they were cathode rays. The maximum distance for the discharge was 30 cm., measured normally to the aluminum window. He (Lenard) admitted that the experiment was not carried far enough to know whether the effect was due to the action of the cathode rays upon the surrounding air, or upon the plate." The above related experiments were performed, it should be remembered, before Röntgen 's discoveries. Dr. Lenard now says, as stated in the letter referred to: "I do not think the electric (discharging) actions at a great distance from the window of my apparatus due to Röntgen rays, because I have convinced myself in the meantime that these latter rays are only present in minute traces, and that there is another explanation of the fact observed. The air is made conducting by the deflectible cathode rays near the window, and afterwards extends to part further apart, whilst retaining its conducting property."

As to the next point, I went so far in the matter of the variety of rays as to head one paragraph, "Cathode Rays of Various Kinds Are Variably Diffused." As intimated in his early papers, Lenard still reasons in the present open letter that there are "Rays of an unbroken series of an infinitely great number of different rays, varying gradually in properties."

Lenard has generally been misunderstood regarding the magnetic deflection of cathode rays, outside of the discharge tube. Dr. Lenard makes this point very clear. The book states on p. 66: "The author could not find in Lenard's papers, any positive or negative proofs that he had actually deflected the external cathode rays by a magnet, while passing through air or gas at ordinary pressures. * * * Dr. Lodge, who briefly reviewed Lenard's experiments, expressed the same opinion. See Elec. Lond. Jan. 31, 1896, p. 439."

Dr. Lenard modifies this by saying: "I have effected the deflection in hydrogen. The deflection is not visible in air of ordinary pressure, only because such air is too turbid to show any distinct rays at all, which could be distinctly observed at sufficient length to show deflectibility."

LITERATURE

THEORY AND CALCULATION OF ALTERNATING CURRENT PHENOMENA.—By C. P. Steinmetz, with the assistance of Ernst J. Berg. New York, 1897. W. J. Johnston & Co. 431 pp., 6 x 9 in. Cloth. Price, $2.50.

Those who have followed Mr. Steinmetz's work, especially in the field of magnetism and applied alternating current phenomena, will be glad to know that he has put himself on record in a formal way. This is a special cause for congratulation, because Mr. Steinmetz possesses in an eminent degree the faculty of a teacher. But in saying this we do not wish to lead any one astray by the belief that this work will enable the casual reader to avail himself of all of Mr. Steinmetz's knowledge. As here embodied, the work is by no means intended for beginners. Indeed it requires no little preparation to enable one to extract from it the large mass of useful and practical information which it contains; but for those equipped properly such as the graduates of our technical colleges ought to be, it offers a mine of information.

The author treats in detail the principal actions met with in alternating current work, both electrically and magnetically, and shows how these various phenomena affect the calculations of the designs, not only of electric machinery, but the external transmission lines. The work includes the treatment of the single phase as well as the various polyphase systems, and a number of appendices, among them one on oscillating currents.

There is no factor which may enter into the design of alternating current apparatus with transformers or machines that Mr. Steinmetz has not covered, and the experience which he has himself had in this direction has been largely drawn upon to furnish the material which he treats of. As stated above some mathematical knowledge is required to get a full appreciation of the work, but the numerous graphical methods employed by Mr. Steinmetz will, nevertheless, make it of considerable value also to those who have only a slim mathematical equipment.

TELEPHONY AND TELEGRAPHY

THE NEW TELEPHONE EXCHANGE FOR NEW ORLEANS.

For some time past the facilities of the existing Bell Telephone Exchange at New Orleans have fallen short of the requirements, but steps have now been taken to remedy that by the erection of a new building which shall embody all that is latest and best in exchange construction and operation. By August 1 the company will move into its new home, which will be erected at the corner of Carondelet and Poydras streets, opposite the present exchange.

Work on the structure commenced immediately after Mardi Gras. The contract, which has caused quite a lively competition among builders from all sections of the country, has been awarded to the firm of Murdoch, Campbell & Co., of Chicago. The piling for the structure was laid some time ago, and it is considered strong enough to hold a building twice the size of the one contemplated. A cut of the building accompanies this article, and a glance at it will show that the new exchange is going to be one of architectural beauty.

GREAT SOUTHERN TELEPHONE AND TELEGRAPH CO.

New Telephone Exchange of Great Southern Bell Co., New Orleans, La.

As will be seen in the cut, the building will be five stories high and will occupy the entire vacant space at the corner of Carondelet and Poydras streets. The entire structure will be built of stone and iron, and will be fireproof throughout. Nothing conducive to the comforts of the large number of people employed by the company has been overlooked.

The entrance to the building will front on Carondelet street. It will be very ornamental in design, and will have a large vestibule finished in marble. There will be two other entrances on Carondelet street—one to the public telephone station and the other to the workshop. The rest of the ground floor will be a large store with an entrance on Poydras street, which will be used for rental purposes. In the rear southwest corner of the ground floor will be stationed the engine room for heat, generating power and pumping. In the rear of this room will be the cable shaft, extending from sub-conduits to the fourth floor for the purpose of carrying all cables and wires which enter the building. The estimated number of wires that will go up this shaft is ten thousand, which means five thousand subscribers on the metallic system.

The second floor will be devoted to office purposes, and when finished will present one of the neatest and best appointed counting rooms in the city. About two-thirds of the second floor will be sub-divided by handsome partitions, which, while leaving the entire counting room as one room, will give privacy to the various departments. The office of the president will be situated on the south side of the cable shaft. In the rear of this office a room will be set apart for the archives. Immediately in the rear of this will be the toilet rooms, which will be finished in marble and will be equipped with every modern improvement. Abutting this on the southwest corner will be the continuation of the second story cable shaft.

The third floor will be finished in one large room, which for the present will be considered a workshop and overflow department for general supplies. The southwest corner of the room will be later set aside as a division for the electricians and engineers.

The fourth floor will be the special feature of the building, as it is upon this floor that the more modern ideas will be introduced in the new switching plans to be provided. In selecting the building site the question of access and distribution of wires was quite an important factor. Coupled with this advantage the question of light and comfort of the large number of employés, necessarily required in the operating department, were quite material. This room will receive its light from three large arched windows and two single windows on the Carondelet street side, and the same number and same style of windows on the Poydras street side. The switchboard and modern apparatus which will be stationed on this floor will occupy nearly the entire room. In the rear south end of the floor space on this floor will be located a mezzanine floor that will include bath rooms, drying rooms and lockers. Immediately under this floor space will be an elaborate system of marble finished toilet rooms and a storage battery and power plant. On the southwest corner will be the lunch room, about fifteen by fifteen feet in size, which will be equipped with a novel heating apparatus. It will also contain a library and such additional details as will make the room an enjoyable one of recreation for the lady employés, who will be exclusively in charge of this floor in its various departments.

The whole work is being actively pushed by General Manager Fowler, whose long experience in the telephone field has given full knowledge of what is best to do and what methods are best to adopt.

NIAGARA POWER TRANSMISSION TELEPHONE SERVICE.

AN interesting special telephone service has been put in for use in connection with the Niagara Falls power transmission, so as to render possible at any time instantaneous communication between all parts of the network of power circuits. The telephone lines consist of two No. 12 hard drawn copper wires, strung all the way between the Cataract Company's power house and the office of the Buffalo General Electric Company in Buffalo. On this circuit one telephone is located in the office of Mr. C. R. Huntley, of the Buffalo Company, and a second one in the power house of the Buffalo Railway Company. These two telephones and one in the Cataract Company's power house, remain in circuit constantly. In addition to this "long-distance" service, the contractors, White-Crosby Company, have also erected fifty telephones along the line, placed half a mile apart and enclosed in cast iron boxes similar to those ordinarily containing police telephones in cities. These are so made that when the door of any one of the cases is opened, the telephone within is thrown into circuit. At other times, all these line instruments remain cut out. This method enables any one patrolling the line to go to the nearest telephone and call up either of the three instruments above referred to that are regularly in circuit. Thus the whole line is in touch with its extremities.

Supplementary to this, an ordinary metallic circuit system has been installed, a 50-drop switchboard being placed in the Cataract Company's power house at the Falls. The circuits to and from this connect up all the instruments in all the various establishments taking power from that plant. The telephonic apparatus was made by the Phœnix Interior Telephone Company, of New York City.

THE HAWAIIAN CABLE.

The United States Senate committee on naval affairs has recommended the incorporation in the Naval bill of Senator Lodge's proposition to appropriate $25,000 to take soundings for a telegraph cable between the Hawaiian Islands and Japan.

ELECTRIC TRANSPORTATION

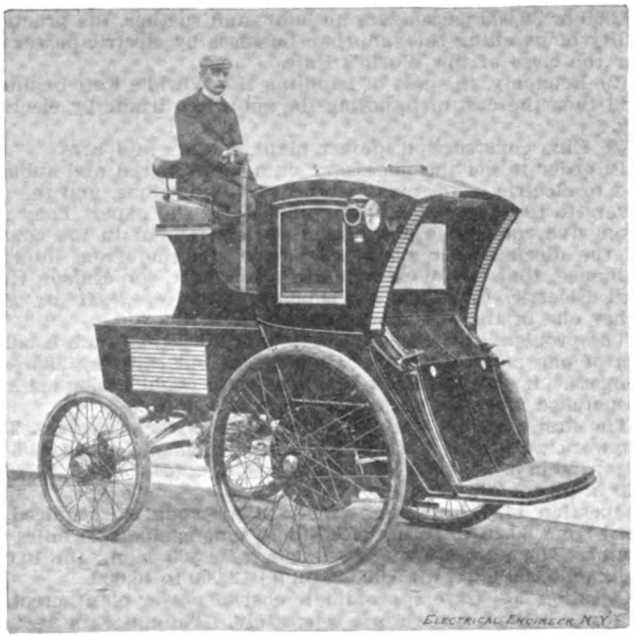
ELECTRIC HANSOM CABS IN NEW YORK CITY.

MUCH attention is now being attracted in this city by a number of electric hansom cabs. These vehicles have been built by the Electric Carriage and Wagon Company, who have installed a depot at 140 West Thirty-ninth street, close to the Edison station, whence the current for charging the batteries is now derived.

The accompanying engraving, made from a photograph, gives an accurate idea of the appearance of the cabs, which differ from the usual hansom in that they have four wheels instead of two, and an extension for the batteries. The batteries are contained in this rear compartment upon which the driver's seat is mounted, and consist of four sets of cells, weighing together about 1,000 pounds.

The steering is effected by a lever which the driver handles with his right hand, as shown in the engraving. With his left hand, he controls the current by operating a small hand wheel. The brake is operated by foot, as is also the whistle. Two motors of the Lundell type drive the front wheels by means of spur gearing.

All the wheels are provided with heavy pneumatic tires. The front pair are fixed, the cab being steered by the rear wheels. The rear axle is also fixed, but to permit of steering, the rear wheel hubs are hollow and are provided with ball joint journals, so that they move independently of the axle. The side lights are small incandescent lamps and a lamp is also provided on the inside of the cab.



ELECTRIC HANSOM CAB, NEW YORK.
(*From Photograph.*)

The cabs have a maximum speed of 15 miles per hour, which is found to be more than necessary to meet all the requirements of city and country travel, although in case a greater speed is called for it can be had up to a rate of 20 or 25 miles per hour, but, of course, only at the expense of the total distance which the vehicle can travel. The vehicles have a maximum mileage on one charge of battery of about 25 miles, depending largely on grades and surface conditions to be overcome.

The cost of operating, with properly equipped stations, is said to be about one-half that of horses. That is to say, assuming that on an average it costs about $1 per day to keep a horse, including the life of the horse, the cost of operating one of these vehicles capable of doing the same amount of work as a horse will not exceed 50 cents per day. As the size of the battery at present used only has a capacity of 8 horse-power hours, the cost of charging, where power is produced at the station, should not exceed 2 cents per horse-power hour, or 16 cents, and when obtained from central station 5 cents per horse-power hour, or 40 cents. To this, of course, must be added 10 per cent. depreciation per annum chargeable to battery renewal, etc.

One of these cabs is employed by Proctor's Theatre for advertising purposes and an electric delivery wagon built by the company will shortly be put in service by a large New York dry goods house.

WALLACE ON ELECTRICITY FOR SUBURBAN RAILWAY TRAFFIC.

At the last meeting of the American Society of Civil Engineers, there was presented a paper by Mr. Wallace, chief engineer of the Illinois Central, entitled "The Substitution of Electricity for Steam as a Motive Power for Suburban Traffic." It was a statement of the chief results of a very careful study made by Mr. Wallace in 1892 in the course of preparation for handling the World's Fair traffic between Van Buren street, and the Exposition grounds. The paper is not offered as a solution, even approximate, of this difficult problem; but the purpose is to place before the members of the society the facts as ascertained by that inquiry, with the hope of drawing out discussion, and other papers from experts in this special line of work. This matter of applying electric power to suburban service is again under consideration by the Illinois Central, and Mr. Wallace promises to give further information in a later paper or in the concluding discussion on the present paper.

He divided the problem into the questions of

(1) Practicability, covering the possibility of carrying 10,000 20,000 or 30,000 passengers an hour; and further, the practicability of handling the suburban business by electric power after the close of the World's Fair.

(2) Economy, the cost of handling the World's Fair business and then the cost of handling the suburban traffic by electricity.

(3) Line construction, power plant, motors and cars.

In order to get the necessary data he prepared and submitted to electric companies a series of 45 questions, and the answers to these questions are embodied in the paper. They are from five companies designated by letters; but in the course of the discussion a guess was made, judging from internal evidence, that (a)=Westinghouse, (b)=Short, (c)=Edison General Electric, (d)=Thomson-Houston and (e)=Daft or any other one of three or four companies.

The problem given was to haul 60 or 70 trains, each consisting of one motor car and two trailers, and carrying 336 passengers. It was assumed that one train could be loaded and dispatched from the terminal station each minute.

The first question was as to the horse-power of motors. The answers were: (a) Two of 75 h. p.; 150 h. p.; (b) two of 75 h. p.; 150 h. p.; (c) four of 50 h. p.; 200 h. p.; (d) four of 25 h. p.; 100 h. p.; (e) 200 h. p.

Question 14.—How much power plant would be required to haul from 60 to 70 trains of 65 to 70 tons each, at 20 miles an hour? The answers to these are: (a) 4,800 h. p.; (b) 10,000 h. p.; (c) 5,000 h. p.; (d) 5,000 h. p.; (e) 12,000 to 15,000.

Question 20.—Give approximate cost of power plant, erected, engines, boilers, generators, separately. The answers are: (a) $475,000, not including real estate, which is almost exactly $100 per horse-power. (b) $1,000,000, being $60 per horse-power for the steam plant and $40 for the electric plant. This includes the cost of building; (c) $320,000, or $65 per horse-power; (d) $455,000, or $91 per horse-power, including the cost of building. This is divided, building, $10 per horse-power; dynamos, $35; steam plant, $46; (e) $1,169,000 or $77 per horse-power, not including the building.

Question 21.—Give estimated cost for operating power plant with coal at $1 per ton. The answers are: (a) $60,000 per year, including fuel, labor and repairs; (b) $30 per horse-power, operating 18 hours a day or for 7,500 horse-power, a total of $225,000 a year; (c) Fuel cost $4 an hour, being 2 lbs. of coal per horse-power per hour; labor account $17 a day; (e) $420 a day of 12 hours.

Question 42 is, What will be the percentage of loss of power between the steam engine and the motor? This is estimated by (a) at 33 per cent.; by (b) and (c) at 50 per cent., and by (e) at 15 per cent.

Questions 36 and 37 ask, What time would be required to build and equip the plant, and whether the company would guarantee on its own specifications, at an agreed price, the successful installation and operation of the plant? The companies were willing to undertake to do the work in one year. (a) was willing to guarantee performance; (b) was willing to make a guarantee under heavy penalties; (c) would like a chance to try one train; (d) was willing to make a guarantee; (e) did not answer.

Question 5 was, What is the best method to transmit the power of the motor to the axle, by gear or by crank? To this (a) replied by placing the armature directly on the axle, or by steel gears. (b) was perfectly well satisfied that there was no method admissible but a gearless motor; that is, with the armature on the axle. (c) preferred cranks or parallel rods. (d) and (e) both recommended gears.

DESTRUCTION OF RAILWAY POWER HOUSE IN PHILADELPHIA.

Through some very extraordinary carelessness in the handling of a crane in the power house of the Union Traction Co., at Thirteenth and Mount Vernon streets, the whole plant was destroyed by fire on the night of March 3, throwing a large part of the system into confusion and delaying several lines of cars until current could be switched on from other sources. The power house in question was equipped with three Westinghouse generators of 2,000 horse-power and one which, it is said, was being worked over into a capacity of 2,500 horse-power. These were driven by Wetherell-Corliss engines. There were also five Westinghouse "Kodak" generating units of 600 horse-power each. In the boiler room there were sixteen boilers of 350 horse-power each. The whole plant and building were valued at about $500,000. It appears that in passing the crane over one of the large units, the hook was allowed to trail across the field and armature, causing a short circuit, which flung around red hot metal and insulation and set fire to the oil soaked wooden floor. The men in the station tried to extinguish the fire, but could not do so. The fires under the boilers were drawn with great difficulty, but the main steam pipe burst and the roar of the escaping steam added greatly to the confusion and alarm. The plant is reported to be fully insured.

THE TROLLEY STEAM FIGHT IN NEW ENGLAND.

The New England Railroad Company has practically withdrawn all opposition to the trolley line to New Britain. When the case is called in the Superior Court, before Judge F. B. Hall, the company will enter no appearance or consent to judgment against it. An agreement to this effect has been entered into, and the Newington Tramway Company and the Central Railway and Electric Company of New Britain will at once build the road. This agreement is made as the result of a compromise by which Section 8, the anti-paralleling clause, of the street railway law of 1895, is not to be disturbed by the General Assembly, but will remain on the statute book as a protection alike to the steam roads and the trolley lines.

STREET CAR FREIGHT SERVICE AT COLUMBUS, O.

The Columbus (O.) Central Street Railway Company will soon establish a freight service on the Westerville division of their lines between the city and the suburb of Westerville. It is the intention of the company to build a car especially designed for carrying freight. The new car will be about the same size of the ordinary cars now in use on the lines of the Central. The business will be handled somewhat after the manner of express business. The car will be placed on the spur at Town and High streets in charge of a man who will give a receipt for all goods turned over to him for transportation. The car will remain there during certain hours to be designated later and when the time comes for it to leave it will be attached to a regular Westerville motor car.

When the Westerville end of the line is reached the car will be left there for a certain length of time during which the goods can be unloaded and packages for Columbus will be received. The rate to be charged for handling freight has not yet been decided upon but it will undoubtedly be less than the express rate which is 25 cents for packages of less than 100 pounds. The number of trips to be made by the car each day will be as frequent as the business warrants, and if necessary additional freight cars will be built to accommodate the business. A service of this kind has long been desired by the people of Westerville, who are greatly pleased with the plan.

"VALUABLE."—The Electrical Engineer is a most reliable and valuable paper, for both young and old—educated and uneducated. We can recommend it as the most valuable journal treating on scientific electrical appliances.—Passaic (N. J.) Item.

SOCIETY & CLUB NOTES

LAMP TESTING BUREAU PROPOSED FOR THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

PRESIDENT NICHOLLS of the National Electric Light Association, has just issued his Interim Report No. 3, discussing a number of questions of considerable interest to the members.

Referring to the work of the Committee on Standard Lamp Socket, attention is called to the meeting held for the purpose as detailed in The Electrical Engineer at the time, and while progress has been made since then some unforeseen difficulties have arisen. At the last meeting of the National Board of Fire Underwriters the rule relating to sockets was amended as follows. "No portion of a lamp socket or lamp base, exposed to contact with outside objects, must be allowed to come into electrical contact with either of the conductors." The proposed standard base and socket would therefore have to conform to this rule.

The Committee on Data has tabulated valuable statistics which are now in the hands of the printer.

The Committee on Incandescent Lamp Standards reports the results of its conferences with the Units and Standards Committee of the American Institute of Electrical Engineers and the establishment of a standard method and apparatus for the measurement of candle-power has been satisfactorily settled, and it now only remains to produce secondary standards—that is, standard incandescent lamps to be used for purposes of comparison—and to draw up proper specifications for uniform rating of lamps and its ready verification.

President Nichols submits also a plan for establishing a lamp testing bureau which we give in full below:

PLANS FOR ESTABLISHING A LAMP-TESTING BUREAU

The proposed bureau to be in charge of an expert employed by the National Electric Light Association, and methods of testing to be approved by a majority of experts of lamp manufacturers, who agree to abide by decisions of the bureau as to quality of product and fulfillment of guarantees.

Any lamp company, whose lamps are being tested at the bureau, will be allowed at any time to investigate the methods used and the accuracy of standards, but to have no access to records of the bureau, except as regards tests which have been, or are being, made on their own product.

The expense of maintaining the Testing Bureau will be met by the income of the Bureau, as hereinafter provided, by certain definite charges for tests made, and could also probably be partially met by subscription or definite dues from central stations or other consumers, who would signify their intention of availing themselves during any year of the services of the bureau.

Lamp companies would be at liberty to guarantee their product at as high a standard of quality as they see fit, and the province of the bureau would be to determine whether such guarantees have or have not been fulfilled. Tests will be made by the bureau on guaranteed lamps furnished by any manufacturer, on application by the customer, the following conditions having been complied with:

1. Before test is made, the customer ordering the test should deposit with the bureau a sum equal to the estimated cost of such test at the following rates:

Initial tests or readings of lamps will be made at....cents per lamp. Tests will be made to determine the value of a lamp burned at its marked voltage at....cents per thousand watt hours.

Conditions under which tests will be made are as follows:

1. Not less than twenty lamps will be tested to determine the value of any given lot of lamps.

2. Where the value of any lot of lamps is to be determined, not less than two per cent. of the entire number whose value is to be determined are to be furnished the bureau for test in their individual unbroken packages (this would only necessitate the placing of a seal or label on the wrapper of each lamp in such a manner that it must be broken to unwrap the lamp) within thirty days after their receipt by the customer.

NOTE.—Where the number of lamps used in a year by the customer is comparatively small, so that a number of shipments from the manufacturer would be required in order that two per cent. of the entire number should equal twenty lamps, two per cent. of each shipment may be sent to the bureau within thirty days after each shipment, and the test not made or ordered by the customer until twenty lamps have been received by the bureau, provided that such test is ordered within one year from the receipt of the samples from the first shipment.

3. Where tests are requested to determine the value of the lamp by burning it at its marked voltage, an initial test will first be made on lamps furnished, which, as above provided, must represent not less than two per cent. of the lamps, the value of which is to be determined. One-half of these, which most nearly represent the average result obtained on the initial test, will be burned at their marked voltage until their value is determined, in accordance with the guarantee. Should any lamp be accidentally broken during the test, its place shall be taken by a reserve lamp, which, on initial test, most nearly represents the broken one. The average result obtained from the test of these samples determines the value of the lamps represented by the samples.

4. The results obtained by tests made by the bureau should, by agreement on the part of the lamp manufacturers and of customers who avail themselves of the services of the bureau be final, claims being settled in accordance with its findings, upon a definite basis agreed upon between manufacturer and customer.

In order that the proposed bureau shall be of value enough to entitle it to the support of lamp companies and their customers, a definite basis of value for a lamp should be determined by agreement between manufacturers and their customers who are to support the bureau. Though lamp companies should be at liberty to guarantee their product at as high a standard of quality as they see fit, the general lines on which such quality is to be determined should be agreed upon by all concerned. The following basis is, therefore, suggested:

1. The effective life of a lamp is to be considered as ending when the lamp reaches some certain percentage of its initial candle-power reading, the value of a lamp being determined by the candle hours given by burning the lamp at its marked voltage and taking readings of candle-power at intervals of 100 hours until the candle-power falls to....per cent. of its initial rated candle-power at the marked voltage; or should the lamp tested burn out before reaching....per cent. of its initial candle-power, it is credited with its actual performance.

Initial readings should be the secondary, and of small value compared to the actual performance of the lamp in service, though manufacturers should guarantee their lamp for an individual variation in candle-power of not to exceed....per cent., and an average variation of not to exceed.... per cent. Economy or watts should allow for an average variation of not to exceed....per cent.

2. The guarantee to the customer should provide that, where the customer requests a test made by the bureau, the cost of the test is to be paid, and certain penalties observed, as follows:

If an initial test only is requested, where one or more lamps are found outside the guaranteed initial range as to candle-power, the customer is entitled to a....per cent. reduction in price of lamps represented by the samples furnished the bureau. If average economy is found outside the guaranteed range, the customer is entitled to a....per cent. reduction. The cost of the above initial test is to be paid by the customer if the lamps are found inside the guarantee, and by the manufacturer if found outside.

Where tests are requested to determine the area, or candle hours, an initial test will first be made on lamps furnished, which, as hereinbefore provided, must represent not less than two per cent. of the lamps, the value of which is to be determined. One-half of these which most nearly represent the average result on initial test will be burned at their marked voltage, and the candle hours determined.

The average results obtained from the test of these samples determines the value of the lamps represented by the samples. Should the average candle hours, or area, fall below the guarantee not more than....per cent., the manufacturer shall only pay the cost of the test. Should the candle hours, or area, fall more than....per cent. and less than....per cent. below the guarantee, the customer is entitled to a....per cent. reduction in price of lamps represented by the lamps tested, and the manufacturer to pay the cost of the test. Should the average candle hours, or area, fall below the guarantee by more than....per cent. and less than....per cent., the customer is entitled to a....per cent. reduction in price of lamps, and the manufacturer to pay the cost of the test.

The above percentage of reduction, or penalty, to be continued in proportion until the customer obtains the lamps (no charge), the manufacturer paying the cost of the test.

Should the average candle hours, or area, be at or above the guarantee, the customer shall pay the cost of the test.

As above provided, where tests are requested by the customer, check should be sent to the bureau before the test is made, covering the estimated cost of the test.

Although not an important point, I believe it would greatly stimulate advance in quality of lamps, to the benefit of both consumer and reputable manufacturers, if every six months the average results of all tests made on the product of different manufacturers were published in the electrical journals, such results to separate various economies, and placing in different classes lamps of voltages from 45 to 60 volts, and lamps from 100 to 125 volts; also separate results on any test which might be made on lamps from 200 to 250 volts.

The following papers are announced to be read at the next convention:

W. Worth Bean, St. Joseph & Fort Benton Railway & Lighting Company, "Municipal Lighting"; J. B. Cahoon, Elmira Municipal Improvement Company, "Standardizing Prices for Incandescent Light and Power"; C. L. Edgar, Boston Edison Company, "Correct Method for Charging for Product"; W. S. Jewell, Toledo Traction Co., "Cost of Delivery of Current from Station to Customer"; T. C. Martin, Editor The Electrical Engineer, "The Daylight Work of Central Stations"; L. B. Stillwell, Cataract Construction Company, "Electrical Development at Niagara"; Prof. Elihu Thomson, Lynn, Mass., "Recent Progress in Arc Lighting"; J. G. White, White-Crosby Company, "The Niagara Power Transmission Line"; Prof. C. A. Wilson, Professor of Electrical Engineering at McGill University, Montreal, "The Induction Factor, a New Basis of Dynamo Calculation and Classification"; Arthur Wright, President Municipal Electrical Association, England, "The Profitable Extension of Central Stations."

INTERNATIONAL EXPOSITION IN BRUSSELS.

The International Exhibition, to be held in Brussels, will open on April 24 and close on Nov. 15. The section of science is expected to be especially rich in exhibits illustrative of the latest progress and the co-operation of many of the leading scientists in Europe has been secured. This section will be divided into three classes. Class A will cover mathematics, astronomy, physics and chemistry. Class 2 includes geology and geography, biology and anthropology. Class 3 will be devoted to bibliography. Transportation by the Belgian railways will be granted free of charge. Reductions on the charges for transportation will also be made by other Europeon railways. Persons desirous of exhibiting in the Class for Physics can obtain all necessary details by applying to M. E. Rousseau, professor at the University of Brussels, 20 Rue Vautier, Brussels, Belgium, or to the secretary, M. L. Gérard, professor at the University of Brussels, 6 Rue du Mèridien, Brussels, Belgium.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

As already announced by us, the National Electric Light Association has decided to hold its next, or twentieth, convention at Niagara Falls, N. Y., and June 8, 9 and 10 have now been selected as the time of meeting. The place is one of utmost interest to electricians, and a large attendance is expected.

TENNESSEE CENTENNIAL EXPOSITION.

New York State will erect a State Building at the Tennessee Exposition. The small appropriation renders it necessary to exercise much economy, and as it is desired to light it well by electricity and to make it cool during the hot weather by means of fans, it is suggested that some manufacturer willing to secure publicity in return for his liberality might be willing to supply a small plant run by steam or gas engine. An offer has already been made of electric light fixtures for the building. Mr. Algar M. Wheeler, secretary of the New York State Commission, may be addressed on the subject at his headquarters, Gilsey House, and 28 West Thirtieth street.

"FULL OF INFORMATION."

"I like your magazine," writes a subscriber in the Northwest, "for the reason that it is full of information about the common everyday business of a plant. We can never know too much about the coal we use, or about speed, belts, belt dressing, oils, treatment of dynamos and motors, lamps, wiring, etc. Many of your patrons are new to the business, and even the older ones are changing places. The abstruse part of electrical industries interests a good number of your readers, but the stations like to read of the daily doings and the common facts. The Data Sheets are good."

MECHANICAL

THE QUIMBY ELECTRIC SCREW PUMPS.

Few realize how much of the total power consumed in civilized communities is absorbed in pumping of one kind or another. Let alone steam power establishments of all kinds, modern domestic life and commerce have brought the pump into use in a variety of places not thought of or required twenty years ago.

Electric power has served to increase largely this use of pumps, for elevator, domestic, and other purposes, and one of the latest departures in this direction is the Quimby screw pump, built by Mr. William E. Quimby, of 59 Liberty street, New York.

The general form and construction of the Quimby screw pump is illustrated in Fig. 1. The four screws that act as pistons in propelling the water are mounted in pairs on parallel shafts and are so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides; the width of the face and the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in Fig. 2. Space enough is left between the screws and the cylinder, and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder and the endwise pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction.

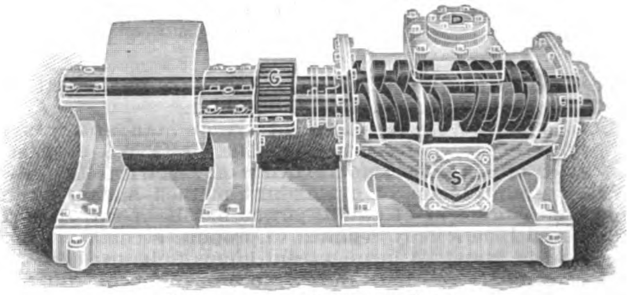


Fig. 1.—Quimby Screw Pump.

The suction connection is shown at S, Fig. 1, and opens into a chamber underneath the pump cylinder. The suction liquid passes through this chamber to the two ends of the cylinder and is forced from the two ends toward the center by the action of the two pairs of intermeshing threads; the discharge being in the middle of the top of the cylinder, as shown at D, and the second shaft is driven by means of a pair of gears. The power to drive the pump is applied to one of the shafts, shown at G in Fig. 1.

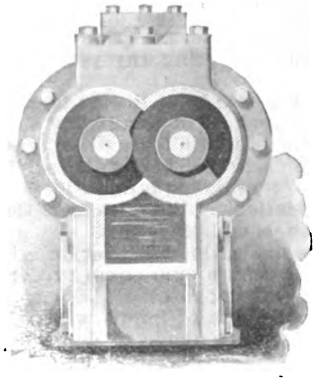


Fig. 2.—Quimby Screw Pump.

The pump has no internal packing, no valves and no small moving parts. The only packing is in the stuffing boxes where the two shafts pass through the cylinder head. As these stuffing boxes are on the suction end of the pump there is no tendency to blow out the packing.

The advantages of this type of pump are apparent. Whether driven by a belt, an electric motor, or a steam engine, the driving power is applied directly and without the loss due to intermediate mechanism.

Having no valves, no internal packing, and no small moving parts, there is very little opportunity for the pump to get out of order; and as the screws are not in contact with the cylinder or with each other, the consequent absence of wearing surfaces gives the pump great durability.

The efficiency of the pumps is also high, because the power is applied direct; the thrust due to back pressure of the column of liquid in the delivery pipe is perfectly balanced. Owing to the absence of rubbing surfaces there is an absence of internal friction; the rotary motion of all the moving parts and the continuous flow of the liquid delivered also contribute to the efficiency.

Fig. 3 shows one of the Quimby screw pumps direct connected to an electric motor. This type is admirably adapted for house service, in connection with an automatic tank switch. Being mounted on the same bed plate, the combination is specially adapted for temporary use and is easily transported.

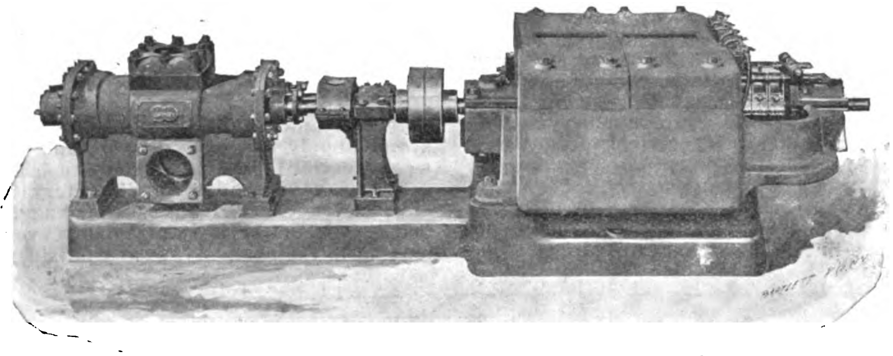


Fig. 3.—Quimby Electric Screw Pump for House Service.

A large number of these pumps have already gone into operation and several can be seen at work in this city on house and elevator service.

PERSONAL

EDWARD M. BENTLEY.

WITH the successful operation of a conduit road in Washington and the coming introduction of this system on a large scale in New York, it is interesting to recall the fact that the first electric street railway in the United States was of this kind. It was started in the summer of 1884 at Cleveland, Ohio, having been constructed by E. M. Bentley and W. H. Knight, two Patent Office examiners, who had resigned to undertake this work. This road was operated for over a year with as much success as could be expected from the primitive electric railway appliances available at that early period, and it led to the formation of the Bentley-Knight Electric Railway Company, which occupied a prominent figure in the early electric railway business until 1889, when it was absorbed by the Thomson-Houston Company.

The Bentley-Knight conduit road at Allegheny City, built in 1887, was in successful operation for several years, and resulted in the building of a conduit road in Boston, on Boylston street, in the following year. This road began operating in mid-winter under most adverse conditions, and as its failure would obviously promote the introduction of the much cheaper overhead system into Boston, it is needless to say that the conduit was not made a success. Its construction, however, was not essentially different from that of the new conduits of Washington and New York, which have been built under the Bentley-Knight patents.

Of these two electric railway pioneers, Mr. Knight became the chief engineer of the railway department of the General Electric Company, and held the position until he was secured by the Whitney syndicate to develop the compressed air motor, and now has charge of that enterprise.

Mr. Bentley, on going with the Thomson-Houston Company, took charge of its department of patents and inventions, and held the position until the removal of the General Electric Company's works to Schenectady. Mr. Bentley is now practicing independently as a patent expert and solicitor of patents, with an office in Temple Court, New York City. He has continued to represent the General Electric Company in its most important patent litigation, having acted as its expert in the suits on the Van Depoele trolley and switch patents, the suits brought against it on the Tesla patents and others. Few, if any, patent experts have had a more extensive and valuable experience to fit them for their duties than Mr. Bentley, who has, moreover, been admitted to the bar as a lawyer. Those having important patent rights to protect, or inventions to be patented, will be interested to know that he is now engaged in general practice, and does not confine himself entirely to electrical subjects.

MR. J. W. BRAID is the chief of the electrical department of the coming Tennessee Centennial Exposition.

MR. JOHN A. HIGHLANDS has been appointed general superintendent of the Hudson River Telephone Company in the place of the late W. H. Cull. Mr. Highlands is an able telephone engineer, is a graduate of the Massachusetts Institute of Technology, and while at Harvard was a nationally famous pitcher in its baseball team.

MR. B. J. ARNOLD, of Chicago, will begin at the University of Nebraska, Lincoln, Neb., on March 15, a series of ten lectures on central station design and construction.

MR. S. INSULL, president of the Chicago Edison Company, was in New York City last week on business, having come on from Washington where he was one of the party with the Governor of Illinois at the McKinley inauguration.

MR. W. J. CLARK, of the Railway Department of the General Electric Company returned to New York last week after a Western trip. He found business conditions decidedly on the mend, and a much better feeling prevalent.

MR. F. J. SPRAGUE injured his leg by a bad fall last week while directing some work at the new Astor Hotel, but escaped fortunately with slight wounds.

MR. A. J. WURTS.—Among the numberous exhibits of the work of graduates of the Stevens Institute of Technology shown during the recent celebration of its 25th anniversary, was that of Mr. A. J. Wurts, of the Westinghouse Company. The exhibit consisted of two marble switchboards with automatic cut-outs, a lightning arrester board, and framed photographs, showing other work of Mr. Wurts. The lightning arrester board has been presented to the Institute by the Westinghouse Company, and the photographs also, by Mr. Wurts, and will be added to the permanent exhibition of the Institute.

MR. W. H. BRENNER has been appointed constructing engineer of the New York and Staten Island Electric Company.

MR. F. SARGENT, the consulting electrical engineer of Chicago, has recently been in New York, and is now making a Southern trip.

MR. C. F. SCOTT, electrical engineer of the Westinghouse Electric and Manufacturing Company, lectured recently in Pittsburg before the First Congregational Church on "Electricity."

MR. JOHN M. WARD, the famous baseball shortstop, now a lawyer, has been engaged by the Nassau Electric Railroad Company to take charge of its claim department, taking over a good deal of the work done by J. C. Church, secretary and counsel of the company.

NEWS AND NOTES.

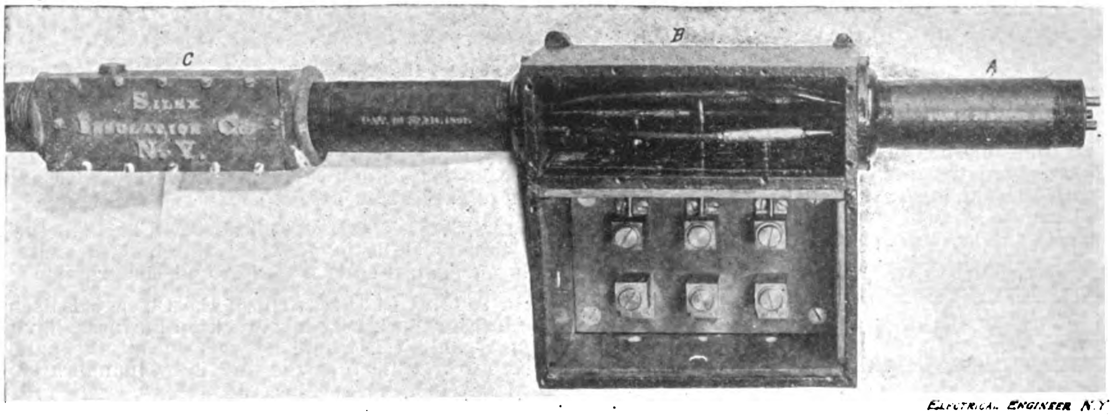
SILEX, THE IDEAL FIRE PROOF INSULATION.

BY OSCAR MOHLE.

TO the Engineers' Club of New York belongs the credit of having in their new home, at No. 374 Fifth avenue, the first absolutely fireproof system of vertical mains for electrical conductors. To any one unfamiliar with the material silex, this might seem at first blush to be a very bold statement. Much has been written during the past six months in the electrical and insurance press about the properties of this insulator, and the following facts are noteworthy:

Silex (di-oxide of silicon) controls electric currents of the highest tension. It has an extraordinarily high fire resisting quality, fusing only at the temperature of the oxy-hydrogen flame, and is practically a non-conductor of heat. It is non-hygroscopic and absolutely proof against the action of water. Its specific inductive capacity is extremely low, being from 10 to 250 per cent. less than any other insulation now in use.

How to apply this substance, so that its undoubted advantages as an insulator could be utilized by providing a reliable safeguard to life and property, has been the task of the Silex Insulation Company, 39 and 41 Cortlandt street, New York. The accompanying engraving shows a section of the system as installed in the above-mentioned club. The steel tubes A contain three No. 0 copper wires imbedded in finely pulverized silex, solidly packed, so as to prevent any possible change in their relative positions, either through careless handling in transportation or installation. These are connected with the street service at the house line in the cellar, continuing along the ceiling to the elevator shaft and thence rising to the top of the building.



OUTLET BOX AND PIPE JOINT FOR SILEX INSULATING SYSTEM.

The lengths in the cellar are joined by a special coupler, C, allowing ample room for connecting conductors, which is then thoroughly packed with silex. At each floor the tube passes through a junction or outlet box, B, in one side of which connections are made, and the space likewise filled in with silex and sealed. The other side of the box is properly slate lined and provided with binding posts for safety fuses of branch circuits. This, in brief, describes the component parts of the silex system of mains.

It has now had a continuous trial for four weeks, and is giving eminent satisfaction.

SOME BRUSH HISTORY THAT IS NOT SO.

SOME curious electrical history finds its way into the daily papers now and again. After circulating awhile it becomes accepted as fact, and thereafter it is a difficult task to show that it is in reality without any foundation. A striking example of this kind of stuff is furnished by the item quoted below, the story being told by "Tip of the Tongue" in one of the New York dailies:

"I wonder what has become of my old friend, Emil Bixel? In 1878 he was keeping a small drug store in Cleveland, Ohio, and had saved up $2,500 which he wanted to invest. The Brush Electric Light Company had just then been organized, and was struggling along in a diminutive factory in the outskirts of the city. One of the officers, hearing of Bixel's $2,500, offered to sell him for that sum $10,000 of the stock in the company, and drove him out to see the plant.

"'Shuh! I wouldn't give $250 for the whole thing,' said Bixel in disgust, and returned to his business.

"I have kept track of that stock. If Bixel had bought it for $2,500 he would have made in sixteen years $240,000.

"Brush got his start in an interesting way. There lived in Harlem two maiden ladies upon whom he frequently called and to whom he was everlastingly talking about his inventions and the difficulties of obtaining funds with which to introduce his light. One became so deeply interested that she persuaded her sister to mortgage their house for $30,000 and lend the money to Brush. Their income from the investment reached the handsome sum of $10,000 a month when the light became well established.

"Brush was too poor to pay the fees of his patent lawyer. They amounted to $1,200, and the inventor wanted to pay in stock of the new company. This the lawyer declined at first, but eventually, finding it impossible for Brush to pay in any other way, consented to accept the stock, which he carelessly tossed into his safe and forgot all about it. In due time it was fished out and the lawyer became rich on it. He lives in a palace in Detroit."

This was shown to Mr. G. W. Stockly, formerly president of the Brush Electric Company, who said:

"No such man as Emil Bixel was ever known by me in connection with any stock matter. No such concern as the Brush Electric Light Co. was organized in 1875, as stated. The Telegraph Supply Company was organized in 1875, and its name was afterward changed to The Brush Electric Company. This company never had a small factory in the outskirts of the city, and never had any such struggles as this article intimates. No officer of the company ever offered any stock belonging to the company, to any outsider, at the time, or in the way, or anything like the way described in this article. The next statement, regarding the increase in sixteeen years, of about one hundred to one, is manifestly absurd, and is very far beyond what any investor ever got from his investment in this company. The next statement, regarding the "maiden ladies in Harlem,' is absolutely without foundation. It is the first time that any such statement has been made, although the papers have been full of inventions and funny stories about the Brush Company, and others. Mr. Brush never was a stockholder in the company, and never had anything to do with its business, or its investments or assessments, until after 1885 at least, which was at about the height of the prosperity of the company. There never was a time when the company had any difficulty about money matters such as this article suggests. These yarns are very pleasant to the general reader, who knows nothing whatever about the subject, and they give some occupation, apparently, to the 'penny-a-liners' who get hard up for material. Some of them have a word or item of truth on which to build the story, but this one is absolutely without foundation of any kind whatever."

PRIZE COMPETITION FOR ELECTRIC PLOWS.

The German Agricultural Society has arranged a prize competition for power-driven plows, intended more especially to encourage and develop the application of electrical power to the working of plows and other agricultural implements, says a German contemporary. The society considers that, for many reasons, the application of electricity to agricultural driving promises considerable success, especially on account of the facility which electricity offers for transmitting power to considerable distances. In the trials which will be made by the society non-electrical plows will also be tested, so that a comparison may be made of the relative efficiency of the different systems. The tests will be made with plows only, since it is considered that only small alterations will be required to apply the power to other implements. Special attention will be attached to the conveyance of the arrangements from field to field. A first prize of 3,000 marks and a second prize of 1,000 marks will be given for the best plow driven by any kind of power, and a special prize for the best electrically driven plow. At the trial a piece of heavy and a piece of light land will be assigned to each plow, and the following points will be noted: 1, the time taken for the plowing; 2, the weight of earth moved; 3, the consumption of fuel by the motor; 4, the power consumed between the motor and the plow; 5, the cost of the plowing, including fuel, water, lubricants, attendance, repairs, interest and depreciation.

ELECTRICAL FIGURES OF PHILADELPHIA.

In his annual report on the work of the Philadelphia Electrical Bureau, Chief Walker gives some interesting figures. This city, with 129 square miles, is equipped with 885 fire boxes, 56 of which are in-doors, paid for by private individuals. New York, with but 31 square miles, has 2,500, and Chicago between 2,500 and 3,000. To thoroughly equip the city they should have at least 2,500 signal stations. The average price per arc lamp per night for 1895 was 41.15 cents; for 1896, 35.05, and proposals for 1897 show 33.3 cents, a reduction of $42,862.25. While the number 6,228 now provided for seems to be large, yet, when the great number of streets yet to be lighted is considered, it becomes insignificant. During the year there have been laid 221,834 feet of conduit by the city.

MOTIVE POWER EXHIBITION AT MUNICH, BAV.

The General Industrial Association of Munich, Bavaria, proposes to celebrate its fiftieth anniversary by an exposition of motors and machine tools, to be held in Munich from June 1 to October 10, 1898. The manufacturers of all countries are invited to participate in the exposition, which will have the cooperation of the Polytechnic Association of Bavaria. The object of the exposition is to show the proprietors of small and medium sized factories, as well as all who are engaged in industrial pursuits, everything that can be of service to them in the domain of motors, machine tools and hand tools for the purpose of facilitating and furthering their work and cheapening their products. Safety appliances will be made a special feature, and it is designed to have public lectures on scientific and technical subjects. A medal for excellence in the various departments will be awarded by an international jury.

THE STOCK MARKET

BETTERING CONDITIONS.

A far more hopeful feeling was created last week than had previously existed, by the plan adopted for refunding the bonds of the Lake Shore Railroad, the old rate being 7 per cent. and the new 3½, on a total of $39,000,000. Inquiry has developed the fact that a similar reduction on bonds to be refunded up to 1905, in the higher class of securities, would result in a reduction in the annual fixed charges of $11,779,000, all of which would naturally go to the improvement of the properties or the direct benefit of the stock. Obviously money is decidedly cheaper, and the increased production of gold will long keep it so.

During the past week, 15,666 shares of General Electric were sold at from 36 down to 34¾. There is a good deal of talk about the strength of this stock in New York and Boston, but present conditions do not afford any safe criterion on that score. Of Western Union 8,361 shares were sold, closing at 83, and in Boston, Bell telephone still lingered around 224 to 225. Local lighting and street railway securities throughout the country are quiet, business not being very active in any of them.

"This anniversary number of The Electrical Engineer is a credit to the publishers and a valuable souvenir to its readers." —Detroit Free Press.

EDUCATIONAL

THE RENSSELAER POLYTECHNIC INSTITUTE.

A brochure by Dr. John H. Peck, reprinted from the American University Magazine, gives a most interesting sketch of the work and purpose of the Rensselaer Polytechnic Institute, Troy, N. Y. This institute has a world-wide reputation as a successful school of engineering. The prevailing purpose of the institution is to teach the relations of science and business. Its chief energies have been directed to prepare students for any engineering work. It has, nevertheless, from time to time, expanded its course in chemistry, physics, metallurgy and astronomy, and retained those in geology and mineralogy, botany and modern languages. The institute presents an example of a school of specialized education, with experience extending over a period of three-quarters of a century.

A $30,000 GIFT TO THE STEVENS INSTITUTE OF TECHNOLOGY.

It may be remembered that in connection with the 25th anniversary of the Stevens Institute recently celebrated, President Morton drew attention to the circumstance that while the original endowment and subsequent gifts had supplied all that was necessary for present requirements, the natural and necessary growth of the Institution would make more ample accommodations and a larger revenue essential for an adequate future development of the work which had been so successfully carried on heretofore.

As an object lesson in this direction, he presented on the same occasion to the Trustees some shares of stock likely to appreciate as the year progressed. This suggestion, we learn, has been acted upon by Mrs. E. A. Stevens, widow of the Founder of the Institute, who has transferred to the Trustees two large lots and houses directly adjacent to the Institute grounds, which, while having at present a valuation of about $30,000, have a prospective value many times as great.

OBITUARY

W. H. CULL.

We regret to announce the death of Mr. William H. Cull, the superintendent of the Hudson River Telephone Company, at Albany, N. Y. He was only 43 years of age. He had been actively engaged in electrical work for many years past, and was at one time engaged in electric railway operation. His experience in telephonic work, however, made him a valuable man in that field, to which he returned.

REPORTS OF COMPANIES

COMMERCIAL CABLE PAYS 8 PER CENT.

The statement of the Commercial Cable Company for 1896 was submitted to the shareholders at their annual meeting held last week. The gross earnings, including interest from investments, amounted to $2,019,255, and the total expenses to $842.690. leaving a balance of $1,176,565. The company paid its regular dividend of 7 per cent., together with a bonus of 1 per cent., making 8 per cent. for the year.

NEW YORK AND NEW JERSEY TELEPHONE CO.

The annual meeting of the New York and New Jersey Telephone Company took place last week at the main office of the company in Smith street, Brooklyn. The following directors were elected without opposition: Charles F. Cutler, Alexander Cameron, Joseph P. Davis, Charles A. Nichols, Hugh Kinnard, William D. Sargent, David B. Powell, George

H. Prentiss, Joel C. Clark, Felix Campbell, Edward J. Hall and Henry Sanger Snow. The treasurer's report contained the following items: Gross earnings, $1,554,585.33; expenses, $1,076,854.76; balance on hand over and above operating expenses, $477,730.66; interest and taxes, $107,268.72; new earnings, $370,461.94. Of this, $253,363 was set aside for dividend purposes, leaving a surplus for 1896 of $117,098.94.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

BY MAX OSTERBERG.

Insolated Plants :

POWER PLANT OF ARMOUR INSTITUTE OF TECHNOLOGY.—On account of the demand for lighting and motor service and additional facilities for laboratory work, the above plant was reconstructed. A Hamilton-Corliss single cylinder non-condensing engine, making 73 revolutions per minute is connected to the main countershaft by means of a rope-drive; a 100 k. w., direct current, 6-pole machine at 115 volts furnishes power for shops and laboratories, as well as for incandescent and arc lights. Another dynamo, giving alternating current is used partly for lighting, and partly for laboratory work. Two other engines are connected to dynamos, one of which is used for lighting at light load, the other for experimental purposes only.—"West. Elec.," Feb. 27, '97.

Measurements :

ALTERNATING CURRENT WATT METER.—Illustration of the Hummel system for single phase alternating currents.—"Elektr't,, Feb. 13, '97.

WATT AND THE MEASUREMENT OF POWER.—By W. H. Preece. A paper read at Greenock, on the occasion of the Watt Anniversary Lecture. Reviewing the work of Watt, author dwells principally on the term horse-power, the way it was created, the way it is being used, and expresses the opinion that it will gradually be discarded.—Lond. "Elec. Rev.," Feb. 12, '97.

Miscellaneous :

INFLUENCE OF ELECTRICITY ON PLANT GROWTH.—Short review of the works of Lemström (1887), Specnew (1892), Bonnier (1892), Paulin (1894), Bailey (1896), and Narkewitsch-Jodko (1896), and some of the results.—"Elektr't," Feb. 13, '97.

SOME DIELECTRICS AND THEIR INSULATING PROPERTIES.—By Geo. T. Hanchett. The peculiar action of disruptive discharges on various materials, such as hard rubber and glass, are described.—"Elec. World," Feb. 6, '97.

A REASONABLE METHOD OF TESTING AND RATING SAFETY FUSES.—By F. A. C. Perrine. Author explains that fuses are no protection against a current rush since the time element is a necessary function in order to make the fuse melt. The true method of testing fuse wires, therefore, is to measure the temperature of the wire which is supposed to be protected as the current is increased in the circuit. Kennelly's experiments give for certain cases the maximum temperatures attained by copper wires when continuously carrying current, and the proper current for a given wire should be chosen, such that double its value will not increase the temperature of the wire more than 75 degs. Fahr. We thus have a basis for choosing the proper fuse to protect the wire against overheating.—"Elec. World," Jan. 30, '97.

PROGRESS OF ELECTRICAL SUBWAY WORK.—By Wm. Maver, Jr. Reviewing the gradual development of the subway work since 1888, the author illustrates and describes the principal methods of laying underground wires and cables. The Van Vleck controllable junction box of the N. Y. Edison Elec. Illuminating Co., by means of which the central station or stations are placed in control of the feeders and branches at any desired point receive special attention.—"Elec. World," Jan. 30, '97.

Power Transmission :

PUMPING OIL BY ELECTRICITY.—Colonel J. J. Carter has established a complete electric plant for pumping oil at Sawyer City. Alternating current is used. (Detailed information is not explicit).—"Am. Man.," Feb. 26, '97.

Railways :

ELECTRIC INTERLOCKING THE BLOCK AND MECHANICAL SIGNALS ON RAILWAYS. By F. T. Hollins.—Paper read before the Lond. Inst. of Elec. Eng's, Jan. 28, '97. Brief description of the principal interlocking systems. The following receive special attention: Spagnoletti, Langdon, Evans, Tyer, Blakey and O'Donnell, Sykes.—"Lond. Elec.," Feb. 12, '97.

STREET RAILWAYS AND THE ILLINOIS LEGISLATURE.—Three bills have been introduced in the Legislature of Illinois providing for the regulation of street railways throughout the State. One seeks to create a commission vested with power to regulate running of cars, kinds of cars to be used, manner of heating, and to fix the rates of fare. Also empowered to determine questions similar to those usually determined by the Railway Commissioners in the State of New York. Another bill provides for the extensions of terms of franchise of existing companies, and the third covers the question of taxation.—"West. Elec.," Feb. 27, '97.

COMPARATIVE ECONOMY IN ELECTRIC RAILWAY OPERATIONS. By Charles H. Davis.—An analysis of costs, pointing out the many points of view that have to be taken to determine comparative values of different systems and different machinery.—"Eng'g Mag.," March, '97.

Roentgen Rays:

TIME OF X-RAY EXPOSURES. By Elmer G. Willyoung.—After a reply to an open letter by Dr. Monell, discussing the time of X-ray exposures, author points out four disadvantages of the Tesla coil over the ordinary induction coil, viz.: (1) Tesla coil has at least twice the number of parts—more complex; (2) Tesla coil uses oil—not so cleanly (not necessarily the case); (3) Tesla coil requires an operating spark gap—noisy; (4) Tesla coil produces alternating current—resulting in either two foci, and consequent blurring, or reversal of tubes and consequent blackening.—"Elec. Rev.," March 3, '97.

Telephony, Telegraphy, etc:

TELEGRAPHING WITHOUT WIRES. By H. J. W. Dam.—Author relates an interview with Dr. Bose, explains in popular language the working of telegraphy by induction, and then refers to a new discovery claimed to have been made by a young man by the name of Marconi, who is now working in conjunction with Mr. Preece.—"McClure's Mag.," March, 1897.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 2, 1897.

Alarms and Signals :—

DANGER SIGNAL. D. A. Gordon and B. B. Weir, Cassopolis, Mich., 577,949. Filed Aug. 29, 1895.

Means in connection with a bridge upon which the track is supported whereby signals may be shown to approaching trains should the track become obstructed.

TESTING APPARATUS FOR ELECTRIC AUTOMATIC SYSTEMS. C. Burger, Newton, Mass., 578,077. Filed December 17, 1896.

Adapted for use in buildings equipped with an automatic electric fire alarm system.

ELECTRIC SIGNALLING APPARATUS. B. J. Noyes, Boston. Mass., 578,114. Filed July 11, 1896.

Police signal system in which a "wagon" call is automatically transmitted from the central station to the stable.

RAILWAY SIGNAL. W. P. Hall, Greenwich, Conn., 578,236. Filed November 28, 1892.

Details of construction.

Batteries, Primary :—

COMBINATION BATTERY CELL. H. A. C. Anderson, New York, 578,131. Filed October 30, 1895.

A cell is so constructed that after its effective term of service as a dry cell has expired it may be revivified and used as a wet cell.

Connectors, Conduits and Insulators :—

ELECTRIC CIRCUIT. J. S. Stone, Boston, Mass., 578,275. Filed September 10, 1896.

An electric conductor consisting of a conducting core provided with a longitudinally discontinuous paramagnetic sheath conductively separated from the conducting core. Designed for telephone cable conductor.

Dynamos and Motors :—

COMMUTATOR BRUSH. J. F. Kester and F. C. Atherton, Buffalo, N. Y., 578,016. Filed June 16, 1896.

Consists of a corrugated core and a wire gauze covering surrounding the core.

ELECTRIC MOTOR. H. A. Stock, Millersburg, Pa., 578,069. Filed April 15, 1896.

Embodies a field magnet having poles arranged in two sets in different planes, the two sets being staggered, and an armature having poles arranged in two sets side by side, and not staggered.

DYNAMO ELECTRIC MACHINE AND ELECTRIC MOTOR. C. P. Turner, New York, 578,280. Filed November 25, 1895.

A field magnet for dynamos and electric motors having the faces adjoining the armature formed of chemically pure iron.

Electro-Metallurgy:—

POROUS DIAPHRAGM. H. Blumenberg, Jr., 578,078. Filed November 15, 1895.

A method of making diaphragms, which consists in treating asbestos with acid to remove the metallic salts and toughen it, and finally forcing binding material into the pores of the asbestos under high pressure.

ELECTROLYTICAL APPARATUS. C. P. Turner, New York, 578,171. Filed February 8, 1896.

Employs a transversely partitioned receptacle to hold the ore, having perforated sides for the entrance of the electrolyte.

ANNEALING APPARATUS. C. P. Turner, New York, 578,170. Filed February 8, 1896.

Details of construction.

Lamps and Appurtenances:—

CONVERTIBLE SIGNAL LAMP. C. H. Dressel, New York, 577,079. Filed June 20, 1895.

ALTERNATING CURRENT ARC LAMP. E. R. Knowles, Brooklyn, N. Y., 577,864. Filed August 19, 1896.

Means to obviate "clattering" in alternating arcs, when starting.

ELECTRIC LAMP. M. M. Kohn, Chicago, Ill., 578,107. Filed December 4, 1895.

Bicycle headlight.

ELECTRIC ARC LAMP. A. Guendel, New York, 578,233. Filed July 7, 1896.

Feed mechanism.

Miscellaneous:—

HEAT REGULATOR. W. J. Robinson, Philadelphia, Pa., 577,026. Filed April 16, 1896.

Details of construction.

IGNITING DEVICE. A. Czarnikow, Berlin, Germany, 578,004. Filed February 26, 1896.

An electric gas-lighter which is manipulated some distance from the burner.

ELECTRODE. A. E. Woolf, New York, 578,070. Filed January 13, 1896.

Consists of an exposed thin plate of metal of the platinum group, the plate being comparatively long from end to end, and narrow from its inner attached edge to its outer free edge.

Railways and Appliances:—

TRAIN CONTROLLING DEVICE. C. S. Shea, Milton, Mass., 578,298. Filed October 14, 1896.

Means to electrically operate the air brake lever on a moving train through a track circuit.

TROLLEY POLE CONTROLLER. L. M. Halsey, Brooklyn, N. Y., 577,853. Filed July 20, 1896.

Device for automatically lowering trolley poles when the trolley leaves the wire.

ELECTRICAL CAR LIGHTING. M. Moskowitz, Newark, N. J., 577,872. Filed December 23, 1896.

Current is supplied from dynamo mounted on car truck and belted to car wheel axle.

ELECTRIC RAILWAY. C. Skinner, Chicago, Ill., 577,885. Filed May 27, 1895.

Closed conduit system.

ELECTRIC RAILWAY. S. G. Brosius, Baltimore, Md., and W. B. Upton and J. Colvin, Washington, D. C., 577,912. Filed February 25, 1896.

Plow for conduit system.

TROLLEY CATCHER. T. Holahan, Rochester, N. Y., 577,921. Filed July 11, 1896.

When trolley leaves wire, the upward pull of the trolley cord releases a spring actuated device which draws trolley down by means of a second cord.

APPARATUS FOR REGULATING AND MODIFYING ELECTRIC CIRCUITS. G. F. C. Adam, Hanover, Germany, 578,182. Filed July 7, 1896.

Switching device for electric motor cars, which are run part of the way by current taken from a line wire and part of the way by a current taken from a storage battery.

ELECTRIC RAIL BOND. B. J. Jones, Chicago, Ill., 578,304. Filed April 29, 1896.

Comprises a loop-shaped body portion, formed of a series of strands arranged side by side, and rivet studs secured by casting to the ends of the body portion.

Switches, Cut-Outs, Etc.:—

ELECTRIC SWITCH. W. W. Doty, New York, and J. A. MacKnight, Mt. Vernon, N. Y., 578,139. Filed July 1, 1896.

Comprises a pair of solenoids, bell crank levers operated thereby and adapted to shift the switch point, an automatic switch for controlling the current passing to the respective solenoid, and means for sending a current to the switch.

DOUBLE POLE REVERSING SNAP SWITCH. H. A. Gorn, New York, 577,950. Filed August 6, 1894.

Comprises oppositely arranged plates carrying the circuit terminals and intermediate contact blocks, a rotating shaft carrying connecting contacts, means for operating the shaft manually, and automatic means for completing the movement of the shaft.

Telegraphs:—

MESSAGE RECORDING INSTRUMENT. B. J. Noyes, Boston, Mass., 578,113. Filed June 25, 1896.

Means by which messages may be recorded upon a strip of paper and the time printed upon the face side of the strip of paper close to the message.

ELECTRIC SIGNALING APPARATUS. B. J. Noyes, Boston, Mass., 578,115. Filed July 21, 1896.

Similar to above.

TELEGRAPHY. R. H. Weiny, Arlington, N. J., 578,126. Filed September 4, 1896.

Transmitting and receiving apparatus, in which an indented paper strip is employed in sending.

Telephones:—

AUTOMATIC TELEPHONE CALL DEVICE. E. P. Boland, New York, 577,911. Filed April 6, 1896.

Automatic coin-operated telephone call device.

TELEPHONE CALL REGISTER. W. A. Heckard and D. Ogden, Columbus, Ind., 577,920. Filed June 8, 1896.

A device which, when operated at a telephone exchange, records in the office of a subscriber the telephone number of any person who has called.

TABLE TELEPHONE APPARATUS. L. M. Ericsson, Stockholm, Sweden, 578,006. Filed October 27, 1896.

Comprises a rotary core, pole pieces with horseshoe magnets attached thereto at each end, the magnets extending downwardly from the core and having broadened and spreading base portions to serve as supporting feet.

COMBINED TELEPHONE AND ANNUNCIATOR SYSTEM. J. R. Strong, New York, N. Y., 578,122. Filed July 31, 1896.

A switch consisting of a number of yielding and stationary contacts connected in multiple to two independent battery circuits and an operating and indicating handle adapted to move over the yielding contacts so as to change the circuit relations when depressed and to simultaneously indicate that the circuit change has or has not been effected according to its position.

LEGAL NOTES

THE BRADLEY ALUMINUM PATENTS SUSTAINED.

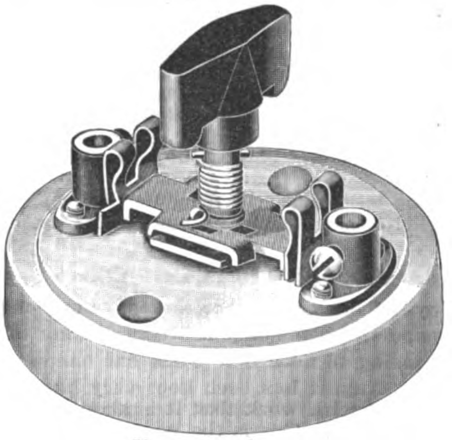
The United States Circuit Court of Appeals has sustained the validity of the Bradley patents for the production of aluminum by the electric fusion. These patents are owned by the Cowles Company, and are numbered 464,933, Dec. 8, 1891; 468,148, Feb. 2, 1892, and 473,866, April 12, 1892. The most important of the above patents is the second, and its principal claim reads as follows:

1. The process of separating or dissociating metals from their highly refractory ores or compounds, non-conductors in an unfused state of which the ores and compounds of aluminum are a type, which consists in fusing the refractory ore or compound progressively by a source of heat concentrated directly upon it rather than by an external furnace, and as it becomes fused effecting electrolysis by passing an electric current there through between terminals which are maintained in circuit with the fused bath, whereby the process is rendered continuous, substantially as set forth.

TRADE NOTES & NOVELTIES

THE HARTFORD SWITCH.

THE switch illustrated herewith is to be known to the trade as the Hartford, being christened after the city of its birth. It is not necessary to introduce the maker, Mr. J. S. Gibbs, as he is well known to the entire electrical fraternity as an inventor and manufacturer of some of the best switches made. In his opinion the Hartford is his crowning effort thus far. Every feature of this new pattern, both mechanical and electrical, has been carefully designed to do the work satisfactorily for the user, and to meet all of the rigid requirements of the rules of the Board of Underwriters. The spring contacts are made of phosphor-bronze. This is considered a decided advantage, as this metal retains its temper permanently and gives full and perfect contact at every movement. The switches turn from left to right, and are actuated by a coiled piano wire spring. The locking and unlocking device is a new combination in switch movements, being accomplished by means of a rack and pinion, which insures a positive but very easy action, without strain or danger of cracking the porcelain base. All parts are substantially made, and are in-



HARTFORD SWITCH.

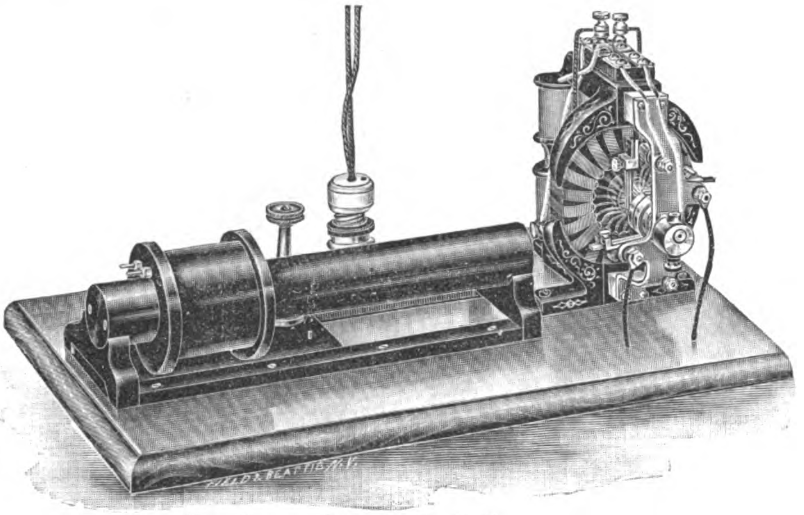
terchangeable, so that if by accident anything should become broken it can be readily replaced. The Hartford switch is made in all of the usual styles and sizes demanded by the trade, and can be bought of all electrical supply dealers. The Conover-Goe Company, Monadnock Building, Chicago, are the general sales agents for the factory.

NEW EDISON DIRECT-CURRENT CAUTERY TRANSFORMER.

THIS apparatus is designed to enable the direct 110 to 120 volt current to be used with absolute safety for electro-cautery work, and will be found of the greatest assistance to those physicians whose offices are equipped with this current. It is also suitable for hospital work, as nearly all of the most prominent institutions are lighted by the Edison direct low tension system.

It consists of a 120 volt Edison motor, the armature shaft of which is provided with two collecting rings which are connected to the armature at points diametrically opposed.

The current taken from these collecting rings, which is now of an alternating character, is led into the primary circuit of the transformer, shown on the left of the cut. The primary circuit is composed of a number of turns of fine insulated copper wire, wound on a core of annealed iron wires, the whole being inclosed in a thin cylindrical shell of hard rubber, which is supported by a hard rubber standard at each end. The secondary coil, composed of a few turns of thick wire, is wound on a hollow hard rubber spool operated by a rack and pinion movement and sliding over the primary coil. The terminals of ~~the secondary~~ coil are brought out to two-pin attachments mounted on one head of the coil, and the cautery cords are connected thereto by split socket connections. On moving the secondary coil to the right, the current is increased, and vice versa. The apparatus is mounted on a highly polished oak base, and is provided with an attachment plug and ten feet of flexible cord for connecting the instrument to the mains.



NEW EDISON CAUTERY D. C. TRANSFORMER.

The apparatus is manufactured by the Edison Manufacturing Company, 110 East 23d street, New York City.

BOSSERT ELECTRIC CO.

In these days of business depression, says one of the Utica, N. Y., newspapers, when many are complaining of the hard times, it is pleasing to note that Utica has one establishment which since last August has been kept very busy, and which is now so crowded with work that it is about to build a new and much larger plant. This is the Bossert Electric Construction Company. Mr. Bossert brought his inventions to the notice of the Utica Chamber of Commerce, and shortly afterward the company was organized, the members being H. P. Crouse, William F. Bossert, Hon. Frank Sang and Seth C. Adams. The company established its plant at 40 Broadway and put in heavy machinery. So popular has its product proved that it is now obliged to enlarge its plant. The company manufactures its well known wall outlet and switch boxes, and also steel clad, slate lined panel and junction boxes and switch board. The superiority of these boxes over others lies in the fact that they are drawn out of steel and are therefore far more valuable than boxes of cast iron, although they are made more rapidly. (See The Electrical Engineer, Feb. 10.)

Architect Constable has nearly perfected plants for the new building, which will be erected in the western part of the city. It will be 48x88 feet on the ground, two stories high, prepared for three, and will be built of heavy timber work. There will be heavy girders of Georgia pine eight feet apart, over which a four-inch floor will be laid. The floors will be supported by heavy posts of Norway pine. There will be three lines of shafting on the first floor, which will be occupied by heavy machinery. Heavy stone foundations will be built for the presses which stamp out the boxes, the largest press giving a blow equal to 84 tons' weight. On the first floor also will be the office, 14x15, a private office, 10x15, and opposite these will be a large store room. The lighter machinery will be on the second floor. Near the building, separated by an alley, will be three brick buildings. They will be an enameling room, 20x21 feet, engine room, 15x10 feet, and boiler room, 15x21 feet, with coal shed attached. All the buildings will be lighted by electricity, connected with city water, and the roofs will be of asphalt and gravel. The new plant when completed will enable the company to largely increase its output. This evidence of its prosperity is very gratifying.

BALL ENGINES.

The Hammond Building of Detroit, Mich., will in the future supply its own electric lighting. The dynamos were furnished by the General Electric Company and the engines by the Ball Engine Company, Erie, Pa.

The Harper Hospital of Detroit, Mich., has recently put in its own electric plant, consisting of two engines built by the Ball Engine Company, Erie, Pa., direct connected to General Electric Company dynamos.

ANCHOR SNAP SWITCHES.

The Electric Appliance Company are just distributing to the trade a catalogue containing a complete line of Anchor snap switches. This is probably the most complete catalogue of snap switches that has been published, and includes a number of new applications of the device; also a complete line of dial or indicating switches. The Electric Appliance Company have prepared a special trade discount sheet for this catalogue, which quotes up-to-date prices on the goods listed. They will be glad to receive inquiries for the catalogue.

I-T-E CIRCUIT BREAKERS.

In the recent disastrous fire which destroyed entirely the principal power house of the Union Traction Company, Philadelphia, on the night of March 3, there were in use a number of I-T-E circuit breakers, as well as circuit breakers of other makes and types. While the engines were still playing upon the flames, Mr. Charles Hewitt, the chief electrician of the Union Traction Company, placed himself in communication with the Cutter Electrical and Manufacturing Company, of that city, and ordered for immediate delivery, one hundred and sixty-five I-T-E circuit breakers. This order was provisional upon prompt delivery, as required by the Traction Company. Inside of twenty-four hours, 116 of these circuit breakers were delivered to the Traction Company.

It would seem that comment upon the merits of the I-T-E circuit breaker, and the size of the Cutter Company's business, which would enable it to fill this order—one of the largest ever placed at one time for circuit breakers—is unnecessary. The fact that standard switchboard types were ordered, made it possible for the entire order, practically, to be filled out of stock.

THE BULLOCK ELECTRIC MFG. CO.

ONE of the most important of the recent moves in the field of electric power and motor manufacture has already been noted, briefly in these columns, namely, the change in style of the old Card Electric Motor and Dynamo Company of Cincinnati, and its development of new plans for handling a business whose magnitude is quite surprising. The Bullock Electric Manufacturing Company, which is the new designation, is simply expressive of the actual conditions of control, Mr. George Bullock in a sense being the company so far as ownership goes, and being also its president. The directors chosen at the recent annual meeting are: Messrs. G. Bullock, J. W. Bullock, G. N. Stone, P. R. Mitchell, J. S. Neave, and G. W. Wilshire, one of whom, Mr J. S. Neave, has been elected vice-president and secretary.

With the new and shorter name the Bullock Company is also free from the confusion existing owing to the similarity of its name with that of another corporation, and the change is generally welcomed, if no other reason existed. As a matter of fact, however, from this time out a more active and aggressive policy will prevail, and special plans have been made to push into the fields where an obviously brisk demand awaits the Bullock dynamos and motors. A separate but closely allied company for the selling and engineering work in the East has been organized by Mr. Bullock and his energetic young coadjutor, Mr. R. T. Lozier, who for some time past has been the company's representative in Eastern territory. In other words, the parent company will restrict itself to the manufacture of the apparatus. The Bullock Electric Company, as the selling organization is called, has its main offices in a fine suite on the 16th floor of the new St. Paul Building, Broadway and Postoffice Square, New York, with branches at 8 Oliver street, Boston, and 665 Bourse Building, Philadelphia. Agencies have also been established in Chicago, St. Louis, Louisville, Atlanta and Spokane. In England, the Bullock interests are represented by Bergtheil & Young, London. The company is experiencing a good inquiry for its machinery for export, as well as at home.

MISSOURI TELEPHONE MANUFACTURING COMPANY.

The illustrated catalogue of the Missouri Telephone Manufacturing Company, 917-919 Market street, St. Louis, Mo., covers every detail of the switchboard, telephonic, and electrical appliances manufactured by the firm, whose factory is fully equipped to supply everything needed in connection with a first-class telephone exchange. One of the specialties of the company is a single plug switchboard, which they claim gives the most rapid service of any switchboard on the market. It is simple in operation; gives no chance for induction, or cross talk, and can be added to by sections. It is equipped for both metallic circuit and single line systems, and can readily be changed from one to the other. Other appliances to which the company give special attention are a new combination switchboard, double-plug, 100-number switchboard, central station switchboard lightning arrester and distributing board, improved forms of transmitters, receivers, magneto signal bells, and batteries, and a full line of construction material, including telephone and telegraph cables, poles, wire, insulators, tools, etc.

ASSOCIATED MANUFACTURERS' TRADE "SPECIAL"

"The Great White Special," consisting of an entire train of Pullman cars, painted white and gold, is the attractive stock in trade of the organizers of the Associated Manufacturers' Trade "Special," who have their office at 714 Havemeyer Building, New York. They propose to fill the train with exhibits of leading manufactured products, and make a tour of the country. The route has been advisedly selected, and will embrace cities of 10,000 population up to 75,000, as stopping places of that class are found to present the most fertile field for an exhibition of this kind.

A fixed price of $750 is charged each exhibitor for the six months over which the trip is to extend. Facilities will be given for establishing agencies and for selling from samples in the towns visited. The representative of each exhibitor, who travels on the train, will be able to arrange to meet any local merchant, show him his samples, and do business. A concern which has no representative on the train can arrange to have any merchant in the cities visited meet the train en route.

The "Special" will be open to the merchants of any city up to noon, and the public will be admitted during the afternoon and evening. The train will consist of twelve cars (ten exhibition cars, a hotel car, and a baggage car), all Pullman vestibuled, each sixty feet long, and equipped with Westinghouse air-brakes and automatic couplers. The entire train will be lighted inside and out by electricity, and heated by steam.

WORTHINGTON COOLING TOWER.

A special catalogue has been published by Henry R. Worthington, New York, on the applications of the Worthington cooling tower. This apparatus is the embodiment of an invention the value of which will be at once recognized by engineers and owners of plants requiring the removal or absorption of large quantities of heat generated during any process. Such absorption is particularly necessary in the condensation of steam from steam engines, and the condensation of ammonia in connection with refrigerating plants; and in these and many other kindred processes the cooling tower is the most modern and efficient means of saving the water usually allowed to run to waste after it has passed over the various condensers and coolers. It is proved by actual service that this device will effect an economy of 85 to 95 per cent. in refrigerating and ice making plants and in locations where heat has to be absorbed, and it has been found especially serviceable where water is scarce.

The catalogue is fully illustrated and shows the application of the cooling tower to various types of steam engines, etc.

ONGLEY ELECTRIC CO.

P. Tecumseh Sherman has been appointed receiver of the property in this State of the Ongley Electric Company, by Judge Pryor of the New York Supreme Court, on the application of John S. Maben, who was appointed receiver in New Jersey, on January 8, 1895. The assets in that State were small, and Mr. Maben was unable to get possession of the books of record or any of the papers of the company. He believes there are assets in New York City consisting of notes aggregating $37,500, which are under attachment, and judgment has been rendered on the attachment for $13,773, which would leave a surplus for the company if the notes are paid in full. To get the surplus is the object for which Mr. Sherman was appointed receiver. His bond was fixed at $10,000.

METROPOLITAN ELECTRIC CO.

The Metropolitan Electric Company, of Chicago, have been given the Western agency for the full line of adjustable incandescent lamp holders, made by White & Co., of Worcester, Mass. These holders are specially adapted for factory, mill and machine shop work, where the operator must have good light. They are simple in construction, strong and durable, and do their work perfectly. They are made in various forms to suit all classes of work. They allow the lamp to be shifted, and no attention is paid to the fastenings or joints, as they are constructed so as to be adjustable in every conceivable position. They pay for themselves easily in the saving of the workman's time, as well as secure better results on account of the perfect lighting. Among the many who are using these holders and recommend them are R. Hoe & Co., New York City; Washburn & Moen Manufacturing Company., Westinghouse Machine Company and Wagner Palace Car Company.

ADVERTISERS' HINTS

JOHN WEDDERBURN & COMPANY, patent attorneys of Washington, D. C., are now offering $1,800 in prizes for new ideas in patentable inventions.

INTERIOR CONDUIT AND INSULATION COMPANY, 527 West Thirty-fourth street, New York, report the new styles of Lundell fan motors for 1897 to be ready.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, show a cut in their "ad" of one of their most recent installations.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, call attention to their catalogue of Anchor switches.

THE LE VALLEY VITAE BRUSH COMPANY are advertising the Vitae commutator brushes, which they are extensively manufacturing.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., have some new designs in their well known fans for any current except alternating.

THE ROYAL ELECTRIC COMPANY mention some of the advantageous features of their apparatus and guarantee their armatures for two years.

NEW YORK NOTES.

REFRIGERATION.—A very interesting pamphlet on the subject of refrigeration has been issued by Westinghouse, Church, Kerr & Co., Havemeyer Building, New York City, and should be found useful in a great many fields of industry. A great deal of practical information is given on the character and use of refrigerating apparatus. A copy of this illustrated pamphlet will be sent on application, and we recommend our readers to get one.

GOLDMARK & WALLACE, 29 Chambers street, New York, are noting an improved business in dynamo brushes, and conclude that people are working longer hours. They have also issued a neat catalogue of their fan and fan motors, one of the best on the market, and will be glad to mail a copy to any address on application.

THE KENNEDY VALVE MANUFACTURING COMPANY, 75 John street, New York, have just issued a fine catalogue of their large line of valves. Their goods are in extensive use among electric plants. The company will take pleasure in mailing catalogue to any address on application.

LOCKPORT, N. Y.—The Holly Manufacturing Company is contemplating putting in an electric plant of its own. The company may submit a bid, it is said, for lighting the city of Lockport.

THE KENDALL CARRIAGE COMPANY, to build electrically propelled vehicles, was incorporated last week at Camden, N. J.

THE ELECTRIC ENGINEERING AND SUPPLY COMPANY, of Syracuse, N. Y., have elected officers as follows: H. C. Hodgkins, president; H. R. Sanderson, vice-president; H. A. May, secretary and treasurer. These are also the directors, with J. E. Zeublin and J. V. Clark.

PROCTOR-RAYMOND MANUFACTURING COMPANY, 444 Niagara street, Buffalo, N. Y., which was incorporated last month, with a capital stock of $30,000, has since then been very busy in increasing its capacity, and putting in stock preparatory to manufacturing on a larger scale than ever, in the line of bells, annunciators, push buttons, etc. They confine the sale of their goods almost entirely to the wholesale trade.

THE AJAX ARC LAMP COMPANY, of New York City, has been formed with a capital stock of $100,000. The directors are B. H. Pomeroy, E. Woltmann, L. E. Shinn, D. H. Gildersleeve, A. Kirkham, J. Lowenthal and C. S. Van Nuis.

THE EASTERN ELECTRICAL SUPPLY COMPANY has opened its headquarters at 26 Cortlandt street, and welcomes all old friends. Its officers are B. H. Ellis, president and manager; C. P. Scott, vice-president and secretary, and C. I. Hills, treasurer. An experience ranging over ten years makes these gentlemen experts in their line, and they will be glad to quote prices on all supplies and fill any orders at lowest prices.

WESTERN NOTES

THE OTTUMWA PRESS, illustrated and described in our pages last week, is made by the Ottumwa Iron Works, of Ottumwa, Iowa., who will be glad to receive inquiries on the subject.

A PAN-AMERICAN EXPOSITION is proposed for Niagara Falls, and Cayuga Island, at La Salle, has been bought for the purpose by the promoters, at whose head is Capt. J. M. Brinker, of the Gorge Electric Railroad.

NEW ENGLAND NOTES

SHAWMUT FUSE WIRE COMPANY, 93 Federal street, Boston, call attention to their new 500-volt, quick-break switch, which they say is the only one approved by the underwriters throughout New England, and the only one coming within the recent specifications issued by the City of Boston.

THE ELEKTRON MANUFACTURING COMPANY have moved their office to 143 Federal street, Boston, Mass.

SOUTHERN NOTES.

THOMAS & HUNTER, electrical engineers and contractors, of Richmond, Va., have been compelled by pressure of business to open a branch office at Charleston, S. C. They have about completed a telephone exchange of 350 subscribers at Augusta, Ga., and are putting in an exchange of 800 subscribers at Charleston, S. C., to be ready by May 1.

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The Electrical Engineer.

Vol. XXIII. MARCH 17, 1897. No. 463.

TELEPHONY AND TELEGRAPHY

THE NEW DEY STREET TELEPHONE BUILDING, NEW YORK CITY.

BY HERBERT LAWS WEBB.

WHEN the first distinctively telephone building in this city was erected, at 18 Cortlandt street, in 1888, it was thought that its six spacious floors of offices would provide accommodation for a long time to come for the various departments of the different telephone companies that became its tenants. The growth of the telephone business, however, has been so rapid and so sustained that within a few years it became necessary to close the doors to outside tenants, of whom at first there were quite a number, so as to make room for the ever-expanding departments of the telephone companies and latterly, since the capacity of a building cannot be increased like that of a switchboard, various of these have had to be moved into other buildings to make space for the expansion of those branches which it is especially desirable to keep under one roof. But as there is no limit at present in sight to the growth of the telephone business the question of securing larger office quarters in order to keep the working forces together and in close touch with each other had to be solved sooner or later and the solution has been found in the erection of the Dey street building.

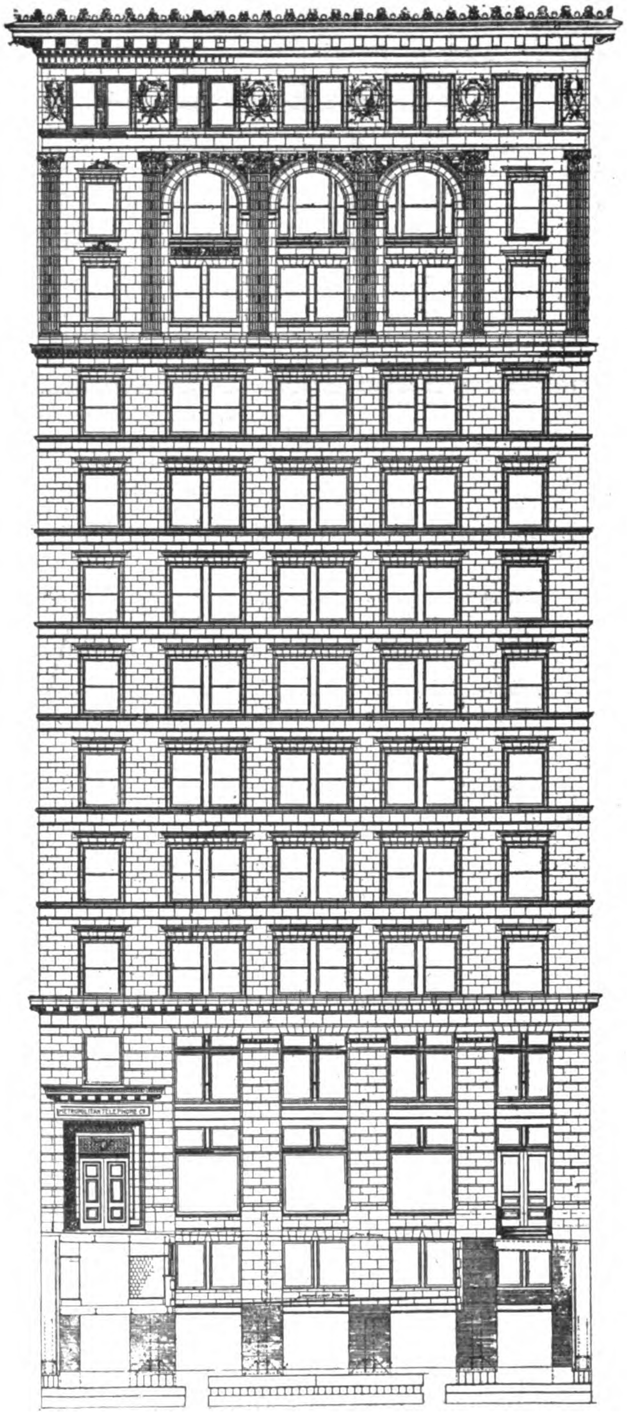
The site of the new building is immediately in the rear of the present telephone building, but does not exactly correspond, beginning one lot west of the site of the Cortlandt street building. One of the old buildings that formerly occupied the site was for a long time used by the New York Telephone Company for the accommodation of its supply, maintenance and construction departments, which were moved last winter, when the builders were ready to tear down the old structures, to quarters in Dutch street.

The new telephone building is remarkable in several ways. As a building proper it has attracted much attention by the elegance of its architecture and the beautiful color and texture of the material used in the external decoration. In point of electrical equipment it is a striking refutation of the old proverb relating to footwear, for the building, which will be exclusively occupied by electrical companies, is provided with the most complete power and electric plant and systems of wiring for lighting and telephone work to be found in New York City. Finally, the building, although on a different street and of a different style of architecture, practically forms an enlargement of the present building, as the rear abuts on the west wing of 18 Cortlandt street, the floors are on the same level and the two buildings connect at each floor—that is, as long as the floors of the old building last out, for it has eight only to the present twelve and future sixteen of the new one.

THE BUILDING PROPER.

The Dey street building is of the steel cage construction, resting on a foundation of grillage beams which practically cover the entire lot. The front of the building measures 72 feet and the depth something over 90 feet. The shape of the floor plan is that of a T, the stem, with a court on either side lined with white enamel brick, running back to the end of the west wing of the Cortlandt street building. The building is designed for sixteen stories, twelve of which, besides the basement and sub-basement, have been carried out at present, the intention being to eventually increase the building to its full capacity by adding the four other stories at a later date. In this the architect, Mr. Cyrus L. W. Eidlitz, who has designed all the telephone buildings in New York, seems to have taken a wrinkle from the telephone switchboard, for the arrangement of a large building, so that its original capacity may be increased by some 30 per cent. as soon as desired, is not an every-day affair.

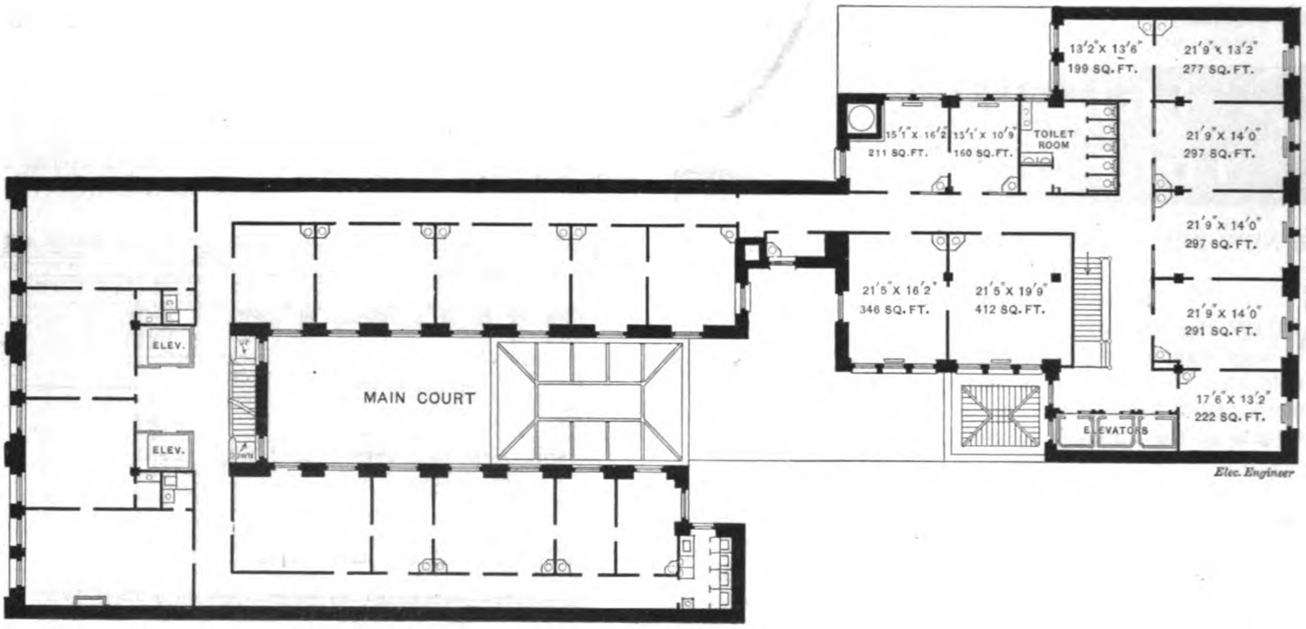
The distinctive feature of the building proper is the method adopted by the architect in carrying out the front, which from the basement to the roof is entirely of terra cotta, backed with brick work in the usual way. The style of architecture is classic in detail, resulting in a general simplicity and distinction of tone which are in the best of good taste and admirably suited to the character of the building. The terra cotta is heavily glazed; its general color is of a buff or cream tint, with such slight variations in shade as are found in burnt clays and which add interest to the color effect of the whole. The entire front has that warm ivory tone so much admired in ancient marble buildings, and this admirable effect has been so much noticed and commented on by those who have watched the construction of the building that general curiosity has been aroused as to the nature of the material used,



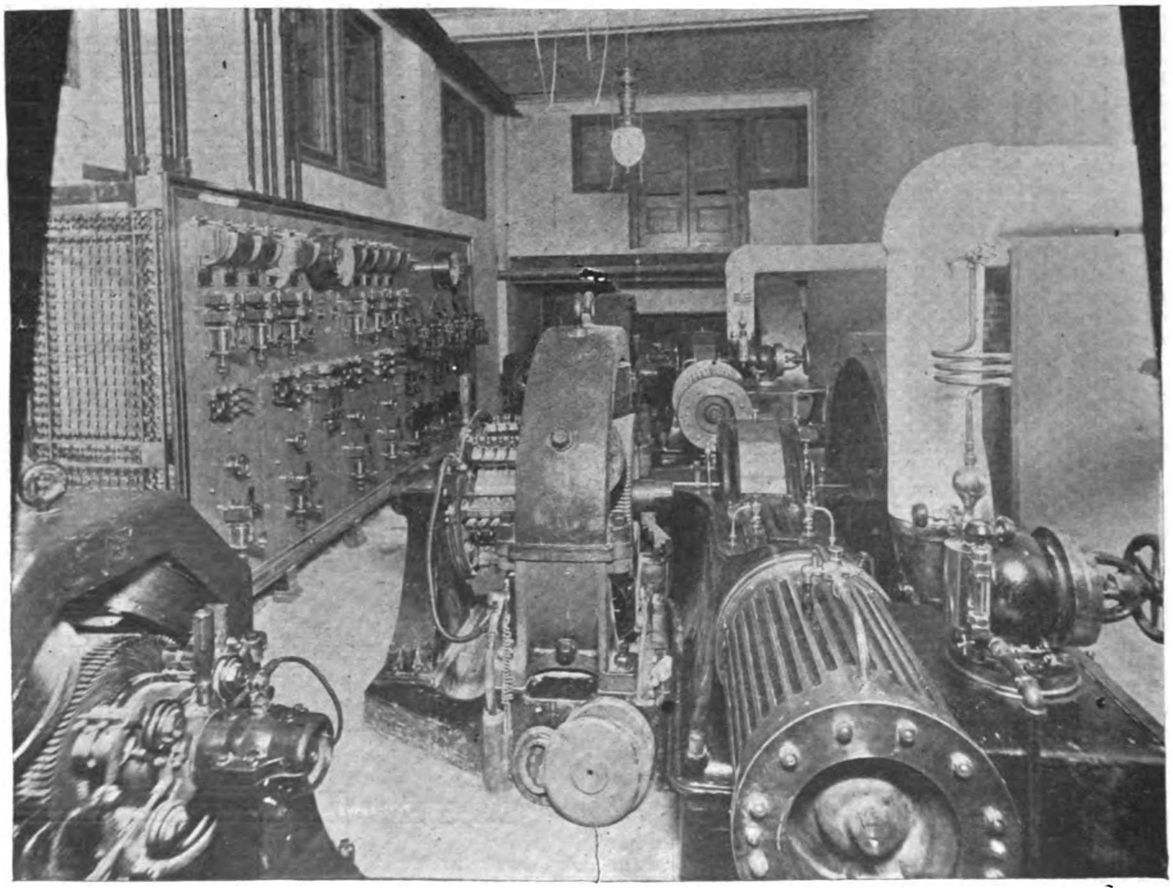
DEY STREET TELEPHONE BUILDING, FRONT ELEVATION.

most of the uninitiated believing it to be stone. The extreme hardness of the terra cotta justifies the impression of the casual observer who should take it for stone, as it is harder and more durable than many kinds of stone, and these qualities, together with the high glaze given to it, make it permanent and prevent staining from soot or the ravages of the weather. Naturally the use of terra cotta has necessitated a different distribution of joints than would have been the case with stone, as it is not practicable to manufacture the material in as large pieces as stone or granite can be obtained in, but the treatment of the joints has been skillfully handled as a part of the general design and in nowise detracts from the harmony of the architecture. The two lower stories are treated as a base and the five succeeding stories as a shaft, which is crowned by more richly ornamented features, with a heavy projecting cornice at the top.

The building is thoroughly fireproof and all parts have been scrupulously carried out in accordance with the latest methods of fireproof construction. The terra cotta is that of the Perth Amboy Terra Cotta Company.



Floor-Plan, Dey Street and Cortlandt Street Telephone Buildings.

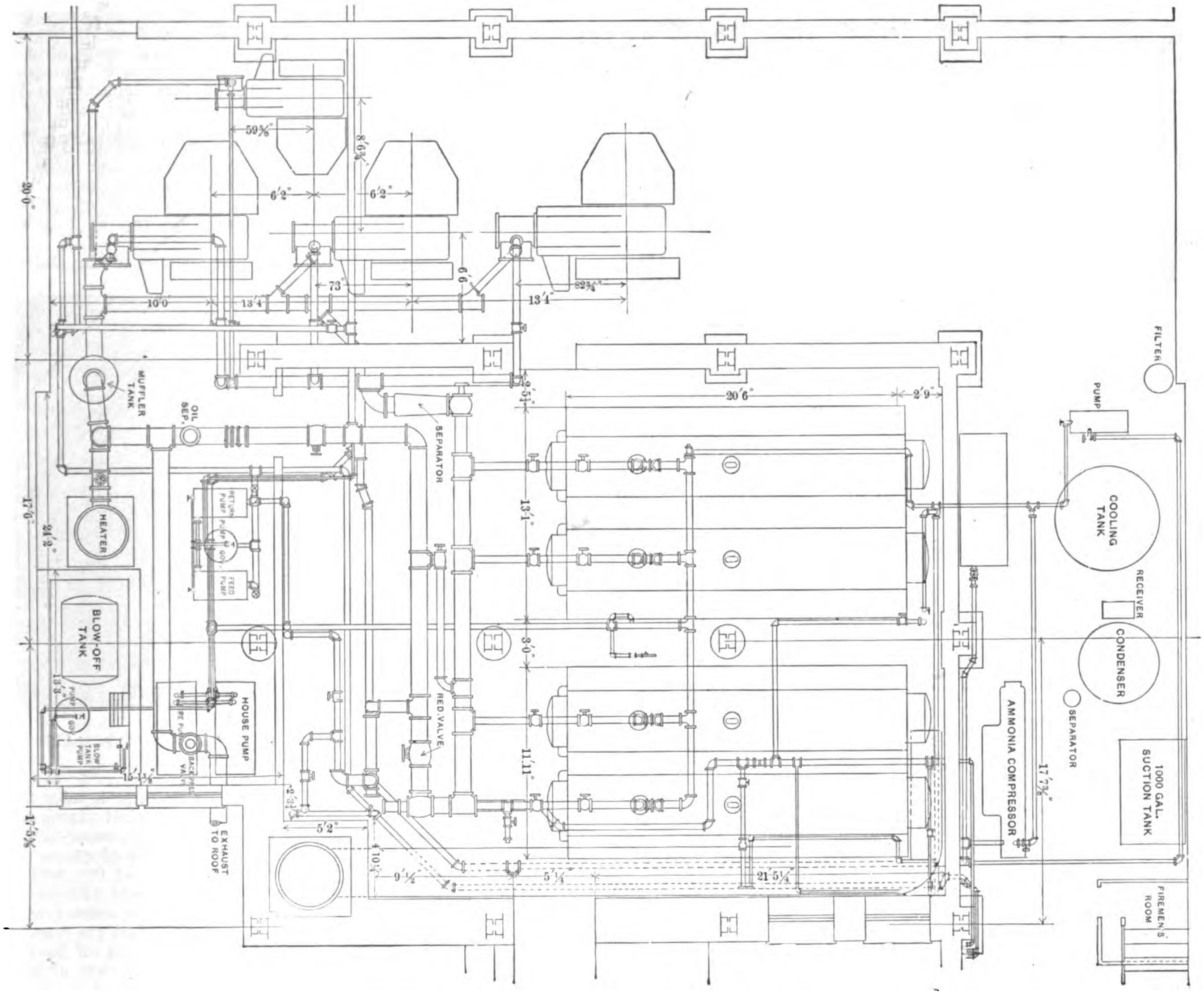


Dey Street Telephone Building.—General View of Engine Room. Western Electric Dynamos, Ball & Wood Engines.

THE POWER PLANT.

The power plant and the wiring of the building for lighting and telephone communication have been laid out by the engineering department of the New York Telephone Company, Mr. Edward P. Decker, formerly of Mr. J. J. Carty's staff, having drawn the specifications and supervised the work of installing the plant, wiring, fittings and fixtures from start to finish. Since Mr. Decker took charge of this work he has been appointed engineer in charge of the power and lighting plants of all the New York Telephone Company's buildings.

The power plant will furnish current for both the new and the old building and the present plant at 18 Cortlandt street will be done away with and the space otherwise made use of. The Dey street plant consists of a general central station to supply the two buildings with light, power, elevator service, heat, hot water and ice water, and its arrangement has given ample scope to its designer to turn out an up-to-date system; an opportunity which Mr. Decker has availed himself of in a manner that would do abundant credit to an engineer of far longer experience. The contractors who have carried out the work are the Western Electric Company, the Sprague Electric Elevator Company, Baker, Smith & Co., and Byrne & Murphy. The refrigerating machine and drinking water system were supplied by G. F. Blake Manufacturing Company.



The New Telephone Building, New York.—Arrangement of Boilers, Steam Piping, Refrigerating Plant, etc.—Plan.

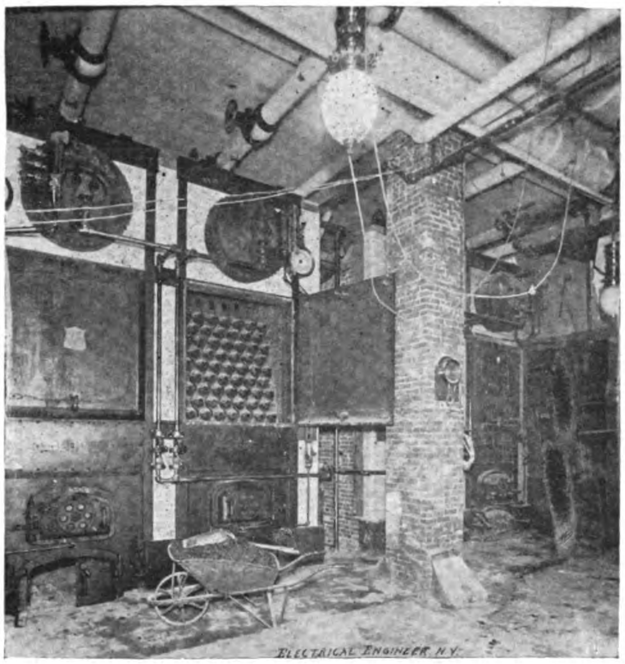
The plant consists of four boilers and four direct-connected units, three of 75-kilowatt capacity and one of 25-kilowatt. One of the 75-kilowatt units is to be used for running the three Sprague electric elevators with which the new building is provided; the other two and the 25-kilowatt unit will be used for the lighting and power work of the two buildings. The various units, although designed to be normally used as described, are so arranged and connected, as will be shown later, that they are completely interchangeable; any unit may be used either for the elevator or for the lighting circuits, and any one unit or all together may be used to supply both circuits simultaneously.

The boilers are Babcock & Wilcox wrought steel sectional type, arranged in two batteries of two each. They are suspended at each end from wrought iron supporting frames, independent of the setting, to allow of contraction and expansion without straining either boiler or brickwork. This arrangement also allows of repairing or renewing the brickwork without disturbing the boilers or their connections.

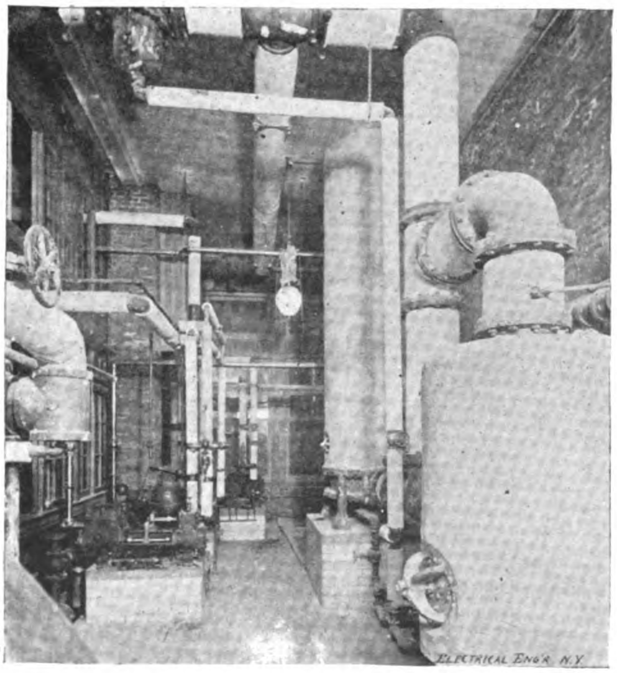
Instead of the usual brick wall at the back of the boilers wrought iron folding doors are fitted, permitting easy access to the entire rear end of each boiler for inspection and cleaning. The front of the battery is of ornamental design, the framework being of heavy wrought iron channel and I-beams, filled in with white enamel brick; the frame is fitted with large doors to give access to the handhole plates and front headers. The heating surface of each boiler consists of a steam and water drum 36 inches in diameter by 21 feet 3 inches long, placed above and connecting with a set of seven sections of tubes in two boilers, and with a set of six sections of tubes in the other two; each section of tubes contains nine tubes 18 feet long and 4 inches in diameter. The total heating surface is 5,208 square feet and the total grate surface 115½ square feet. The boilers are designed for a working pressure of 200 pounds and have been tested in place and made tight at 300 pounds, but the actual working pressure at present will be 100 pounds.

ENGINES AND DYNAMOS.

The engine and generator plant consists of four Ball & Wood single cylinder, high-speed engines directly connected to four Western Electric compound-wound multipolar dynamos, three



Dey Street Telephone Building.—Boiler Room.



Dey Street Telephone Building.—Pump Room; Showing Muffling Drum and Feed Water Heater.

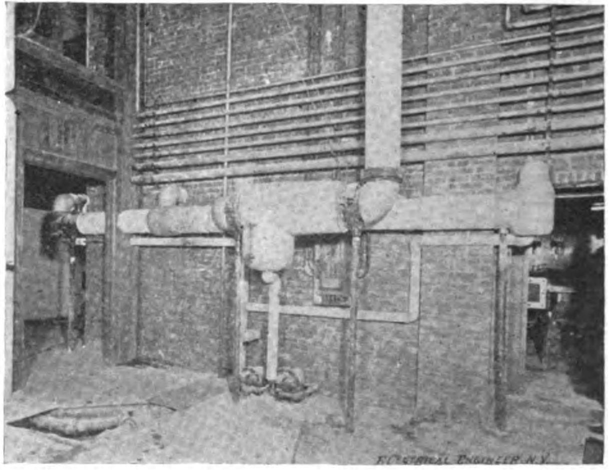
of 75-kilowatt capacity and one of 25 kilowatt. One 75-kilowatt unit is specially designed to run the electric elevators and the engine is slightly larger and with a heavier fly-wheel than those of the other two 75-kilowatt sets, which, together with the 25 kilowatt set, are for the lighting of the two buildings. The 75-kilowatt sets will be driven at 275 revolutions per minute and the 25-kilowatt set at 300 revolutions. The generators are designed to furnish a pressure of 120 volts at these speeds and at normal load must deliver at least 8 amperes per kilowatt capacity. The specifications require a commercial efficiency at full load of not less than 90 per cent. for the 75-kilowatt machine and not less than 86.5 per cent. for the 25-kilowatt machine, and at half load of not less than 88 per cent. and 83.9 per cent., respectively. When working continuously at full load the temperature of the field and armature windings is not to exceed 60 degs. Fahr., and that of the commutator is not to exceed 80 degs. Fahr. above that of the surrounding air.

Each dynamo is to be capable of carrying an overload of 30 per cent. for a period of one hour without sparking or injurious heating. The machines must operate from no load to 30 per cent. overload without the brushes being shifted and without sparking, and to 50 per cent. overload without flashing or injurious sparking. The four machines must operate perfectly when running in multiple.

ENGINE AND BOILER ROOMS.

The four steam and electric units are set in a row in a spacious and lofty engine room in the sub-basement immediately opposite the bottom of the elevator shaft. The engine room, containing the engines and dynamos, elevator motors and switchboard, measures 64 feet by 19 feet and is 20 feet high. Immediately adjacent, and practically forming one department with the engine room—as the brick partition between the two has, besides the steam pipe openings, a large doorway, throwing the two departments together—is the boiler room, which measures 40 feet by 33 feet, containing the boilers and furnaces, feed-water heater, pumps, oil pump and filter, etc. A praiseworthy feature of this department is a small gallery containing a toilet room and shower bath for the use of the engineer in charge of running the plant.

In close proximity to the hot-water plant is installed an outfit for the very opposite purpose—a Blake refrigeratitng machine with storage tanks for containing ice water. From these tanks ice water will be pumped to every floor of the two buildings where it will be continually on tap at fountains placed in the halls.



Dey Street Telephone Building.—Decker Steam-Drying Device.

A device introduced by Mr. Decker to secure the delivery to the engines of perfectly dry steam is a large header main provided with a drain to carry off the water that may collect in it. The main steam supply from the boilers passes through a separator and then feeds into this pipe; the pipes running to the engines branch off from the upper part of it. Any water carried over from the boilers with the steam and not collected in the separator will naturally tend to collect at the bottom of the pipe or header main and will find its way into two pockets at the ends whence it will be carried off by drain pipes protected by a trap operated by the collection of water in the drain pipes. A grease extractor is inserted in the exhaust pipe to cleanse the steam passing through the heating system of particles of grease.

The house pumps are controlled by automatic regulating valves which stop the pumps when the tank is filled and restart them when the water falls to a certain height. The pumping plant is separated from the rest of the boiler room by a glass partition which permits the engineer of the plant to keep a watchful eye on the operation of the pumps while it protects them from the dirt and dust incident to a boiler room. The pumps are of Worthington make.

The ventilation of the engine and boiler room has been well attended to by the placing of three large ventilating flues in the upper part of the rooms connecting directly with the air-space surrounding the main boiler flue. This arrangement will give a permanent and sufficiently powerful draught to ensure efficient ventilation without the use of mechanical blowers.

The brick partition which partially shuts off the boiler room from the engine room is double, with a large air-space in the middle, in order to prevent the heat of the furnaces and boilers from making things too warm in the engine and dynamo room; the opening in the partition is at the end of the room furthest away from the boilers. The engine and boiler rooms are lighted by arc lamps.

MACHINE FOUNDATIONS.

In the installation of the power plant every precaution has been taken to guard against vibration. The foundations of the engines, dynamos and elevator machinery have been combined into a single mass, consisting of a solid prism of concrete, three feet thick, which extends nearly the entire length of the engine room and has been so planned that it in no part touches the foundations of the building. Where this concrete foundation overlaps the grillage beam piers that support the columns of the building the overlapping parts are supported by I-beams bridging over the grillage beam piers without touching them, thus leaving an air space between the machine and building foundations. In this way an absolutely separate foundation for the engines and dynamos has been obtained and vibration from them cannot well be communicated to the building. To reduce the possibility of vibration being transmitted from the exhaust pipes the exhaust from each engine is connected to the main exhaust pipe at an angle of 45 degrees instead of at right angles, as is the common practice; the main exhaust pipe has been much increased over the standard practice and is connected to a large muffling drum provided with screens to collect the water before the steam passes to the feed water heater and to the steam heating system.

The steam heating system is arranged so that it may be supplied either from the exhaust steam or direct from the boilers, and the entire plant may at any time be connected with the New York Steam Company's supply, so that even in the unlikely event of all the boilers being put out of service at the same time the entire plant of engines and dynamos, heating systems, etc., could still be operated without interruption.

THE SWITCHBOARD.

The switchboard is a notable piece of work, of which the electrical contractors have every right to be proud. It is of pink Tennessee marble, two inches thick, and measures 19 feet long by 7 feet 10 inches high, and stands 8 inches above the floor. It is enclosed in a bronze frame and flanked with bronze wire doors which close the space between the board and the wall. About a third of the space of the switchboard at the right hand end is occupied by the pilot motors, rheostats, switches and instruments governing the operation or the elevator plant. The rest of the board carries the switches, circuit breakers, fuses, rheostats and measuring instruments relating to the generators and lighting feeders. At the rear of the switchboard run two sets of bus bars, one of 2,000 amperes capacity for the lighting system and one of 1,000 amperes capacity for the elevator system. The two sets of bus bars are so arranged that they may be connected together and operated from any one or all of the machines, or either set may be independently operated from any machine or combination of machines. The generators are connected through fuses and magnetic circuit breakers to double-throw switches by means of which they may be thrown on to either the lighting or the elevator bus-bars. The field rheostats, of the Carpenter enamel type, are mounted at the back of the switchboard, their controlling handles only projecting through in front.

The arrangement of measuring instruments is very complete and affords most perfect control of all the circuits. The adoption of the Van Vleck edgewise system of instruments has added much to the appearance of the board and has made it possible to install the required amount of apparatus in much less space than is usually required. The lighting bus bars are provided with an ammeter reading up to 2,000 amperes and a voltmeter reading up to 125 volts, and with a Thomson recording wattmeter; the elevator bus bars have an ammeter reading up to 1,000 amperes, a voltmeter reading up to 125 volts and a recording wattmeter. On the lighting section there is also a Weston illuminated dial ground detector.

At the center of the lighting section of the switchboard are mounted four ammeters, three reading up to 750 amperes and one reading up to 300 amperes, for the four generators. On the lighting section of the switchboard is also mounted a differential voltmeter, reading up to 130 volts, which is connected to a double-pole multiple-throw switch so that it may be used to register the voltage of any single machine or pair of bus bars. All the measuring instruments except the Thomson recording wattmeters are of the Weston type.

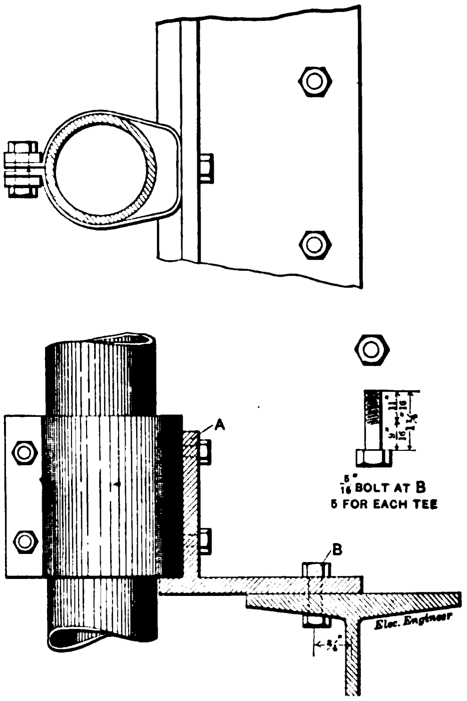
The leads from the generators to the switchboard and from the switchboard to the elevator motors are run in iron-armored conduits under the floors. The positive, negative and equalizing bus bars pass in a horizontal direction across the back of the switchboard; the elevator bus bars are connected through circuit breakers to the rheostats controlled by the pilot motors which govern the operation of the elevator motors proper. Another noticeable feature of the switchboard is that there are no feeder switches, the feeders being connected to the lighting bars through automatic circuit breakers.

THE ELEVATORS.

The three elevators are of the improved Sprague screw type and embody the latest developments in electric elevator machinery. At the bottom of the shaft of the elevator nearest the street door is placed an auxiliary machine operating a drum, the cable from which can be connected whenever desired to the counterweight of the elevator to furnish additional power for the raising of safes or other heavy loads.

DISTRIBUTION SYSTEM.

The system of distribution is as follows: A vertical shaft runs the entire height of the building with openings, protected by folding iron doors, in the main hallway of each floor. The shaft measures 3 feet 6 inches by 12 inches and accommodates both electric lighting and telephone cables, the former occupying the northern end and the latter the southern end. The openings in the shaft are framed with steel beams, the floor beams of the building forming one side of the frame, to which the iron-armored conduits containing the lighting cables and the lead-covered telephone cables are fastened by means of the regular telephone cable clamp. This clamp is a split iron tube, four inches long, which binds on the cable by means of a pair of bolts and nuts; the purchase obtained is so firm that it was found impossible in a recent test to budge a cable so clamped by hauling on a lever three feet long clamped on just above the clamp undergoing the test.



THE "TELEPHONE" CABLE CLAMP.

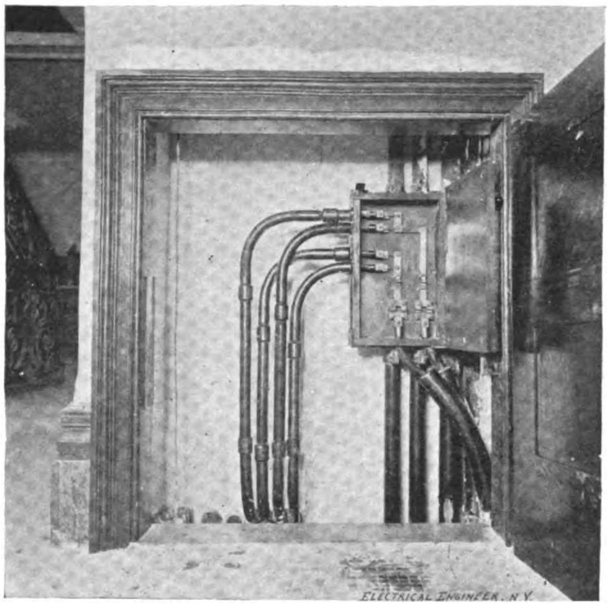
Through the shaft, from the basement to the twelfth floor, extends a pair of mains of 133,000 circular mils cross-section, placed in 1¼-inch iron armored conduit; these mains open at each floor into slate boxes bound with iron, supported on the frame of the shaft, at which connection is made with the submains supplying the various rooms on each floor. From the switchboard run three sets of feeders which are connected to the mains at different floors through slate junction boxes. The first pair of feeders are of 214,000 circular mils cross-section, in 1¼-inch iron armored conduit, and connect to the mains at the second floor; the second pair are of 266,000 circular mils, in 1½-inch conduit and connect at the sixth floor; the third pair are 310,000 circular mils in 1½-inch conduit and connect to the mains at the tenth floor.

Each floor is divided into two sections under the scheme of distribution, and from the slate junction boxes two pairs of sub-mains are run in ¾-inch iron-armored conduit under the flooring to two distributing boxes set in the walls of the corridors, one in the north part of the building and one in the south part. These distributing boxes consist of an inner box of slabs of pink Tennessee marble ⅝ inch thick surrounded by an outer case of kiln-dried hard wood, an air space of 2¾ inches separating the two boxes; the front is closed by a heavy bevelled plate glass door in a bronze frame set flush with the wall. On the back panel of the marble box are mounted the terminals and fuses connecting the sub-mains with the branches extending to the fixtures in the different rooms and hallways. In each distributing box is mounted a knife switch connecting the sub-mains with the terminals of the branch circuits. The appearance of these distributing boxes is extremely pleasing and they give an air of finish and thoroughness to the system of distribution which is convincing of the completeness of those portions of the system which are not so much in evidence.

From the distributing boxes the branch circuits go in ⅝ inch iron-armored conduits to the various fixtures, one circuit going to each room and hallway. The conduits are carried as much as possible in the concrete over the iron floor beams, every precaution being taken to avoid notching the wooden sleepers that carry the flooring. All joints in the conduits are made tight with red lead and painted with insulating paint. The conduit is that of the Interior Conduit and Insulation Company.

LAMPS AND FIXTURES.

The lamps used are 118 volt, taking .5 ampere of current, a total drop of 2 volts being allowed for in the mains. The total number of lamps to be installed at present in the new building is over 1,100; in the old building the total number of lamps is 940. Another departure from general practice has been made in adopting chandelier pull switches, which throw on all the lamps in the fixture at once, in place of the wall switches commonly used, thus effecting a very considerable saving in the amount of wire used in the system. The general arrangement of lighting in the various offices consists of one central combination chandelier and four wall brackets.

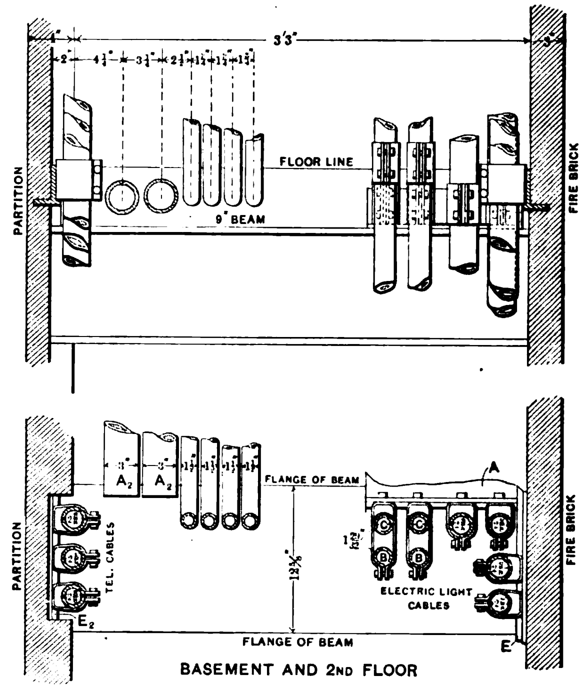


Dey Street Telephone Building.—Cable Shaft, Showing Electric Light Junction Box.

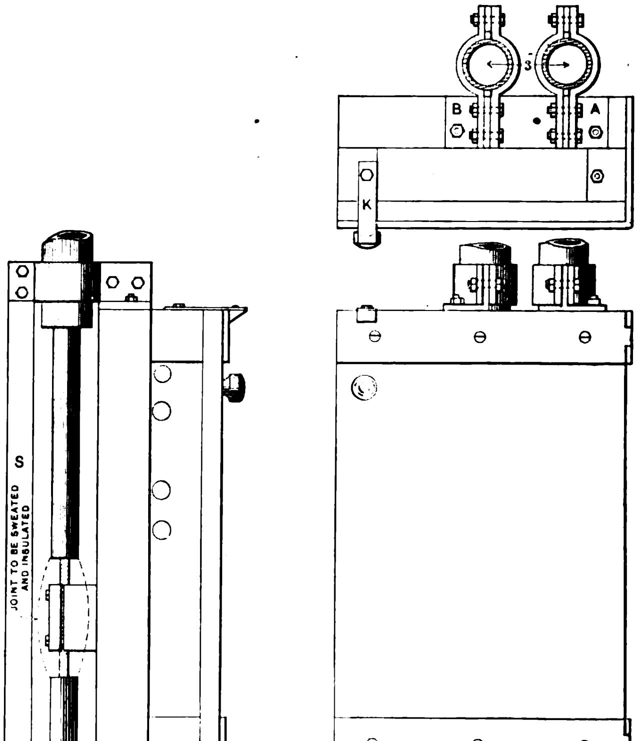
The fixtures are of lacquered brass; each wall bracket is provided with a spare socket at the base of the fixture so that a plug for a portable lamp or for a fan motor may be attached without interfering with the lamp belonging to the fixture. All lamps will be enclosed in opalescent globes and the lamps are all turned upward, a sign of the sensible reaction which has set in lately toward the normal way of placing lights. Since combination fixtures are now so seldom used there is little sense in the turning down of incandescent lamps after the fashion so slavishly followed by fixture makers all these years, and a reversion to the natural and proper position for an ordinary light is quite refreshing.

POWER FOR THE CORTLAND STREET BUILDING.

The lighting and power work of the Cortlandt street building is to be supplied from the new plant by a pair of feeders of 750,000 circular mils cross-section run in 2-inch iron-armored conduit to the present switchboard in the Cortlandt street engine room. At this point the feeders will connect at a special slate junction box with six distribution circuits supplying the old building. These circuits are as follows: East branch, 130 amperes; center branch, 150 amperes; west branch, 175 amperes; long-distance operating room, 30 amperes; sub-cellar, 30 amperes; power circuit, Cortlandt street exchange, 25 amperes.



Arrangement of Electric Light and Telephone Cables in Cable Shaft.



Slate Junction Box in Cable Shaft for Connecting Lighting Mains to Sub-Mains on Each Floor.

When this work is completed the engines and dynamos now supplying the Cortlandt street building will be taken out and the only machinery that will be retained there will be the blowers used for forcing air into the subways for the ventilation of the manholes.

TELEPHONE DISTRIBUTION SYSTEM.

The distribution of telephone wires through the building is effected by means of a miniature subway system running under the various floors. Starting from the underground room in the basement of the Cortlandt street building are two 200-pair cables which run up the cable shaft in the new building, being supported by clamps attached to the steel beams forming the framework of the shaft in a similar manner to the iron-armored conduits containing the electric light mains and feeders. On the various floors two 2-inch wrought iron ducts are extended under the flooring from the cable shaft to two main distributing boxes, one for the north section of the building and one for the south, set in the partition walls of the halls. These distributing boxes contain cross-connecting strips of the usual telephone pattern.

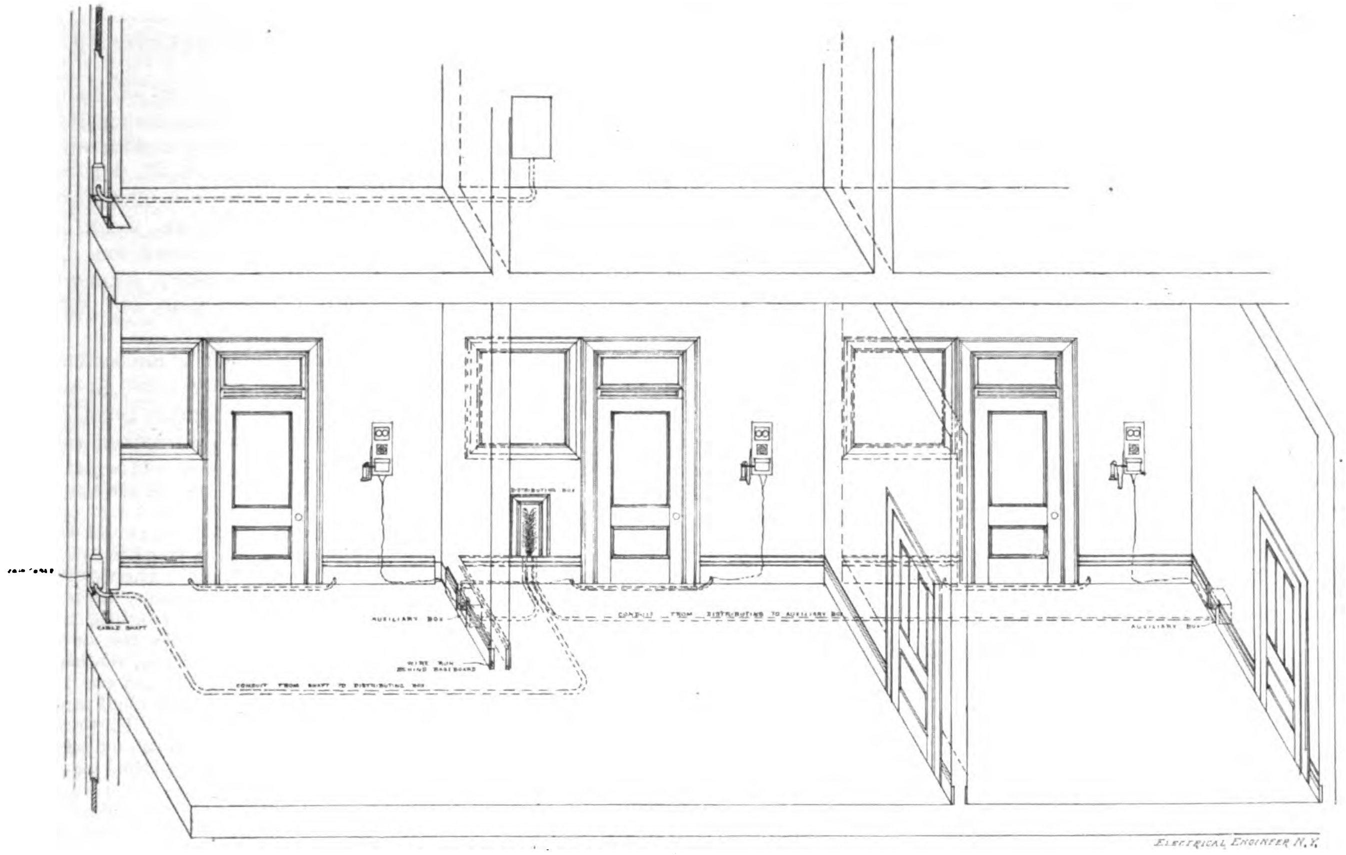
From the main distributing boxes lateral iron ducts of 1¼-inch diameter are carried to sub-distributing boxes placed in the partition walls of the various rooms. From these terminal boxes, each of which serves two rooms, the telephone wires will be drawn through a square duct or way behind the baseboard of the wainscoting; a little door is mortised in the baseboard at each corner of the room, from which points wires may be fished for in either direction. The wires may be brought out from this room duct through the beading at the bottom of the baseboard at the exact points where telephone instruments are needed. In order to pass the doors which afford communication between the different rooms lengths of 1¼-inch iron pipe, with an easy bend, are placed under the door frames, the ends of the pipe giving into the wall duct on either side.

On each floor branch cables will run from the main cables in the shaft through 2-inch ducts to the main distributing boxes, where they will be headed up in flexible heads and connected to the distributing strip terminals, and from these points either smaller cables or separate pairs of wires may be run through the lateral ducts to the room terminal boxes set in the partitions of the rooms. The intention is at first to run separate pairs of wires, except where the number of telephones required justifies the use of a small cable; but the individual pairs may at any time be drawn out and a cable substituted whenever the demand for telephones increases. If at any time fifty telephones were required in one room the necessary wires could be run in a few hours and without any inconvenience.

This system of distribution embodies the maximum of elasticity and flexibility in the arrangement of wires together with extreme durability and great facility for maintenance and prompt location of troubles. The building, as is meet and proper, will undoubtedly have the most substantial and up-to-date system of telephone wire distribution yet devised for an office building. It is to be hoped that architects and engineers who may be called on to lay out the wiring and accommodations for wiring of large buildings will take a hint from the work done at Dey street. In most business offices to-day the telephone takes a more or less important place; in the majority of offices there is at least one telephone and in many cases a number of wires are required in a single suite of rooms. Yet even in the most modern buildings the accommodation provided for connecting the various rooms is ludicrously inadequate, and it is often necessary to run wires or cables up elevator shafts or in through windows. A proper system of ducts, through which cables and wires can be drawn in and out as required, is the only proper and workmanlike method of providing for the numerous telephone circuits required in the modern office building, and the installation in the new telephone building is an excellent model for architects and engineers who desire to be up to date in this important detail of office building equipment.

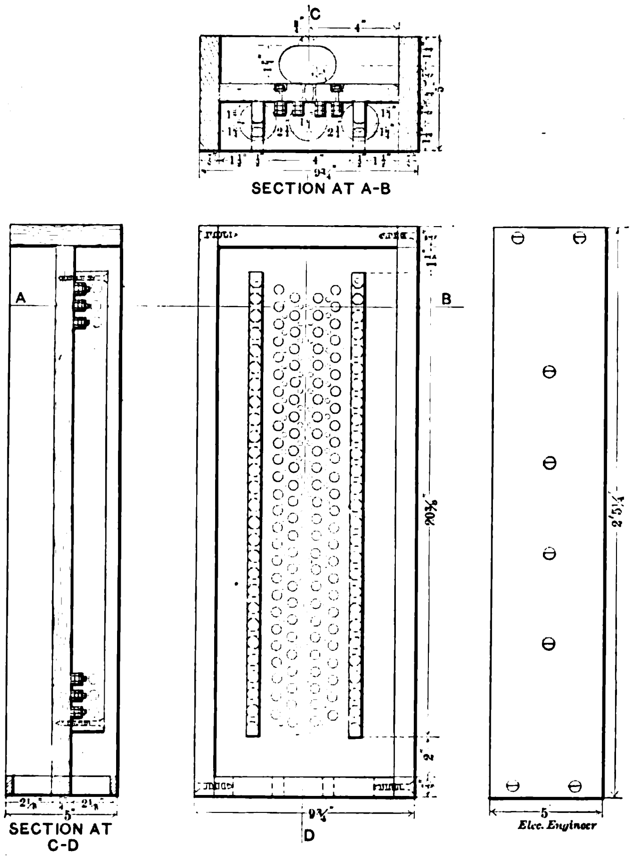
The internal arrangements of the building call for little remark beyond what has already been described. The ground floor is divided into a large hall, with the entrance at the eastern end of the building, and a spacious department, with two entrances, available to be leased either as one store or two. The main hall will communicate directly with the hall of the Cortlandt street building, making one long hall through from street to street. The main pay station now in the hall at 18 Cortlandt street will be retained there, the arrangements being slightly altered so as to make a clear passage through from building to building. By placing the engine and boiler rooms at the back of the new building two large departments are obtained in the front of the basement and sub-basement available for storage purposes and served by a sidewalk elevator. The principal entrance to the building is No. 15 Dey street.

The second floor is open to tenants, while the rest of the building will be occupied by the various departments of the telephone companies now in 18 Cortlandt street. The rear part of the eighth floor, which is on a level with the operat-

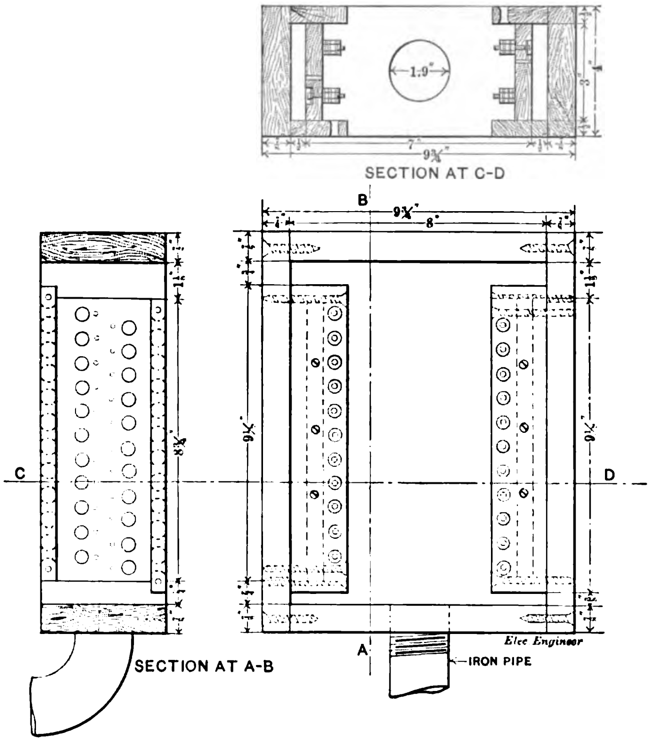

CABLE SHAFT
DISTRIBUTING BOX
AUXILIARY BOX
WIRE RUN BEHIND BASEBOARD
CONDUIT FROM SHAFT TO DISTRIBUTING BOX
CONDUIT FROM DISTRIBUTING TO AUXILIARY BOX
AUXILIARY BOX
ELECTRICAL ENGINEER N.Y.

DEY STREET TELEPHONE BUILDING.—DIAGRAM OF TELEPHONE DISTRIBUTION SYSTEM.

ing room of the Cortlandt street exchange, has been left without partitions as it will probably be ultimately used for exchange purposes. The front part will be occupied by the engineering department of the New York Telephone Company.



Telephone Distribution.—Main Distributing Box.—Two of These on Each Floor.



Telephone Distribution.—Auxiliary Distributing Box Placed in Partition Between Each Pair of Rooms.

The ninth floor will be occupied by the general manager's, contract and filing departments of the New York company, and by the operating room of the common battery telephone system which serves the various offices. On the tenth floor will be the offices of the president and of the secretary of the New York company, and on the eleventh and twelfth those of the executive and general manager's departments of the American Telephone and Telegraph Company.

It is expected that the building will be completed and ready for use before the beginning of April, a pretty quick piece of work, as it was begun in March, 1896.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE—I.

BY JOSEPH APPLETON.

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INTRODUCTORY—CONSTRUCTION AND OPERATION OF STORAGE BATTERIES.

THE storage or accumulation of any form of energy or force is an important factor in determining its commercial value. Conditions exist in the daily routine and pursuits of life, which render it absolutely necessary to have a reserve supply of any commodity which is indispensable. With electricity this is especially so. When the secret of storing electrical energy became known its value was greatly enhanced, and to-day electricity is universally acknowledged to be the ideal power on account of the ease with which it can be generated, distributed and stored.

Electricity is stored in a manner which is impossible with any other power. More energy can be contained in a given space and weight than with any other known force. While stored, the energy is dormant, and can be retained for long periods with very little loss. It is capable of being transmitted over great distances with safety, and is always under perfect control.

A better illustration of the above cannot be found than in the utilization of stored electrical energy at the Electrical Exhibition, held in New York City in May, 1896. Electricity generated at Niagara was stored there in batteries, then transmitted by rail to the exhibition and used for sending the congratulatory messages around the world; also for operating various apparatus in the exhibition, such as the model of the Niagara plant in the daytime. Until recent years the storage battery has not played a prominent part in electrical engineering work in the United States. In Germany, England and France its value has been proved beyond a doubt, and it has become an accepted factor in all important electrical problems. Unfortunate litigation was the principal cause of the unsatisfactory results in this country, affecting the industry in two ways; namely, first by preventing capital from becoming interested in the development of the art, and second, by deterring the use of battery installations for fear of protracted and expensive litigation. However, matters have now been smoothed out, and there is no longer any need for electrical engineers to refer to foreign practice as a justification for the use of storage batteries, for here in the United States we can find battery plants, which excel those in Europe, both as regard magnitude and method of installation. Owing to the more general use of electricity in this country and the rapid growth of the same, future prospects bid fair to eclipse the steady and more conservative demand which exists in Europe.

A storage battery, or electric accumulator, consists of one or more cells, each cell being a distinct unit in itself, the number employed depending entirely on the purpose for which they are used.

A cell consists of three principal parts, the plates, the electrolyte and the containing jar or box.

The plates are divided into two kinds, positive and negative, and a set or group of these is commonly known as an element. The element is placed in a containing jar or box, which is then filled with a solution or electrolyte.

Up to the present time only one metal has proved practical for storage battery work; that is, lead. Many others have been tried, and while it is quite possible that future improvements may lead to the use of other metals, notably zinc, for the negative plate, yet the lead storage battery is the only one which can at present be considered a practical piece of apparatus.

The storage of energy in electric accumulators is accomplished by means of chemical action, produced by the passage of an electric current through the element and electrolyte. The lead plates which form the element must be so constructed as to present a large surface upon which the chemical action may take place, as the amount of energy which can be stored up in a cell depends on the capability of the plates to take up the chemical action. This is termed the capacity of a cell. There are several ways of preparing the plates for this end, and they will be considered later.

The positive plates consist of lead, upon which a coating or covering of peroxide of lead has been formed, while the negative plate is pure lead, the surface of which is of porous or spongy formation. The peroxide of lead and spongy lead, respectively, are the portions of the plates which are subjected to the chemical action, and are, consequently, called the active material. The electrolyte used with all lead storage batteries is sulphuric acid diluted with water, the specific gravity ranging between 1.15 and 1.30, according to the type of cell.

The positive and negative plates of each cell are arranged alternately in a group, all the plates of like denomination being connected together in multiple. Insulating pieces, or separators, are provided to keep the plates apart, so that when they are connected respectively to the positive and negative poles of a source of electricity the current can only pass from one to the other by flowing through the electrolyte.

The chemical condition of the plates and electrolyte differs when charged and discharged. When the cell is fully charged the positive plates have a coating of peroxide of lead, the negatives being porous or spongy lead as previously described, and the electrolyte is of its full strength or specific gravity. During discharge, that is, when the positive and negative poles of a cell are connected through an external circuit, an e. m. f. is set up in the cell, a current flowing into the circuit from the positive plate.

The chemical action which takes place during discharge is as follows: The sulphur radical in the electrolyte enters into combination with the active material on both plates forming sulphate of lead, the specific gravity of the electrolyte being correspondingly reduced. When all the active material has been acted upon in this manner, the cell is discharged, for an equilibrium has been created between the two plates and the e. m. f. has fallen to zero. In practice, however, the discharge is not carried to this point, but is stopped before all the active material has been acted upon.

The e. m. f. of a cell during discharge commences at 2 volts or a little over, and drops to 1.8 volts when the cell is discharged down to a practical limit. The discharge might be carried further than this, but only under certain conditions would this be advisable, as will be shown later.

The current which can be obtained from a cell, and the time for which it can be maintained, depends on the number and sizes of the plates, together with their construction.

When a cell is being discharged the chemical action is reversed. The current enters the cell at the positive plate, passing through the electrolyte to the negative. The passage of the current through the electrolyte decomposes it, oxygen and hydrogen gas being given off. The oxygen is given off at the positive plate and converts the sulphate of lead into peroxide of lead again, the sulphur going back into the electrolyte; the hydrogen which is given off at the negative plate enters into combination with the sulphate of lead, reducing it to pure lead, the sulphur returning to the electrolyte and increasing its specific gravity. This action restores both plates and electrolyte to the original condition of full charge. If the charging current is continued after the cell is fully charged; that is, when all the active material has been reconverted to peroxide of lead and spongy lead respectively, the oxygen and hydrogen gas will be given off in bubbles.

Naturally the chemical action can only take place at a certain rate, depending on the amount of active material and the construction of the plates. If it is attempted to give to, or take from, a cell too much current the efficiency and durability are affected. The given output of current per unit of weight and area of plate or capacity will be considered in a subsequent chapter.

Generally speaking, there are two distinct methods of preparing the active material of storage battery plates. One of these consists in applying mechanically some material to the surface or exterior of a lead conducting plate or grid, which is either active itself or can be converted into active material by a process of electrical or chemical formation. The second method consists in treating or forming electrically or chemically the surface of a lead plate, which has been designed to present a large area to the electrolyte, whereby the surface is converted into active material.

The first method is commonly known as the "pasted" type of cell, although the active material is not always applied in the form of paste. The second method is known as the "Planté" type, so called because Gustave Planté was the first to utilize practically the electrical method of forming the plates without the use of applied material.

It will be seen from the above description that the storage of electrical energy is entirely different from the storage of any other form of energy. A quantity of electricity cannot be stored or accumulated in a vessel or reservoir, because it does not exist in a tangible form. We are able, however, to make the electric current perform work in the shape of chemical action and afterward, by setting up certain reactions, can reproduce the current stored. As long as the materials used are free from impurities and the chemical action is continued until completed, there is practically no limit to the time which may elapse between the storage of electricity with its contingent chemical action and the reaction which, practically speaking, sets free again the electric current.

Having considered the principles upon which the storage of electrical energy depends, and noted the various elements which are necessary to make up the complete cell or storage battery, we will now examine the various types of cell, which are the outcome of all the time and money expended on the attempts to produce the ideal storage battery.

AMHERST EXPERIMENTS ON THE ELECTRO GERMINATION OF PLANTS.

THE Hatch Experiment Station of the Massachusetts Agricultural College has just issued a bulletin (No. 43) on "Electro Germination," which describes an extended series of experiments carried out by Mr. Asa S. Kinney. This work is of such general interest and value that we give below an extended abstract of the bulletin, from which the accompanying illustrations are also taken.

The experiments have followed in many instances those of Specnew. The objects of these experiments have been three-fold. First, to determine whether the seed germ responded in any way when subjected to electrical influence. Second, should there be any visible action, to determine whether it was injurious or beneficial. Third, to determine the effect of different strengths of current. These experiments have been carried on from a scientific standpoint rather than from any practical application to which they may be put, although with proper apparatus the use of electricity may prove of considerable service in the germination of some small seeds which under ordinary conditions start very slowly.

Apparatus and Methods.—The kinds of apparatus and the methods described are those which gave the best results.

The batteries used in the experiments were of two kinds, namely, four Leclanché cells arranged in series giving an electro-motive force of from four to five volts and two No. 1 Samson cells giving an electro-motive force of two and eighty-eight hundreth volts.

In order that a large variation in electro-motive force could be obtained, an induction coil was employed. The one in use was a Du Bois-Reymond inductorium, manufactured by the Cambridge Scientific Instrument Company, England. This coil is a form of the Ruhmkorff apparatus, but has several special modifications which make it especially adapted to this form of experiment. In Fig. 1 there is shown at I a side view of the coil as it is set up for use. The primary coil, C, consisting of a core of soft iron rods, is fixed and wound with about one hundred and thirty turns of moderately thick insulated copper wire. The secondary coil, B, having six thousand turns of fine copper wire, is quite separate from the primary coil and slides in a groove in the wooden standard. In this way the secondary coil may be brought over the primary coil or removed quite a distance from it.

In some of the experiments hourly treatment was desired. This was accomplished by passing the wires from the battery to an electric clock and thence to the induction machine. Each hour, the clock formed a connection completing the circuit and a current was passed through for a period of about thirty seconds.

Methods of Applying the Stimulation.—In some experiments the apparatus represented in Fig. 2 was used. This consisted of two glass cylinders, a larger one about two inches in diameter for large seeds and a smaller about three-fourths of an inch in diameter for those of less size. Within these cylinders, thoroughly moistened seeds were placed and the openings closed with copper discs having wires attached. By means of these wires the discs were connected with the poles of the induction coil and a current passed through, the moist seeds making a good conductor. After the seeds had been

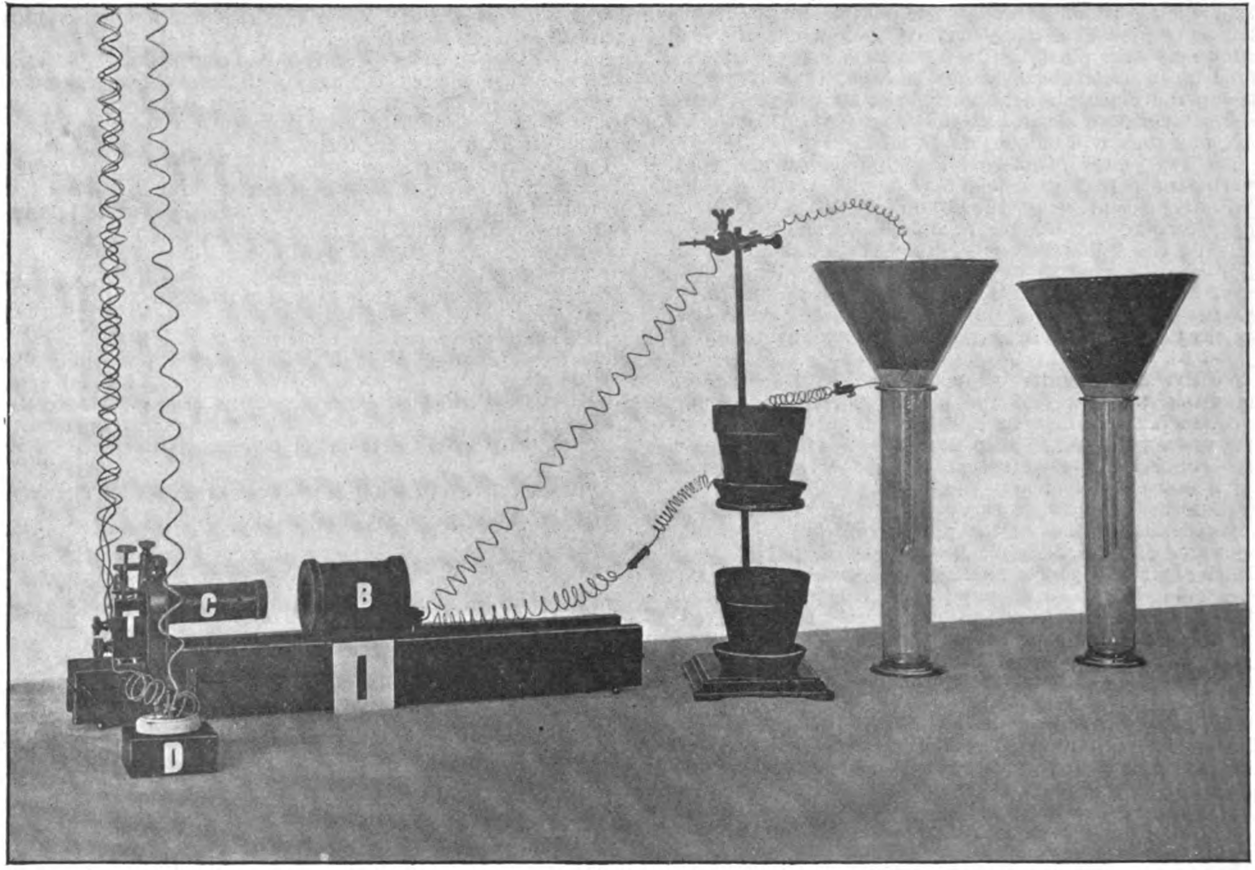

FIG. I.—INDUCTION COIL AS ARRANGED FOR ELECTRO GERMINATION WORK.

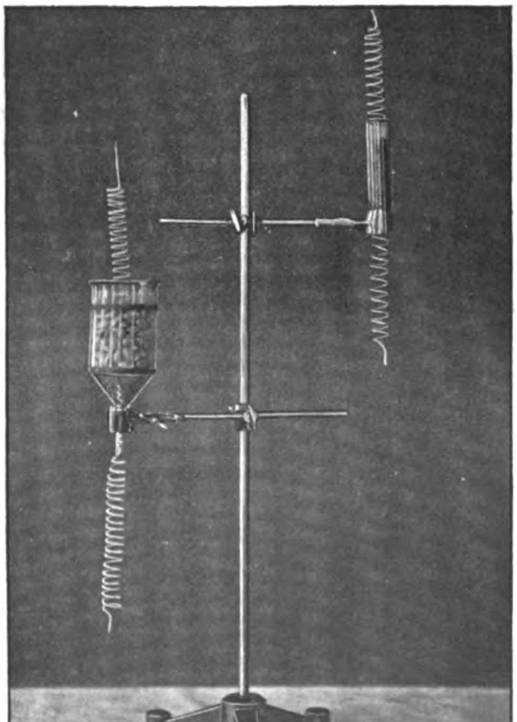

FIG. 2.—ELECTRO GERMINATING APPARATUS.

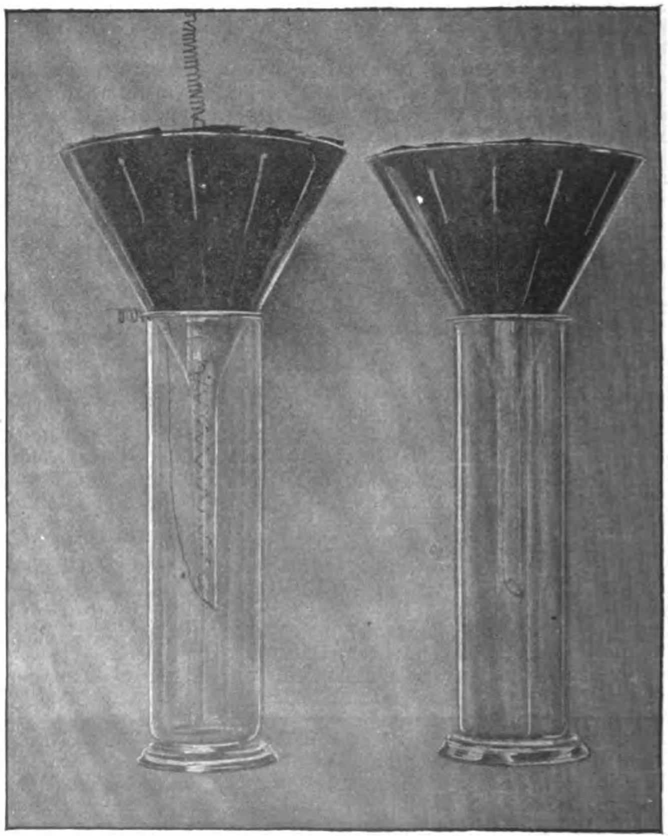

FIG. 3.—ELECTRO GERMINATING APPARATUS.

stimulated by passing the current through them they were placed in germinating pans as shown in Fig. 5.

Another method of applying the stimulation is shown in Fig. 3. This consists of two seven-inch glass funnels. Within each of these funnels are two copper discs, a small one at the bottom and a larger one at the top. In the upper disc of each funnel are twelve holes, at equal intervals around the edge, to allow the hypocotyls to grow through. Between the discs of each funnel is placed a layer of moist sand in which the seeds are planted. To the discs of one funnel are attached wires, by means of which they are connected with the poles of the induction coil. In this way a current may be passed through the moistened sand which acts as a good conductor.

The object of taking a funnel, rather than a cylinder, is that the action of gravity constantly draws the roots against the glass, allowing measurements to be taken from the outsides, whereas were the sides vertical, nutation and such forces as hydrotropism might cause the root to grow inward and away from the glass.

In experiments with this apparatus the seeds were first germinated in sawdust, and when the radicles had reached a length of about two centimeters they were removed to the funnels where the subsequent growths of the normal and stimulated plants were compared.

In Fig. 4 is shown an apparatus very similar to that in Fig. 3, with the exception that in this case four-inch clay pots were substituted for the funnels. This apparatus is not adapted for observation of root growth, but simply that of the hypocotyls. In the upper discs are seven holes through which the young seedlings grow, as shown in the diagram in Fig. 4, which represents a cross section of the pot where the plants were treated with electricity.

Germinating Apparatus.—In the selection of germinating pans for this work two chief points have been taken into consideration. First, that the normal or untreated seeds should have exactly the same environments as those treated, aside from the conditions brought about by the application of electricity. Second, that the conditions for germination should be as favorable as possible, that is, that there should be the proper amount of heat, air and moisture to give the best possible conditions.

The form of apparatus which was used in these experiments, and which seems to fulfil the requirements very well, is shown in Fig. 5. This consists of two plates, an outer of porcelain about nine inches in diameter, and an inner of clay seven inches in diameter. Within the inner plate filter-paper is placed upon which the seeds are sown. In the outer plate a constant supply of water is kept which gradually passes through the plate of porous clay, keeping the filter-paper within constantly moist. The seeds are sown upon the filter-paper in the manner shown in the left-hand pan in Fig. 5. The paper is divided into eight equal parts; seven of these are used for the treated seeds, while the eight or 0 is for the normal or untreated seeds.

A second piece of moist filter-paper is placed over the seeds, resting upon them and touching at various points the paper beneath. In this manner the covering is kept moist by absorption. A plate prepared for germination is shown at the right in Fig. 5. In order to insure perfect darkness a piece of black cardboard was placed over the pan in such a manner as to shut out the light, but not prevent a free circulation of air.

In this form of pan the young plants can be grown without difficulty until the hypocotyls are two or three centimeters long. The moist filter-paper, which constitutes the covering of the seeds, offering but little obstruction to growth.

Effects of Electricity in Germination and Growth of Radicles, (Roots).—Experiments were made with White Mustard (Brassica alba, Boiss) Red Clover (Trifolium pratense, L) Rape (Brassica napus, L.) and Barley (Hordeum vulgare, L.) The seeds were treated with an interrupted induced current from a Du Bois-Reymond induction coil for a period of two minutes, the coil being connected with a four Leclanché cell battery. Two-hundred seeds of each variety were taken. These were soaked in water for a period of twenty-four hours, after which each lot of two-hundred seeds was divided into eight lots of twenty-five seeds each. Seven of these lots were treated with the electric current in the apparatus shown in Fig. 2, as previously described. The eighth was left untreated and served as normal plants for comparison. After treatment, these seeds were sown in germinating pans as shown in Fig. 5, which, after having been prepared for germination, were placed where the temperature was kept from 18° C. (64.4° F.) to 20° C. (68° F.).

An average was made of the 1,600 seeds germinating in 24, 48 and 72 hours respectively. The following table shows the result obtained by such an average:

		Treated.	Untreated.	Gain per ct. by treatment
Average number.. seeds germinated in each lot in....	24 hours	9.93	7.50	32.40
	48 hours	18.00	14.87	21.05
	72 hours	19.14	18.00	6.33

From these results it will be noticed that by applying electricity germination was considerably hastened, and that those lots of seeds which received treatment, gave a higher percentage of germination at the close of the experiments. An examination of the tables seems to prove that the electric current awakened life in some seeds which, without treatment, would have remained dormant.

Some of the results seem to show that there is an optimum strength[1] of current for germination as well as for growth of radicles.[1]

Effects of Electricity on Germination and Growth of Radicles (Roots) and Hypocotyls[2] (Stems).—Experiments were made with White Mustard (Brassica alba, Boiss) Rape (Brassica napus, L.) and Red Clover (Trifolium pratense, L.).

The experiments are similar to those previous, with the exception that measurements were also taken of the hypocotyls, in which case it was more convenient on account of the greater maturity of the hypocotyls, to make the measurements at the end of 96 hours instead of at 72 hours as in the previous tables.

An average of the number of seeds germinated in the various lots in tables IX.—XI. gives the following:

Average number seeds germinated in each lot in	Treated.	Untreated.	Gain per cent by treatment.
24 hours	13.33	11.33	17.65
48 hours	17.19	15.33	11.47
72 hours	18.43	18.00	2.38
96 hours	18.43	18.00	2.38

These results do not show so high a gain by use of electricity as in the first series, but prove that at the end of 72 hours all the seeds that retained vitality would germinate.

A Comparison of Different Kinds of Current.—In these experiments the seeds were treated with three forms of current.

The average growth of radicles and hypocotyls and gain per cent. were as follows:

Kind of current.	Average growth (in centimeters) of radicles in 72 hours.	Gain per ct. by treatment.	Average growth in (centimeters) of radicles in 96 hours.	Gain per ct. by treatment.	Average growth (in centimeters) of radicles in 96 hours.	Gain per ct. by treatment.
Normal	1.95	0	4.00	0	2.96	0
Interrupted induced..	2.96	51.79	4.67	16.75	3.22	8.78
Inter'pt'd induced 10 interruptions	2.93	50.25	4.52	13.00	3.13	5.74
Direct	2.47	26.66	4.17	4.25	2.99	1.01

It will be noticed from these results that the interrupted induced current, where ten interruptions were used, gave the highest percentage of germination, but the experiments have not been repeated enough times to definitely ascertain whether this will always follow. It will also be noticed that the interrupted induced current, where the Wagner hammer was used, gave a much longer growth of radicles and hypocotyls, and, in fact, this form of current has given the best results in all the experiments which were carried out.

Where the direct curent was used, the gain was not as high as with the other forms. These experiments, and others which have been made since, seem to prove that the optimum strength of direct current is of somewhat lower voltage than with the induced current, and that the cause of the low gain per cent. in the tables is due to the fact that the optimum strength of direct current was not used.

Effects of Hourly Treatment on Horse Bean (Vicia faba, L.).—For this work the apparatus shown in Fig. 3 was selected, as it gave a good chance for examination of the radicles from time to time, and in it the plants could easily be subjected to the electric current.

The glass funnels were filled with moist sand to within about an inch of the top, as stated in the description of Fig. 3. Twelve small holes were made in the sand along the inner surface of each funnel and in each of these holes a bean radicle was placed, the bean itself resting upon the surface of the sand. This having been done, the funnel was filled with sand, covering the beans to a depth of about one-half inch. The copper discs were placed upon the sand and the plants treated. Fig. 3 shows an apparatus set up in this way, the seeds in which receiving hourly stimulation lasting about thirty seconds for a period of forty-eight hours. The discs of one funnel were attached to the poles of the induction machine, the secondary coil being removed five centimetres, and a current was passed through hourly from a four Leclanché cell battery during the experiment.

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[1] The optimum current or stimulation is that which gives the best result.

[2] The term Hypocotyl is used by botanists to indicate that portion of the stem below the cotyledons or seed leaves.

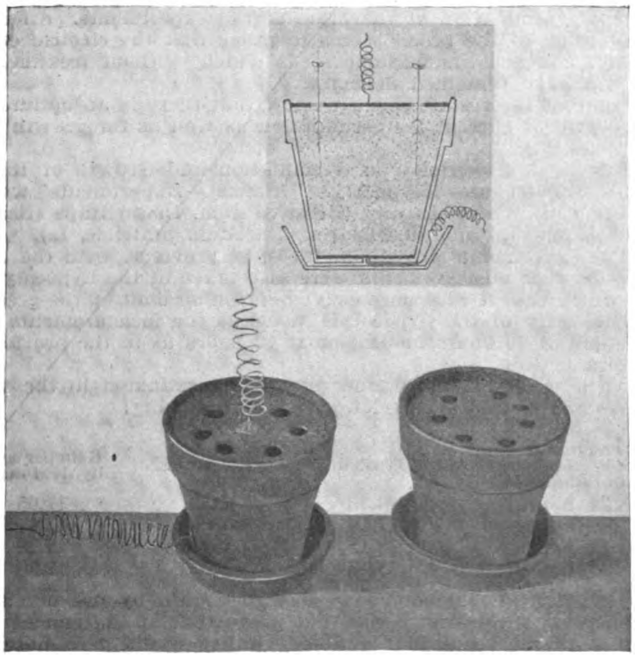


FIG. 4.—ELECTRO GERMINATING APPARATUS.

The effect of hourly stimulation upon the growth of radicles of Horse bean (Vicia faba) was as follows:

Time.	Treated.	Untreated.	
	Average increase in length of radicles in centimeters.	Average increase in length of radicles in centimeters.	Gain per cent by use of the electric current.
12 hours	1.87	1.57	19.11
24 hours	1.58	1.09	44.95
36 hours	2.53	1.78	42.13
48 hours	2.65	1.90	39.47

In this table it will be noticed that in the first twelve hours the gain by treatment is not so great as at subsequent periods, a fact which has been seen in all of the other experiments in this line, but the cause of which has not been fully ascertained.

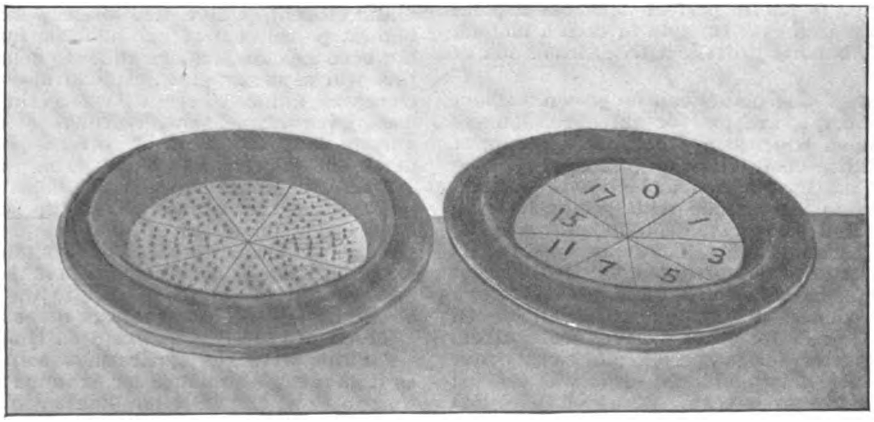


FIG. 5.—GERMINATING PANS.

This experiment, as do others which have been made, but which are not recorded in this work, shows a decided increase by treatment, proving conclusively that the beneficial effect of electricity upon growing plants is quite constant.

SUMMARY.

1. Electricity exerts an appreciable influence upon the germination of seeds.

2. The application of certain strengths of current to seeds for short periods of time accelerates the processes of germination.

(a) As a result of experiment it has been found that at the end of twenty-four hours over 30 per cent. more seeds were germinated in the treated lots than in the normal. At the end of forty-eight hours about 20 per cent. and in seventy-two hours 6 per cent.

3. Those lots of seeds, receiving electrical stimulation gave a higher percentage of germination than the normal.

4. The range in the strength of current which accelerates germination is exceedingly limited.

5. The effect of electricity upon the germination of seeds shows that there is a maximum, optimum and minimum current.

6. The minimum strength of current which just perceptibly accelerates germination when an interrupted induced current is used, is quite close to number 17 in the tables and probably represents considerably less than one volt.

7. The optimum strength of current which shows the maximum growth of radicles and hypocotyls is equal to about three volts where an interrupted induced current is used.

8. The maximum current which the seed germ can withstand without being destroyed has not been ascertained in these experiments, but probably represents a comparatively high voltage.

9. The optimum strength of current is practically constant for such small seeds as mustard, red clover, etc.

10. The optimum current for radicles and hypocotyls is the same.

11. Seeds subjected to but one application of electricity show the effect only for a few hours.

(a) In those lots of seeds which received an optimum strength of current, an increase of over 30 per cent. in the length of radicles was found at the end of seventy-two hours, while at the end of ninety-six hours this increase was less than 15 per cent., showing that the beneficial effect was lost as the plants matured.

(b) The gain in the hypocotyls by use of an optimum current was about 13 per cent., or a little less than that of the radicles in the same lots of seeds.

12. Electricity when applied hourly to germinating seeds or growing plants, does not lost its effect, but acts as a constant stimulation to their growth and development.

BETTING ON RAPID STREET RAILWAY CONSTRUCTION.

Frank Miller and Clinton Cribbs, of Benton, Harbor, Mich., got into a dispute as to whether the Benton Harbor & Eastern Electric Railway will be built to Sister Lakes within the next 90 days, as the company says it will, and, finally, they each wagered a house and lot worth about $1,000. Deeds for both pieces of property have been placed in the hands of a stakeholder, to be delivered to the winner at the expiration of the time.

THE PACHUCA POWER PLANT.

THE City of Pachuca, State of Hidalgo, Mexico, is famous for the richness of the silver mines which, for over two hundred years have been continuously adding to the wealth of Spain and Mexico. This picturesque city is located on the edge of the valley of Mexico and behind it rise the Sierra Madre Mountains, on whose sides are located the building of the mines which are the largest producers of silver in the world, the annual output amounting to about $12,000,000, Mexico money.

With such extensive workings much power is necessarily required and as the wood fuel of the region was long ago exhausted, coal is imported, costing $20 a ton in Pachuca and from there is carried over the mountain roads and burro trails to the mines. In addition to the mines themselves, the haciendas de beneficia or Ore Reduction Works, in Pachuca and the neighborhood are large users of power.

On the other side of the mountain range, about twenty miles east of Pachuca is the Rio Regla, a mountain stream which for generations has furnished power to the mining haciendas of San Miguel and Regla by means of ancient overshot wheels built in the early days of the old Spanish viceroys. At Regla it falls over the basaltic cliffs into the Cañon of Regla and rapidly descends for some five miles until the bottom of the barranca finally reaches a depth of 2,000 feet below the flat surrounding country about it.

That distinguished Mexican engineer, Señor Rafael M. de Arozarena, conceived the idea of developing this power and formed the Compania de Transmission de Potencia, del Estado de Hidalgo, at the head of which was Senor Jose de Landeroy, Cose, of the Real del Monte mines of Pachuca. The preciptous walls of the upper cañon and the loose crumbling detritus which composed the sides of the lower barranca presented difficulties which it required more than two years' work to overcome. The plant, however, was completed at the beginning of the present year, and is now in regular operation.

Just below the waterfall and hacienda of Regla the hydraulic work begins by the construction of a dam across the cañon to divert the water into the canal. The river, although usually but a small arroyo of about fifty cubic feet per second, during the rainy season becomes a torrent of enormous proportions so that it was found necessary to construct a heavy masonry dam, with a massive feed gate bulkhead at the side to protect the canal.

At first the canal runs in a cut in the face of the cliff, the overhanging rock being supported by masonry piers. From this point on, it passes over an aqueduct through no less than seven tunnels, with stretches between of open ditches cut either in the solid rock or securing a difficult foothold in the sloping débris under the cliffs. The length of the canal is nearly two miles, with a grade of 8-10 of 1 per cent. to prevent filling with sand, and is lined throughout with masonry faced with cement. It ends in a mesa in the barranca in a tank from which the pipe runs to the power house 800 feet below.

The pipe line consists of 1,700 feet of thirty-inch pipe of steel, one-eighth-inch in thickness at the top and three-quarter-inch at the bottom. The lower half of the pipe line is at an angle of 45 degs., and here the pipe is completely embedded in masonry stepped into the side of the barranca.

The power house is a handsome masonry building in the Spanish style of architecture, with a structure at one side for the receiver valves and water wheels. The pipe is connected by a main valve to the receiver, which is forty inches in diameter, seventy-five feet long, and three-quarter-inch thick. It weighs 50,000 pounds, and was tested for 700 pounds pressure. Attached to the bottom of the receivers are the valves and deflecting nozzles for five forty-inch diameter, 400 horse-power Pelton water wheels running at 600 revolutions per minute, and two twenty-four-inch diameter, forty horse-power wheels at 1,750 revolutions. Under the wheels is the tail race, covered on the sides with timbers and on the bottom with plates of iron in order to stand the impact of water at such a high velocity—even the iron being cut away by the jet from the nozzle and having to be replaced at frequent intervals. The shafts of the water wheels pass into the power house through iron water-tight ports in the wall, and are connected by flange couplings to the generator shafts.

The five generators are G. E. three-phase alternators of 300 kilowatt capacity, each built with twelve poles, for a speed of 600 revolutions, a potential of 700 volts and a periodicity of 60 cycles per second. The exciting current is derived from two 25-kilowatt Edison bipolar 125-volt machines, each of sufficient capacity to excite the fields of all the generators. On the wall by the side of the generators are the Pelton differential governors for controlling the wheel speeds by deflecting the nozzles and the hand wheels for working the valves.

Opposite the generators are the step-up transformers and switchboards. The transformers are of G. E. manufacture, seven in number, of 200 kilowatt capacity each, and raise the potential from 700 to 10,000 volts. Two 50-inch blowers driven by small direct-connected motors force air for cooling through the transformers. The switchboard consists of fifteen panels of blue Vermont marble and on them are mounted the instruments and switches for the generators, exciters, transformers and lines.

The transmission line passes in a direct line over the mountains of Pachuca, with lateral branches to the Difficultad and San Rafael mines. The distance from the power house to Difficultad is twelve miles, to San Rafael, nineteen miles, and to Pachuca seventeen miles. The loss of power in transmission is 10 per cent. at full load. The transmission line is No. 3 B & S wire on G. E. porcelain insulators, carried on iron poles with iron cross arms. It is thoroughly protected from lightning by G. E. ball lightning arresters.

At Real Del Monte is the substation for the Difficultad mine in which are three 120-kilowatt step-down transformers changing the potential to 1,000 volts, and marble switchboards. Underground in the mine are four Knowles horizontal plunger pumps driven by induction motors. The pumps are 7¼-inch x 12-inch triplex double-acting, of a capacity of 600 gallons per minute against a head of 300 feet and are driven by 1,000 volt 75-horse-power motors running at 600 revolutions per minute. Both motor and pump are mounted on the same cast iron base, forming a rigid self-contained unit.

The San Rafael substation contains three 90-kilowatt air blast transformers with marble switchboard and small blower ventilating set. Current is carried underground at 1,000 volts by lead-covered cables to two 50 horse-power three-phase induction motors geared to horizontal duplex double-acting Dow pumps, arranged to be operated either by electricity or steam. These station pumps have each a capacity of 300 gallons a minute against 600 feet head, and are partially fed by two 20 horse-power General Electric sinking pumps of a capacity of 125 gallons against 300 feet head. The sinking pump is of particularly compact design so as to pass down the narrow shaft. The motor is completely enclosed, the ends of the armature bearings even being fitted with stuffing boxes, so that the constant fall of water from above, or even the complete submersion of the pump can do no damage to the motor. The potential used for the sinking pumps and the electric lighting of the mine is 110 volts, obtained from oil transformers. The recent flooding of the lower levels of this mine has called for largely increased pumping machinery, which is now under construction and will be driven by electric power.

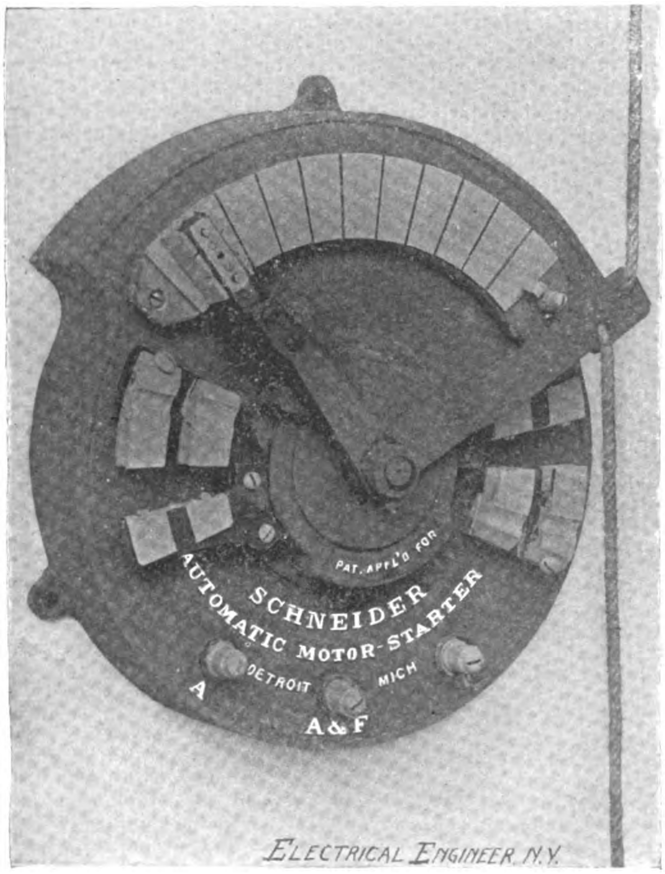
The silver is obtained from the low grade ores of Pachuca almost entirely by the patio system. In this system the crushed rock is first pulverized by stone arrastras or Chilian mills. The resulting slime after passing through settling tanks is conveyed to the patio court of the hacienda, where mercury, sulphate of copper and salt are added and the metal amalgated by the slow process of driving horses around in the "torta" of ore for weeks continuously. In place of the patio process the barrel amalgamator is also used to some extent.

In Pachuca the substation is a large building of Moorish design. In it are the offices and store rooms of the company and the substation proper, containing three 40-kilowatt and three 90-kilowatt transformers with space for a large increase in capacity, together with switchboards, blowers, etc. The Guadalupe Hacienda uses three 50 horse-power G. E. 1,000-volt induction motors, running at 720 revolutions, which drive fourteen Chilian mills and a large rock breaker. The buildings and grounds are lighted by a 10 horse-power motor generator set, consisting of an induction motor and continuous current generator, continuous current being employed on account of the arc lighting. Some small pumps are also employed.

The Union Hacienda uses a 150 horse-power 1,000-volt induction motor at a speed of 600 revolutions to drive thirteen barrel amalgamators, a 100 horse-power and 50 horse-power motor for twelve Chilian mills and their rock breakers. The Bartolome de Medina Hacienda uses two 50 horse-power 1,000-volt induction motors, which are used also for Chilian mills and amalgamators.

SCHNEIDER AUTOMATIC MOTOR STARTER.

THE engraving herewith illustrates a new automatic motor starter recently brought out by Mr. George J. Schneider, of Detroit, and now being manufactured and sold through Messrs. Thomas Muir & Son, of Detroit, Mich. There are a number already in successful service in Michigan and Ohio. The switch controls elevator plants under all direct current voltages, including 500 volts, in the most perfect and reliable manner. This high voltage being taken from street railway current, is necessarily of a very varying character and difficult to control automatically; but the Schneider starter overcomes all difficulties, and secures a steady and reliable service under all conditions.



THE SCHNEIDER AUTOMATIC MOTOR STARTER.

The special features of this starter are the fewness and simplicity of the working parts, no solenoid and dash pot, and extra independent knife switch being entirely dispensed with.

In case of failure of the current, the main switch on the box is thrown automatically open, insuring perfect safety against a short circuit, either of the box or motor. As will be seen, the apparatus is controlled by rope from any floor, and, besides the elements of safety, it effects great economy in expense of operation.

Owing to the simplicity and perfection of the mechanism, the switch can be thrown out and in quickly in succession without delay or damage.

ELECTRIC POWER FOR CRIPPLE CREEK.

The Colorado Electric Power Company, which has been recently organized, will establish an electric generating plant near Cañon City, and will furnish power to mines and mills in the Cripple Creek district. The officers of the company are: O. B. Shallenberger, J. H. Haynes, J. R. McKinney, H. G. Lunt, R. F. Howland, W. P. Bonbright and D. V. Donaldson. Nearly all the stock will be held by Colorado Springs parties.

The company has secured water rights and a large coal mine near Cañon City, where the plant is to be erected. Twenty miles of wire will connect the plant with Cripple Creek.

LETTERS TO THE EDITOR

EXPENSES AND PROFIT OF CENTRAL STATION OPERATION.

HAVING looked over your issue of February 17, giving data on municipal plants, I fail to find anything encouraging to the advocates of municipal ownership in them, when subjected to a fair analysis. As far as the taxpayers are concerned, it appears to be a case of "heads I win, tails you lose." If earnings fall short of expenses the balance is taken from the general fund. If a surplus is shown, it is taken for granted that rates are too high and they are lowered, leaving in many cases the little items of interest, depreciation and bonds issued, to posterity—a legacy to remind them of how something could be produced from nothing in times past, but not now. I also note your editorial remarks on the same subject, with regard to educating the public to know that in most cases it does not pay, etc. There is another point upon which the public also needs educating, and I have never yet seen it raised by any writer on the subject, and that is, that in allowing the electric light people to use the streets of a city or town for the distribution of their product, there is nothing more given to them than is freely accorded to everybody else, namely, the free use of the highways for the purpose of serving their customers. All other manufacturing and jobbing interests are allowed this use without question, and in order that they may do so without interruption the streets are paved and kept in repair by the abutting owners and the municipality itself. That the distribution of electricity requires permanent fixtures is that much the worse for the business and those engaged therein, as it requires a large investment in material which once placed is of not much use elsewhere. Another point that I cannot reconcile is how a person or company can be expected to erect a plant at great cost, keep it in operation through thick and thin, and the only return to be the legal rate of interest on money invested for a term of years. If more than this is earned above expenses, repairs and taxes, a howl is raised that they are robbing the people and the threat of a municipal plant is held over them. These rigid requirements would be all right if the business was permitted to be established on a permanent basis, but if all parties understand that it is to be temporary or limited only, then in all fairness the return must be such as will repay the original investment with interest for the time used. There would be serious doubts of a man's sanity who would erect a building of like cost upon ground of which he only held the lease for a limited time and be required to rent it on the same terms.

Referring again to those reports, they are only from plants now in operation. Why not include more of those which have been suspended or sold? Among the reports from this State, I see none from Newton or Lyons. I think it might prove interesting and instructive if a compilation could be made of the towns which have made the attempt and given it up, with a condensed history of each case.

WM. C. WINDETT,
Secretary and Treasurer What Cheer Elec [illegible]t & Pwr. Co.
What Cheer, Ia., March 2, 1897.

WHEN IS A CENTRAL STATION OVERMANNED?

I AM in charge of a central station operating the apparatus enumerated below. The directors of the plant have inferred that I am employing too much help. In my own mind is the impression that the present force is hardly large enough. All the electrical machines are full loaded and the railway generators run on a constant 25 per cent. overload. I subscribe to The Electrical Engineer and find much of profit to me therein, so I take the liberty of asking its editors their opinion on the subject. Here is the list:

1 pair Corliss engines, 500 h. p. each, 1,000 h. p.; 1 cross-compound Buckeye 600 h.-p. engine, 14 turbines from 100 to 200 h. p. each, 37 turbine bearings, oil cup feed; 1 main shaft, belted to water wheels and engines; 28 main shaft bearings, oil-cup feed; 5 boilers, 3 T. H. type M arc generators; 1 4-circuit arc switchboard, 3 G. E. A.-70 alternators (independent of each other), 3 T. H. D.-6 exciters, 1 switchboard for same, 5 D.-62 T. H. railway generators, 1 switchboard for same, 1 A. T. 100-k. w. three-phase alternator for day lights and power circuits, 1 D.-6 exciter for three-phase alternator, 1 switchboard for three-phase alternator, 2 D.-62 T. H. railway generators; 2 M. P.-90 T. H. railway generators, 1 switchboard for same.

One constant pumping steam pump, run by water wheel when able; 12 station arc lamps trimmed twice daily (24 hours); 3 Lombard water wheel governors whose filters have to be cleaned out on account of sawdust.

The present crew is divided into two watches of 12 hours each, and comprises one chief engineer, two assistant engineers, two firemen, one coal passer, one millwright, two dynamo runners, two oilers, one man to clean water wheel racks, two laborers, fourteen men in all, or seven in each watch. The oilers have to keep the station floors and yard for 100 feet all around clear of dirt.

The railway switchboards are about 50 feet apart and the circuit breakers are out on an average of a dozen times a day.

If you can give me a schedule of work for these men whereby any fewer can be used and run the station properly, I would consider it a great favor. B. C. R.

Our correspondent raises a very important and interesting question and we will be glad to receive and publish replies thereto from central station superintendents.—Eds. E. E.

THE CASE HÆMOGLOBIN OR BLOOD CELL.

If any one proposes to carry forward such an investigation as is illustrated in the blood cell referred to by Mr. W. E. Case, in his recent lecture before the New York Electrical Society, I venture to suggest the utility of a previous careful study of the work of Matteucci, De la Rive and others in the same field. Matteucci especially has gone into this matter, and, it will be remembered, reached the conclusion that organic currents in the body are due to chemical action between muscular fibre and arterial blood in contact with it. His "Traité des Phenomènes Electro Physiologiques des Animaux" (Paris, 1844), will be found quite useful in its warnings against possible errors. For example:

"A liquid which I have been interested in testing in these experiments, in place of acidulated or alkaline water, was blood or its serum. I took some human blood the coagulation of which had been delayed by agitating it as soon as drawn from the vein. I began by assuring myself that the two galvanometer plates plunged simultaneously in distilled water gave no current. We shall see from the following how this was known. Then I withdrew the two plates from the water and at the same instant plunged one into the blood, the other into water like that from which they had been withdrawn. A few seconds after I withdrew both plates, one from the blood, the other from the water, and plunged both in the water. Instantly I obtained a remarkable galvanometer deviation, due to a current which goes in the liquid from the plate wet with blood to the other plate.

"I have wished to vary the experiment so as to place myself, as much as possible, in the same conditions found in making experiments in animal electricity. To that end I took a wick of cotton from 5 to 6 cm. in length, one-half of which I saturated with distilled water, and the other half with blood drawn from a pigeon, agitated as before to prevent coagulation. I used the wick, so prepared to form a communicating arc between two capsules, one filled with distilled water, the other with the same pigeon's blood. Then I closed the circuit with the two galvanometer plates, which when plunged in water had given no current. I obtained a current showing 12 degs. galvanometer deflection, always directed in the wick from the blood to the water.

"I continued the experiment from time to time for three days, always with the same liquid; the current did not vary sensibly either in intensity or direction. If I used acidulated water (sulphuric acid) in place of pure water the current went from the acidulated water to the blood in the wick; that is to say, in the opposite direction from the current obtained between the blood and the water (distilled). The contrary takes place with alkaline instead of acidulated water; that is to say, the current goes from the blood to the alkaline water, as it went from the blood to the pure water.

"The results first stated prove that the greatest precautions must be used in making experiments on animals with a very sensitive galvanometer, and explain a host of erroneous conclusions drawn from ill-made tests."

Mr. Case complains of the sensational articles concerning his lecture in the "yellow" journals; but for these no one will hold him responsible, and, besides, in this he is in good company and is only undergoing the annoyances of which Mr. Edison and Mr. Tesla have at times been victims. He has the consciousness of much creditable priority in the art, for, saving the blood cell, he does not seem to have referred in his lecture to any cell of his own invention which was not patented by him some ten years ago. One of these patents, No. 368,190, Aug. 16, 1887, will be of especial interest to the investigator of cells consuming carbon at low temperature, since it has, among others, the following claims:

"1. The improvement in the art of converting chemical into electrical energy which consists in chemically attacking carbon in a galvanic cell without the application of heat.

"2. The improvement in the art of converting chemical energy into electrical energy, which consists in causing the oxidation of carbon in a galvanic cell without the application of heat."

If this is a pioneer patent it would seem that future discoveries in this field, for the next seven years must conform their prospects to a reckoning with Mr. Case.

G. VOLTA FARADAY.

ELECTRICITY AND THE NAVAL RESERVE.

I was much interested in your editorial in the issue of Feb. 10 entitled "Telegraphic Heroes," and especially in the concluding paragraph which expressed your disappointment that the Naval Reserve devotes so little time to the naval applications of electricity, and so much time to antiquated sailorizing, despite the fact that it contains many very highly educated electrical engineers, who could, as electrical engineers, do the Government valuable service in war time.

In your files for October, 1890, you will find printed a lecture which I gave at Columbia College, proposing the formation of a "Corps of Naval and Military Electricians" as part of the National Guard. The ideas advanced were approved by the body of scientific men of the country, many of whom wrote letters to the Navy and War Departments and to the Governor of New York, and received replies which were favorable in the main. I believe, therefore, that it would be possible to form such a corps; and I also believe (more strongly, if possible, than ever) that such a corps would prove a national benefit.

An idea going a step farther has often occurred to me; and that is, that in the years to come, a distinct Corps of Electrical Engineers will be formed, which will constitute one of the corps of commissioned officers of the regular navy. It is impossible now for naval officers to be competent electricians, just as it is impossible for bankers, doctors or lawyers to be competent electricians, and just as it was for the naval officers of 1840 to be competent steam engineers. Therefore, if the Government wishes to add to its means of warfare the many and powerful agencies of electricity, it may some day form a corps of specialists in electricity, just as it formed a corps of specialists in steam. How distant that day is, no one now can tell.

B. A. FISKE, Lieutenant, U. S. Navy.

U. S. S. Petrel, San Francisco, Feb. 24, 1897.

MORE ABOUT THE BURGLAR AND THE SAFE.

There are one or two points in the late Lieutenant's reply to "Sleuth's" recent letter to the editor, which, if space is permitted, I would like to notice. I think the criticism on the difference between experiment and practice eminently unfair, even coming, as it does, from a superior officer. I think if the gentleman is as well versed as I hope he is, that even he will acknowledge that hundreds of electrical experiments have been perfectly successful in the laboratory, or where all necessary arrangements were made beforehand, and utterly failed when put where what the electrical fraternity calls "bugs" got into them. Hundreds of duplex and quad combinations in telegraphy, any number of telephone schemes, and plenty of electric light systems have been wiped off the face of the earth in this way.

No, I do not contend that 350 or 500 amperes at 40 to 50 volts pressure cannot practically be obtained outside a laboratory. I distinctly stated that large currents had been so taken, but the thieves never told of it.

No one doubts the ability of current to cut a hole into a safe. The point at issue is how will the burglar reach and handle his current without detection. The present (I believe the Holmes system) probably can be beaten for the Lieutenant says it has been. Here is no disputing a prophet, or one who adduces no proof. While I am aware that all this controversy is free advertising for the explosive expert and his system of protection, whatever it may be, there are those who would like more definite information which it is hinted is kept on tap. The supposition that the writer is a detective is far from right. SLEUTH,

Late Fourth Corporal, Indiana Home Guard, and Bell Hanger Electrician.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - 1564 Monadnock Block, Chicago, Ill
Philadelphia Office - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - - .10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

Vol. XXIII. NEW YORK, MARCH 17, 1897. No. 463.

STEAM BOILER DETERIORATION.

T its object the utilization of carbon in the battery as a cur- HE active work which is now being prosecuted, having for rent producer, is to be encouraged in every way. But while it is going on—and it has been proceeding intermittently for years—we have still to fall back on the old and well-tried steam plant. We hear much of the refinements which have been brought about in the construction of the steam engine, and the large reduction in coal consumption consequent thereon, but we hear comparatively little of the boiler, that useful but much abused adjunct of the present power plant. All things are subject to deterioration and decay, but it seems that the boiler is, among mechanical apparatus, particularly subject to this inevitable law of nature. Anything that can throw light on the causes which work for the destruction and against the efficiency of boilers must be welcome information to all electrical generating plants. We are pleased, therefore, to note in the Engineering Magazine for March, an excellent essay by Mr. Albert A. Cary, in which that gentleman discusses in a very lucid manner the cure for corrosion and scale from boiler waters.

It must be apparent that if absolutely pure water were available from natural sources for boiler use, practically no precautions whatever would be required in the care and handling of a boiler, so far as the quality of the water is concerned; but unfortunately such is not the case. It is even erroneous to suppose, as Mr. Cary points out, that if the boiler be fed by good dinking water it must necessarily be good for boiler use, a delusion which many have indulged to their cost. Indeed, Mr. Cary goes so far as to say that no pure water is obtainable from natural sources, even rain water being found to contain more or less impurities, it being only a question of degree, although, of course, rain water is among the purest natural sources. Unfortunately, however, the supply from this source is usually inadequate to the demand, but when used arrangements should be introduced to free the water from the dust, soot and other dirt which accumulate on roofs, and it is advisable even to allow the first rain that falls to run to waste. In order to show that even pure water, such as that obtained from melted ice in Switzerland, and that supplied to the city of Glasgow, Scotland, which is of exceptional purity, may do harm, Mr. Cary instances the fact that the pitting of boilers gives a great deal of trouble to the latter city, the result being the perforation of the boiler as though it had been drilled. Experiments have shown that pitting occurs when gases are found dissolved in the water, oxygen and carbonic acid gases being the most active destroyers, especially when present together. The explanation of the action on boilers is not an easy one, yet that the result is due to their presence is no longer a matter of doubt.

It has long been suggested that the corrosion of boilers was due to electrolytic action set up between the impurities in the iron (occurring at small points) and the iron of the boiler itself; the iron being electro-positive to the impurities, gradually disappears, while the impurities remain unaffected to further this destructive action. If this is a correct explanation, it has been argued that it may be overcome by suspending zinc in the boiler, and connecting it carefully with the boiler shell by copper wire. The zinc being electro-positive to iron will disappear gradually, and in so doing will protect the iron. Mr. Cary believes, however, that the gas in the water is all sufficient to account for the trouble.

In treating of the general corrosion of a boiler, that is, the gradual wasting away of its parts, Mr. Cary points out the necessity of rigid examination, which can only be accomplished by actually drilling holes through the plate, as even experienced inspectors may be deceived by surface appearance. As to the cause of this general corrosion, the electrical theory seems to be the one most generally put forward. In regard to the application of zinc to prevent the wasting away of the iron, we are glad to note that Mr. Cary lays particular stress upon the fact that several conditions must be fulfilled. In the first place, either the water itself must be a good electrolyte, or must be made so by the addition of suitable material, such as salt. Another, and this is of paramount importance for the successful application of zinc, is that the electrical communication between the zinc and the shell must be not only good but of permanent nature, and not affected by the local action which might interrupt the circuit. It is interesting to note that so much faith has been placed in the electrical remedy for boiler deterioration that Mr. Cary cites an instance of a concern in Cardiff, Wales, that has gone so far even as to supply the current to its boiler from a dynamo, ana it is claimed that superior results are obtained by reversing the current periodically. It is claimed that this reversal makes the suspended plate electro-negative to the shell to facilitate the disintegration of the scale and hasten the mechanical action of the hydrogen in flaking it off, and also to prevent the polarization of the shell and tube. Mr. Cary prefers to see these claims proved by more extended use before accepting it as good practice.

Regarding the methods employed for preventing the formation of scale, Mr. Cary has done a good service by pointing out the dangers which may arise by introducing kerosene into boilers for this purpose, a practice which is widespread in the United States. He shows that serious corrosion is often followed by the use of this material, and has puzzled many to account for it; but the reason is not hard to seek, when, as Mr. Cary points out, it is known that sulphuric acid is employed in the manufacture of kerosene in order to purify it. If all of this acid is not removed, the oil, when in the boilers, volatilizes and passes off with the steam, while the acid remains behind, concentrates as additional oil is added, and attacks the iron. As an antidote, Mr. Cary cites a case where kerosene is varied with an alkali, such as the carbonate of soda, on alternating weeks, and trouble has thereby been avoided. Oil and grease are also apt to give trouble due to the presence of mineral and vegetable acids.

Enough has been said to demonstrate the importance of the proper selection of feed water for power plants. Frequently, of course, there is no choice in the matter and waters have to be used which are, in themselves, totally unfit for steam making; but if means must be employed to purify them, the proper selection of the material and methods of purification should command the closest study in order to avoid excessive boiler repairs, or even destructive explosions. We commend Mr. Cary's article to all interested in steam engines for whatever purpose.

THE STOCK TICKER SERVICE.

THE New York Stock Exchange, and other legitimate exchanges, appear to be in constant difficulties over the control of the quotations made on their floors. What they wish chiefly to do is to prevent these quotations from falling into the hands of the bucket shops, their underselling competitors, but the policy or plan of cutting off never seems to succeed for very long periods. Just now the New York exchange is dealing again with the problem of the extermination of the gambling bucket shops, and out West serious difficulties have also arisen. There are two principal quotation companies in this city, and the best legal opinion apparently is that the exchange cannot confine itself to the giving up of the quotations to the one company that it controls. In Kansas City, a decision has just been rendered in the United States Circuit Court, in keeping with one in Chicago, practically compelling the Western Union Company to furnish such quotations without discrimination. The Chicago Board of Trade has sought to limit the delivery of its quotations to its members and their patrons, but the effect of such decisions is to render the quotations public property to the extent that all may get them who are willing to pay for them from the telegraph company.

The extent of the injury done by the bucket shops to the regular exchanges is not easy to estimate. It is said they deal certainly in not less than 1,000,000 shares daily in this city; the stock exchange has of late been doing a business on some days of less than 100,000. The allegation is made that the bucket shops cheat the customers by employing a "fast" and a "slow" ticker, the proprietor having the exclusive benefit of the "fast" one. It would strike most electricians as an impossibility to carry out this scheme with the two instruments on one circuit; but even if there are two services, they are likely to deliver their news pretty closely, and the customer must indeed be a fool who did not discover that he was the victim of such a "thin" device. It needs only the ordinary amount of human, ineradicable love of gambling and excitement to explain the popularity of the bucket shops, which, with their facilities for cheap betting in these days when the police close up at once the gambling hells, afford an opportunity sought after by a great many people. It is generally supposed that in Monte Carlo, big or little, the bank wins in the long run, even with an honest, "square" game, and thus, too, without loaded dice in the shape of fast and slow tickers, the bucket shops may still win handsomely and pocket fat commissions, even at half the regular stock exchange rate of one-eighth of one per cent. The situation is one of great interest electrically, as there are not less than from 2,000 to 2,500 tickers in use in this city, and the tendency is to increase their employment in a variety of ways not contemplated upon their first introduction many years ago, although the telephone has probably checked such growth.

A LAMP-TESTING BUREAU.

THE plan for a lamp-testing bureau put forward by the National Electric Light Association and published in our pages last week has obvious merits. We intimated then our belief that some plan of the kind had already been tried, and we are now able to state, as the result of further inquiry, that such an organization was established last year at the Harrison lamp works of the General Electric Company by the Association of Edison Illuminating Companies, as the result of negotiations started while Mr. J. I. Beggs was chairman of the association's Executive Committee, and consummated under Mr. Edgar's chairmanship. The importance of this can be well understood, as the Edison Association represents the largest consumers of lamps in the country. Under this plan, such companies as those of New York, Boston, Chicago, Philadelphia and Brooklyn, have tests, by sample, of their lamps made by their expert, Mr. W. S. Howell, and it is obvious that other Edison licensee companies can also enjoy the advantages of the system, and will gradually come in. The lamps are tested in a separate department, and a method of bonuses and penalties, dependent on quality, governs the price to the purchasers.

We are informed that the plan is working admirably, and it can readily be understood that it inures to the decided benefit of the consumer and results in steady improvement in the lamps. This being the case, and the proposed plan of the National Electric Light Association being modeled or copied after that of the Edison Association, it would seem that, perhaps, some arrangement can be come to that would permit co-operation, so far as purchasers of Edison lamps are concerned; but it would also appear that some other plan would be necessary where the purchases were made from other lamp companies, especially those who are "independent" and outside the pool.

STORAGE BATTERY ENGINEERING PRACTICE.

THE introduction of one large storage battery plant after another in central stations and of smaller isolated plants all over the United States, indicates unmistakably that gradually, but surely, this type of apparatus is receiving the patronage which it deserves. From frequent inquiries which we have received, it has become evident to us that there existed a woeful lack of knowledge on the methods of handling storage batteries for the many purposes and situations to which they can be applied. Possibly it may be due to this fact that the battery itself has been so long allowed to remain in the background. The recognition of this fact has determined The Electrical Engineer to lay before its readers the information which will enable them to gain a knowledge of the uses and workings of storage batteries for every purpose to which such batteries have thus far been applied. To this end it has begun, in this issue, a series of articles which will take up and treat the subject systematically in all its phases. The author of the series, Mr. Joseph Appleton, has had long and varied experience covering practically the whole period of existence of the modern storage battery. His articles embody results which have been found best in practice, and which have been, so to speak, the outcome of successful experiments. This series of articles is not intended in any way to treat of the manufacture of storage batteries or to describe historically the various types which have been brought forward. This has been done frequently and a history of the art in this respect can be found in numerous excellent works. The present object has been to place before the readers of The Electrical Engineer the best modern practice in the handling of storage batteries, after they leave the manufacturer and pass into the care of the engineer.

ACCORDING to the Detroit "Free Press," a well-known engineer in that city has been advocating free electricity as an even greater boon to the populace than free water. An abundant, cheap supply of either is undoubtedly a good thing, but we cannot quite grasp the idea of getting them for nothing. How is it done? Water distribution in most cities is an expensive thing, and electricity is a manufactured article. Now, somebody in the long run has to foot the bills, and we are not aware that the rest of the country is willing to do this for Detroit; so that the citizens must pay for these things themselves, if not at so much per gallon or per kilowatt, then in the shape of local taxes. We do not see how a thing can be free that people are taxed for, unless by a pretty little process of confiscation which would throw the burden on property and labor. How much property and how much labor there would be left in Detroit after, say, ten years of free water and free electricity, it is, perhaps, not difficult to imagine. Detroit is a city of many attractions, but her taxpayers would all probably have sought some other place at the end of the period.

TOWER lighting by arcs is still practiced and is often proposed, for new installations, but does not appear to make much headway. It has recently been mooted in connection with the municipal plant for Des Moines, Ia., but it occurred to one of the aldermen to write to the mayor of Davenport, Ia., asking why the tower system was given up in that city some years ago. The mayor's reply is rather emphatic and amusing: "Because," he says, "we did not consider it legitimate expenditure to attempt to light the road to heaven at the expense of the citizens of Davenport." He adds that it is a nice thing to talk about, but a poor substitute for surface lighting as furnished by pole light. That seems to be about the general idea, although there does not appear any good reason why reflectors could not be brought into play to aid in throwing the light downward from inverted arcs. It is possible the plan has been tried and found wanting.

THE resources of electricity are varied, as some burglars discovered the other night, at Providence, R. I., where, after cutting the telephone wires, they proceeded coolly and calmly to break into the Colwell mansion. They were just about settling down to business when Mrs. Colwell appeared at the head of the stairs and pushing a button illuminated the whole house, so that they could the more comfortably do their work. But if there is any one thing objectionable to the burglar it is to be exposed to identification, and in this case, the gang, instead of waiting to enjoy the aid of the light, fled headlong before its beams. What with telephones, burglar alarms, concealed switches and electrified doorknobs, the honest burglar now has a hard time earning his livelihood.

A GREAT deal of feeling, and with good warrant, is manifested from time to time by working men whose product has to meet the competition of cheap goods made by convict labor, and who argue that there are plenty of things for criminals to do for the benefit of the State, when under arrest, besides underselling honest men. A new aspect of the problem is presented at Leavenworth, Kan., where Mr. L. M. Erb, the manager of the Leavenworth Electric Railway, has closed a contract with the directors of the Kansas Penitentiary there for current. Mr. Erb is to build an extension line of road, and put in the plant, but the penitentiary mines the coal already and has the labor, so that the power will, it is said, be very cheap. It is a curious arrangement, and we should imagine that the local labor organizations will have, as usual, an emphatic opinion to express on the subject.

ELECTRIC LIGHTING

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.[1]—I.

BY JOHN W. HOWELL.

THE first part of this paper, which relates to the conductivity of carbon filaments, is in the nature of a discussion of a paper read before the institute by Prof. Anthony, at the May meeting in 1887.

Prof. Anthony spoke of a change from negative to positive of the temperature co-efficient of some carbon filaments which he had observed. Prof. Anthony stated that this change did not occur in all filaments, and that he was unable to explain the circumstances under which it did occur. Prof. Elihu Thomson, in his discussion of Prof. Anthony's paper, said that he had observed the same phenomenon, but had not investigated it sufficiently to explain its cause.

I made a set of ten lamps with various amounts of treatment, all made from similar base filaments. These lamps had filaments the resistances of which, when cold, were 90, 80, 70, 60, 50, 40, 30, 20 and 10 per cent. of the cold resistance of the original base. I found, upon plotting the curves of these filaments, that the untreated filament fell in resistance as it was made hotter, and that this fall continued to the highest temperature at which I dared run it.

The slightly treated filament fell in resistance more rapidly than the untreated filament at first, and less rapidly as the high temperatures were reached, its curve finally rising above that of the untreated filament. As the amount of treatment is increased, the curve falls more and more rapidly at first, and less rapidly at the higher temperatures. When we reach the filament treated to 50 per cent., we find that it falls rapidly to about 50 per cent. of its cold resistance, and remains practically constant at higher temperatures. The curves of filaments treated to less than 50 per cent. all rise after reaching their lowest point, which is reached at about 50 per cent. of their three watts per candle voltage. See Fig. 1.

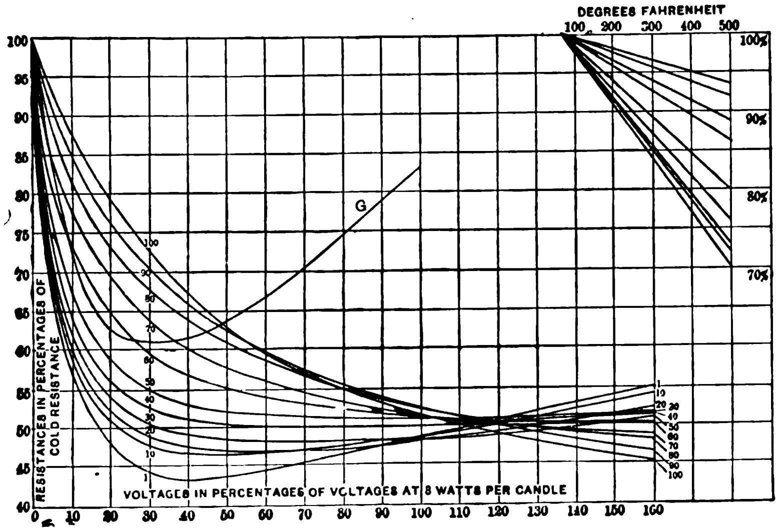


FIG. 1.—CURVES SHOWING CHANGES OF RESISTANCES OF LAMP FILAMENTS WITH VOLTAGE AND TEMPERATURE.

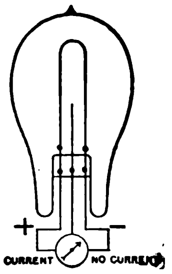


FIG. 2.

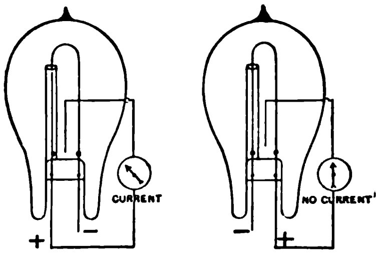


FIG. 3.

These curves show the changes in resistance of these filaments. The ordinates are percentages of the cold resistances of the various filaments, so that all curves start from the 100 per cent. mark. The abscissæ are percentages of the voltages at which the various lamps take three watts per candle. The bottom curve on this sheet illustrates the resistance curve of a carbon filament which had been treated to about one per cent. of its original resistance. This made a filament which was nearly all treatment. This curve shows an increase in resistance from its lowest point to the last point obtained, of about 25 per cent. The cold resistance of the filaments, after being measured was found to be the same as before any measurements were made.

I then obtained untreated base filaments from as many kinds of amorphous carbon as I could obtain, and plotted their resistance curves. I tried filaments made of bamboo, silk, cotton, cellulose (made by the ordinary squirt process), tamidine and paper. All of these base carbons gave the same curve, and all of them continued to fall in resistance as long as I was able safely to increase the temperature.

I was entirely unable for a long time after making these curves to come to a satisfactory theory regarding them. The reverse curve is not caused by changes in the characters of the surfaces of the carbons, due to emissivity, because no corresponding changes in emissivity occur.

I made observations upon untreated and heavily treated filaments, to see if they acted differently in regard to their expansion with heat, thinking that possibly the changes in the resistance curve may have been caused by a change in the expansion curve with temperature. These observations were not very refined, being simply observations made by means of a telescope, but they showed clearly that all of the carbons expanded with heat, and apparently there was no difference in this respect. The curve marked G is the resistance curve of an Edison graphite filament; it does not fall as the other curves, and rises much more. The resistance of this filament, after the measurements had been made, was just the same as before they were made. This indicates quite clearly that our calling the treated carbon "graphitic" is correct, and that the change in the resistance curve of treated filaments is due to the graphitic nature of the layer of carbon which is put on during the treating process.

The second part of this paper, which relates to the conductivity of the vacuous space surrounding incandescent filaments, may be considered as a discussion of the paper upon the "Edison Effect" in incandescent lamps, which was read before the Institute by Prof. Houston, in October, 1884, and which was the first paper read before this society.

"Edison Effect" is the name given to the effect produced by those currents, first observed by Mr. Edison, which pass from one leg of an incandescent filament across the vacuous space to the other leg, and which can be observed by connecting a galvanometer between the positive lamp terminal and a wire sealed into the bulb and projecting into the vacuous space.

Fig. 2, which is taken from Prof. Houston's paper, serves to illustrate Mr. Edison's original experiment. The galvanometer indicates a current flowing from the positive lamp terminal through the galvanometer and third lamp wire, and through the vacuous space to the negative leg of the incandescent filament. If the external connection of the galvanometer be changed from the positive terminal to the negative terminal, no current will flow through the galvanometer. This effect can be observed in the most highly exhausted lamps. A lamp so highly exhausted that it shows no glow when tested with an induction coil, giving a spark three-quarters of an inch long, will allow a current sufficiently large to show plainly on a not very sensitive galvanometer, to pass through its vacuous space. This current increases as the temperature of the filament is increased, but in a well exhausted lamp is never greater than a very few milliamperes, when the lamp is burned at about 2½ watts per candle.

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[1] Read before the American Institute Electrical Engineers. Abstract.

In 1884 Mr. Preece secured from Mr. Edison some lamps having wires sealed into the bulbs, and read a paper before the Royal Society describing some experiments made upon them, illustrating the "Edison Effect."

Prof. Fleming read a most elaborate paper before the Physical Society of London, in March, 1896, upon this same subject. Prof. Fleming's experiments proved that in well exhausted lamps the vacuum is not a conductor in the ordinary sense of the word, and that the current which passes through it is carried by negatively charged molecules, which pass constantly from the negative leg of the incandescent filament to the positive leg and to any inserted wire, thus bringing the inserted wire to the same potential as the negative leg. Prof. Fleming also proved that these molecules pass in straight lines, and that their passage is completely or almost completely stopped by a glass or mica screen placed between the negative leg and the inserted wire. The following experiments serve to illustrate these effects:

Fig. 3 shows a lamp having a glass tube surrounding one leg of the filament, and a wire sealed in the side of the bulb. which projects into the center of the vacuous space. When the leg of the filament which is in the glass tube is made positive, and the filament heated to about a 2½-watt candle temperature, the galvanometer, which is connected between the wire and the positive lamp terminal, shows a strong deflection, but when the leg in the tube is made negative the galvanometer, being as before connected between the wire and the positive lamp terminal, shows no deflection.

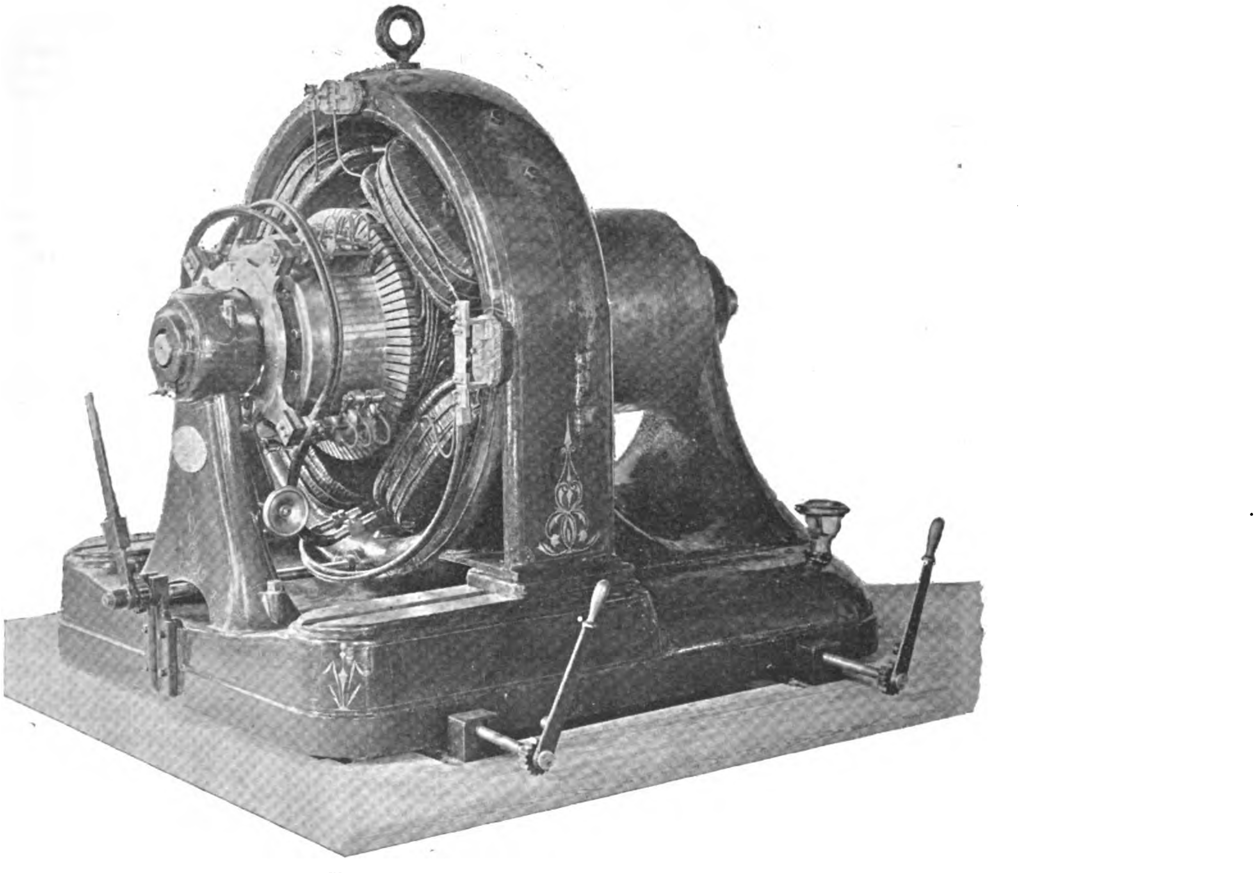
THE IMPROVED CARD GENERATORS.

The accompanying engraving illustrates the improved generator manufactured by the Card Electric Company, of Mansfield, Ohio, which embodies a novel and convenient method of moving the pole frame and field magnets away from the armature, so that inspection can be readily effected.

The manner in which the pole frame and field magnets are mounted on the base and the convenience it affords for inspecting the armature or field coils, can readily be seen. The brackets for supporting the pole frame have tongues cast on them on the under side, which are planed to fit in the grooved slides on each side of the base. On the front of the base is a bracket with a screw, which passes through a nut fastened to the bottom of the pole frame. With the ratchet lever the field core or frame and field magnets can be slid forward on the base, completely uncovering the armature. If it is desired to take the field core or frame entirely from the base, two pieces of timber, made level and placed at the end of the base, and a crowbar, are all the tools necessary.

The above method is applied to direct-driven as well as belt-driven generators. A number of the Card generators having this particular feature, are at present being installed in various localities.

The armature is supported on three self-oiling and self-aligning bearings; the two at the pulley end are cast together in a very rigid form.



The Card Improved Generator

THE JACKSONVILLE, FLA., MUNICIPAL PLANT.

Jacksonville, Fla., has a somewhat different story to tell of its experiment with a municipal electric light plant. A report, recently presented, repeats the assertion in a previous report, that the city is much better lighted than it had been under the contract system, and at a much less expense, while the charge to private consumers is so small that the requests for service are far beyond the present capacity of the plant. Not taking into consideration interest on the cost of the plant and a sinking fund for retiring the bonds that represent its value, but taking the difference between the receipts from commercial lighting and the operating expenses added to the construction of new lines, etc., and the actual cash cost of lighting the city varied from $4 for each arc light in January to sixty cents in September. There is a different showing, however, when allowance is made for interest, sinking fund, and depreciation. The plant represents an expenditure of about $100,000. Calculating the interest at 5 per cent., adding a like amount for a sinking fund and estimating depreciation at 5 per cent. (a rather low estimate), makes a total of $15,000. As the Jacksonville Citizen shows, the net profits from the plant will not be sufficient to meet this sum annually, and unless the income shall be increased, other means must eventually be devised to pay the original cost of the plant, and to meet at least a part of the annual interest on the bonds.—New York Evening Post.

THE MUNICIPAL PLANT AT LISBON, IA.

Mr. W. H. Runkle, Mayor of Lisbon, Ia., and superintendent of the electric light and water plant, sends us a revised report of that plant of later date than the one included in Mr. Winchester's report on municipal plant data printed in our issue of Feb. 17. "Fourteen 2,000 candle-power arcs on streets, eight 1,200 candle power arcs in commercial service, 600 16 candle power incandescents in use, a combined water and light plant. The 14 arcs are counted at $600 for the year, and a very low rate is charged for all commercial and residence lighting. Earnings of the plant for the year ending Feb. 28, 1897, $2,517.95; running expenses for both water and light plants, not including the interest or depreciation of plant, $1,998.88; net earnings over income, $519.07. I think the city should in each case own its plant and service on streets and supply its citizens at a normal cost. Can be managed economically by a single superintendent at a small cost."

LITERATURE

POWER DISTRIBUTION FOR ELECTRIC RAILROADS. —By Dr. Louis Bell. New York, 1897. Street Railway Publishing Co. 268 pp., 6 x 9 in. Ill. cloth. Price, $2.50.

There is, perhaps, no system of electrical distribution which has given rise to more disappointment than has electric railroad work. While the principles do not differ from those involved in other systems of electric distribution the undetermined factors which are entirely beyond the control of the engineer require a special equipment and the exercise of considerable judgment, not to say the faculty of guessing. Still there is enough real engineering in plants of this nature to make it absolutely necessary to base the main work on established principles.

It is somewhat in this light that the author has treated the present subject. He begins by a description of the fundamental principles which apply to the laying out of electric railway conductors, and shows how the center of gravity method of calculation may be applied to the location of the centers of distribution, and taking into account also the variations of load, their nature and magnitude. He then takes up the return circuit, describing the methods that have been employed for this purpose, and showing how troubles may be avoided, and energy saved by proper attention to the bonding of joints, etc. Direct feeding systems are then treated in extenso, showing where re-enforcements should be made at special points. Here we find a valuable chart, giving the area and weight of copper required for transmitting 100 amperes 25,000 feet and less at 50 volts loss, with various constants for track return. An attentive study of this chart will show where many mistakes have been made by designers of railway distributing systems. But, as the author says, the art of feeder design is one that calls for great finesse, and cannot be reduced to formulæ that will be of use in anything save special and unusual circumstances. Succeeding chapters are devoted to the important topics, of special methods of distribution by means of boosters, 3-wire system, etc., sub-stations, and transmission of power from the latter.

Although somewhat in advance of the times the author has very wisely included a good review of the present status of the alternating motor as applied for railway work. He shows the advantages and disadvantages of the various types of these motors for this purpose, but admits that, so far as polyphase motors are concerned, none of the methods of regulation as yet devised is quite the equivalent of the series parallel controller employed at present, that is, so far as efficiency is concerned. The lines of work for which alternating motors are most needed, in his opinion, are the long interurban and similar lines, where the need of highly efficient control at very slow speed is not so great as in ordinary street railway work. He also calls attention to the necessity of at least two trolley wires for polyphase induction motors, and to the bad effect of lagging current in this type of motors; although, of course, this difficulty decreases, the higher the speed of the motor in large machines of this type.

In order to give a concrete picture of the various systems of distribution, the author has worked out an actual example, comparing the following four systems: 1. Direct supply from two symmetrically placed stations. 2. Supply from a single station with boosters. 3. Supply from one station with a rotary transformer substation. 4. Supply from a single station by alternating currents and static transformers. These calculations show that the annual charges for the three systems first mentioned are practically identical, while No. 4 has an advantage over the others of about 16 per cent. The details of these calculations are highly interesting and should be studied by all whose work lies in this direction. Chapters on interurban and cross-country work and fast and heavy railway operation conclude the work.

In this brief notice much that might have been profitably dwelt on, had, of course, to be passed over, but we have rarely seen a work in which there was contained so much real meat and intelligent discussion as in the one before us. It is full of practical information and evidently written by one who is a thorough master of his subject. The only serious criticism we have to offer is on the entire absence of an index.

LEGAL NOTES

WISCONSIN ELECTRIC MEDICAL COLLEGE.

A special dispatch from Madison, Wis., of March 8, says: The Secretary of State this morning received notice of the dissolution of the articles of incorporation of the Wisconsin Electric Medical College. This institution has proceedings pending against it brought by the Attorney General to cancel its incorporation on the ground that it is not properly fitted to give medical education.

ENLARGING THE SCOPE OF LIGHTING COMPANIES.

Assemblyman Scherer has introduced in the New York Legislature a bill providing that electric light and power companies incorporated under special laws shall have the right to operate by electricity railroads four miles in length in cities of the first or second class, and twenty-five miles in length elsewhere. They shall also, except in the class of city mentioned, have the right to acquire property and franchises of other railroads not more than twenty-five miles long operated by electricity. The bill also provides for the acquiring of the capital stock of waterworks corporations by electric light and power companies when the latter furnish the former with power.

THE DECISION ON HEATER SWITCHES.

In reference to the decision on heater switches noted in our issue of February 24, 1897, it would seem that the broad construction put upon the decision of Judge Coxe by the American Electric Heating Company, is not fully borne out. We have received from the Consolidated Car Heating Company a copy of Judge Coxe's decision. According to the latter, the only claim involved is the ninth, which reads as follows:

"In an electric heating apparatus having heating conductors or sections adapted to be connected in different ways with the supply conductors, a switch for controlling said connections, and an indicator operated by the movement of the switch to indicate how the connections stand."

Judge Coxe rules that the patent has been infringed, but states that "the defendant has only to drop one element of the combination and it will be absolutely safe from attack."

The decision has been appealed from by the Consolidated Car Heating Company, who inform us that it affects nothing but the use of a particular kind of indicator on a switch, and that it has nothing to do with the electric heating system, or with the switch itself, or the combination, but merely the indicator; and they state that if the indicator is changed, infringement is avoided.

UNWILLING TO CRIPPLE CORPORATIONS.

The South Carolina Legislature has killed bills putting telegraph and express companies under the control of the Railroad Commission, providing for a labor commission, regulating hours of labor on electric roads, and several others tending to bind or hamper the management of corporations.

HOUSE AND HOME is the subject of the next exposition in Grand Central Palace, to be held April 3 to 28. The proceeds are to be devoted to a charitable purpose. One of the features will be a Twentieth Century Electrical Kitchen, and many other electrical things will be included. The general manager is Daniel Browne, 34 Park Row, N. Y.

PERSONAL

KINSMAN & KNUDSON.

F. E. Kinsman.

IT gives us pleasure to announce the recent formation of a co-partnership between Mr. F. E. Kinsman and Mr. A. A. Knudson, both very well known in the art, and both men of extended experience. Mr. Kinsman's experience, as is well known, dates back to the earliest inception of the telephone business. As formerly published in these columns, his early experience with the telephone was quite a remarkable one. He designed the first central office telephone system built. His Boston experience, which consisted in the conception and working out of a central office system for another purpose than the telephone, before that valuable instrument was made practical, and his subsequent unique experience in adapting it to telephonic uses, justified his being retained by the Gold & Stock Telegraph Company of this city during the preliminary and actual arrangements connected with the organization of the American Speaking Telephone Co. He was sent to Chicago by the late George Walker, vice-president of the Gold & Stock Co., in the winter of 1877, to assist in the establishment of the telephone business in Chicago, under the auspices of the Western Union Telegraph Co. and the American Speaking Telephone Company. As early in his Chicago experience as the first part of 1878, he invented the "multiple switchboard," now so important in telephone business. He interested the late Gen. Anson Stager in this invention to the extent of selling him one-third interest in his invention, and, later on, he sold to the Western Electric Company the remaining two-thirds, which they amalgamated with the inventions of others, and upon which their extensive switchboard business of the present day is based. Through Gen. Stager's influence, Mr. Kinsman returned to New York, where he has since been intimately identified in the broadest sense with the growth of almost every branch of the electric business. During the years of 1879 and 1880, he was superintendent of repairs and attachments for the Metropolitan Telephone Company. Resigning from this position, he organized the firm of Kinsman & Tobey, whose business was soon merged into that of the Electric Construction and Supply Company, of which Mr. Kinsman was president until the year 1889, when he sold his interest in that company for the purpose of engaging in railroad and block system work. The Electric Construction and Supply Company's history, under Mr. Kinsman's management, is the record of the commercial introduction in this country of arc lamps on low tension circuits, as Mr. Kinsman was the first to burn arc lamps on incandescent circuits in this country. His early predictions in regard to this class of lamp have been fully verified, as more than 100,000 of them are now in use in this country alone. The Kinsman railroad block system is unique, and fully bears out his reputation as a practical designer and engineer. For long and practical experience in electrical and railway matters, Mr. Kinsman stands pre-eminently qualified, from every point of view, as a conservative and safe adviser. To those who knew him in his past experience as a construction and supply man, little need be said. He brings to this new enterprise not only the experience of an engineer and inventor, but what is, perhaps, of more importance to the investor who seeks his advice, is his long experience as a manager, financier and employer, qualifications, all of which are seldom found in an engineer.

A. A. Knudson.

Mr. Knudson's experience in electrical matters dates back to 1872. He was an inspector in the "ticker" service of the Gold & Stock Telegraph Company, when Gen. M. Lefferts was president. In this position, his inventive ability began to show itself, and in 1873, he invented and patented the first self-winding "stock ticker," which he sold to the Western Union Telegraph Company, and which, of late years, has been brought into common use. He has also taken out a considerable number of other patents for improvements in printing telegraphs, nearly all of which have been purchased by the Western Union Telegraph Company, and form no insignificant portion of the patents now held by the Gold & Stock Telegraph Co. In 1876, Mr. Knudson was made inspector in the private line department of the Western Union Telegraph Company, and had much to do with the early and successful work done by that department. He was also prominent in the private line department of the American Speaking Telephone Company, and afterward with the Metropolitan Telephone and Telegraph Company (now known as the New York Telephone Company), from whose service he resigned to engage in business for himself in 1883. The "K. K." wire, and other well-known brands of telegraph and electric lighting wire, were invented by him. No less an authority than Prof. Perrine, in an article in these columns on insulated wire, some time ago, gave Mr. Knudson the credit of being the originator of weather-proof wires. The so-called "K. K." patents date as far back as 1880, and were the first attempt in this direction. Mr. Knudson's experience in electrical matters in Canada, Nova Scotia and New Brunswick, is known by the fraternity to have been extensive and varied, covering several branches of electrical science. He was the first to introduce the alternating electric light in Halifax, and was afterward general superintendent of the telephone companies in Nova Scotia and New Brunswick. Then as general superintendent of the Canadian Electrical Exposition, in St. John, N. B., he won much credit and many friends. Later he was manager and electrician of the Eastern Electric Company, afterward called the Consolidated Electric Company (which combined the Electric Railway, Arc and Incandescent Lighting of that locality). His experience with electrical enterprises in Mexico, added much to his experience in matters relating to export and foreign usages. He has frequently been called as expert in patent suits, relating to electric matters, and has several times been called to Albany by members of the State Legislature, and consulted by them in relation to electrical subjects. He is one of the oldest members of the New York Electrical Society, and has frequently appeared before it with papers of special interest on electrical matters. His latest invention, the ampliphone, was recently illustrated in these columns. Both Mr. Kinsman and Mr. Knudson are full members of the American Institute of Electrical Engineers, and now offer their combined experience as experts and consulting or supervising engineers in all classes of electric work. They report, as a recent engagement, their selection as experts in an important municipal case in a neighboring city. They have established their headquarters in the Manhattan Life building, 66 Broadway, New York. We are indebted to these gentlemen for the biographical data given above.

MR. W. B. SOMERVILLE, the superintendent of the Press Bureau of the Western Union Telegraph Company, New York City, has been dangerously ill the past few weeks, but is now, we are glad to say, safe and convalescent.

MR. W. G. LEVISON gave a lecture recently with experiments, before the department of physics of the Brooklyn Institute on phosphorescent and fluorescent light.

MR. EDGAR T. BRACKETT, member of the New York State Senate, has been elected president of the Saratoga, N. Y., Gas, Electric and Power Company.

MR. J. E. LOCKWOOD, of Detroit, Mich., was in New York last week, looking into matters of recent inventive and engineering interest.

CINCINNATI, O.—The new electrical club has elected T. J. Creaghead, as president, W. M. Venable, as vice-president; Hugo Damer, as secretary and treasurer, and L. E. Bogen, as librarian.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 9, 1897.

Alarms and Signals:—

CAR ANNOUNCER. W. A. Heckard & D. Ogden, Columbus, Ind., 578,402. Filed May 14, 1896.

Adapted for use by suburban residents, whereby they may be notified of the approach of a train which they may desire to take.

DEVICE FOR OPERATING SIGNALS. S. S. Bogart, Schraalenburg, N. J., 578,442. Filed Feb. 7, 1895.

The weight of the signal is adjusted to be raised by a magnet of little power, and is lowered by its own weight aided by a counterbalance.

Connectors, Conduits and Insulators:—

PIPE. H. B. Hilgeman, St. Louis, Mo., 578,333. Filed Dec. 10, 1896.

A pipe having a glass lining and a layer of cement surrounding the glass.

Electro Therapeutics:

ELECTRICAL CANE. W. N. Sherman, Merced, Cal., 578,471. Filed April 2, 1896.

A cane combined with an electric battery.

ELECTRO-THERAPEUTIC SYRINGE. J. D. Rively, Pittsburg, Pa., 578,611. Filed April 24, 1896.

Lamps and Appurtenances:—

MANIPULATING DEVICE FOR INCANDESCENT LAMPS. J. J. Dunn & J. W. Regan, Boston, Mass., 578,394. Filed March 9, 1896.

For removing lamps difficult of access.

ELECTRIC LAMP POST. J. Buckner, Boston, Mass., 578,595. Filed June 8, 1896.

Comprises a tubular metallic base section having a tapered socket, an elongated wooden section having a metallic lamp holder at its upper end and a tapered shank at its lower end formed to enter the socket, and a hood affixed to the wooden section above the metallic section.

Measurement:

ELECTRIC METER. E. Thomson, Lynn, Mass., 578,430. Filed Aug. 26, 1889.

Comprises armature coils carrying a practically constant current, field magnet energizing coils in which a rotating armature moves, and an accessory field circuit supplied with current from any suitable source.

Miscellaneous:—

THERMAL CIRCUIT CLOSER. H. F. Maxim, Norfolk, Va., 578,-345. Filed May 29, 1896.

Comprises two parallel expansible bars of different strength, and each adapted to be connected with one terminal of an electric circuit, and a relatively stationary contact arranged in the path of one of the bars and adapted to be connected with one terminal of an electric circuit.

ELECTRIC GAS LIGHTER. F. N. Pike, New York., 578,420. Filed March 11, 1896.

Details of construction.

PROCESS OF AND APPARATUS FOR SIMULTANEOUSLY PRODUCING AMMONIA, SODIUM HYDROXID, AND CHLORIN. C. Kellner, Vienna, Austria-Hungary, 578,457. Filed Feb. 24, 1896.

The process which consists in decomposing the chlorid, forming an amalgam, and imparting to the amalgam a gyrating motion toward a central point.

MAGNEIC APPARATUS. A. Boetcher, Philadelphia, Pa., 578,673. Filed May 31, 1895.

Magnetic apparatus by which a long movement of the armature is attained for use in throwing switches, signals, etc.

PROCESS OF AND APPARATUS FOR PRODUCING CALCIUM CARBID. E. R. Whitney, Manchester, N. H., 578,685. Filed May 25, 1896.

Consists in subjecting a moving mixture of pulverized lime and pulverized charcoal to the action of a number of separate electric arcs proceeding from charcoal electrodes and crossing each other.

COIN-FREED APPARATUS FOR ADMINISTERING ELECTRICITY. K. Rudolph, Poessneck, Germany, 578,526. Filed March 18, 1896.

Comprises two springs arranged below the slot through which the coin is dropped, a lever mechanism operated by the movement of one of the springs under the weight of the coin, and connections for controlling and operating the electric circuit.

PAPER REGISTERING MACHINE. T. C. Dexter, Pearl River, N. Y., 578,549. Filed Aug. 9, 1895.

Details of construction.

Railways and Appliances:—

CONTACT FINGER FOR ELECTRIC CONTROLLERS. E. C. Parham, Johnstown, Pa., 578,464. Filed Nov. 18, 1896.

Comprises a magnetizable finger member, means for magnetizing the member, and a contact carried by the member and carried between the poles thereof.

TROLLEY SUPPORT. E. Blamey, Jersey City, N. J., 578,539. Filed Dec. 4, 1895.

A yoke connected with the trolley, the sides of which are directed upwardly.

TROLLEY ROPE PROTECTOR. H. M. Brooks, New Haven, Conn., 578,542. Filed Aug. 26, 1896.

A cup-shaped guard provided with a discharge spout at one side and placed adjacent to the trolley pole.

Switches, Cut-Outs, Etc.:—

ELECTRIC CUT-OUT. D. B. Kinch, Pittsburg, Pa., 578,643. Filed Sept. 26, 1896.

Consists of a socket plate adapted to receive in electrical contact a plug carrying one end of the loop connection, the plug being adapted to be turned in the socket and also to operate the switch-lever to break the main circuit and cause the current to pass through the loop.

CEILING CUT-OUT. H. T. Paiste, Philadelphia, Pa., 578,655. Filed May 8, 1895.

Comprises a binding post consisting of a single piece of sheet metal cut and bent so as to form a pair of jaws, an attaching lug projecting in the opposite direction from the jaws, and a connecting web bent so as to bring the jaws and attaching lug back to back.

TURN BUTTON FOR ELECTRICAL SWITCHES. J. S. Gibbs, Hartford, Conn., 578,695. Filed Jan. 6, 1897.

The key is utilized to retain the casing in position.

Telegraphs:—

TELEGRAPHIC REGISTER. C. E. Beach, Binghamton, N. Y., 578,386. Filed Oct. 21, 1895.

A device in which the printing attachment is impelled with greater force than usual with similar apparatus.

Telegraphs:—

CALL RINGER FOR TELEPHONES. J. A. Williams & S. Abbott, Cleveland, Ohio, 578,380. Filed April 10, 1896.

Comprises a tripolar permanent magnet and an electromagnet fixed between the legs of the magnet whereby the polarity in both of the magnets is in the same plane.

TELEPHONE TRANSMITTER. N. Lombard, Boston, Mass., 578.-520. Filed June 24, 1896.

Comprises a vibrating diaphragm consisting of a flexible plate adapted for support within a stationary holder and without mechanical attachment thereto, a loose pin centrally from the surface of the plate, and spring mechanism to maintain the surface of the plate convex toward the mouthpiece of the transmitter.

TELEPHONE. J. Weigel, Boston, Mass., 578,670. Filed July 14, 1896.

Comprises an inclosing casing provided with a diaphragm, a permanent magnet provided with a front pole piece, a spring interposed between the casing and the magnet and acting on the latter in a direction to move the pole piece away from the diaphragm, and means to limit the movement of the pole piece away from the diaphragm.

REPORTS OF COMPANIES

WESTERN UNION QUARTERLY REPORT.

The directors of the Western Union Telegraph Company have declared the regular quarterly dividend of 1¼ per cent., payable April 15. The quarterly report following shows that the earnings for the current quarter will be within $90,000 of the sum required for the dividend:

Surplus October 1, 1896		$7,795,907
Net revenues, quarter ended Dec. 31		1,545,454
Total		$9,341,361
Dividend January 15	$1,191,961	
Interest on bonded debt	223,358	
Sinking funds	20,000	
		$1,435,319
Surplus January 1		$7,906,041
Estimated net revenues quarter ending March 31		1,100,000
Total		$9,006,041
Interest on bonds	$223,358	
Sinking funds	20,000	
		$243,358
Balance		$8,762,682
Dividend 1¼ per cent		1,191,961
Surplus		$7,570,721

In 1896 the estimated net revenue for the quarter ending March 31 was $1,250,000, and in 1895 the actual net revenue for the same quarter was $1,163,781. The estimated surplus a year ago was $7,837,023.

THE STOCK MARKET

AND NOW CONGRESS.

There can be no question that the action of Congress now called to meet in extra session this week will have a great deal to do with the coming conditions of business. Not only is there the necessity to make the government of the country pay its way instead of running further into debt, but there is the associated necessity of making such changes in the tariff or excise as will yield that income. Hence, while such uncertainty exists in more or less degree till Congress has done its worst and gone home, the business of the country can hardly be expected to be very active or buoyant.

At the same time, better conditions do exist, and the stock market though generally dull has been remarkably strong and in spots quite optimistic. On the whole, financiers seem to have settled down to a belief in coming better times and to scepticism about any sudden amelioration.

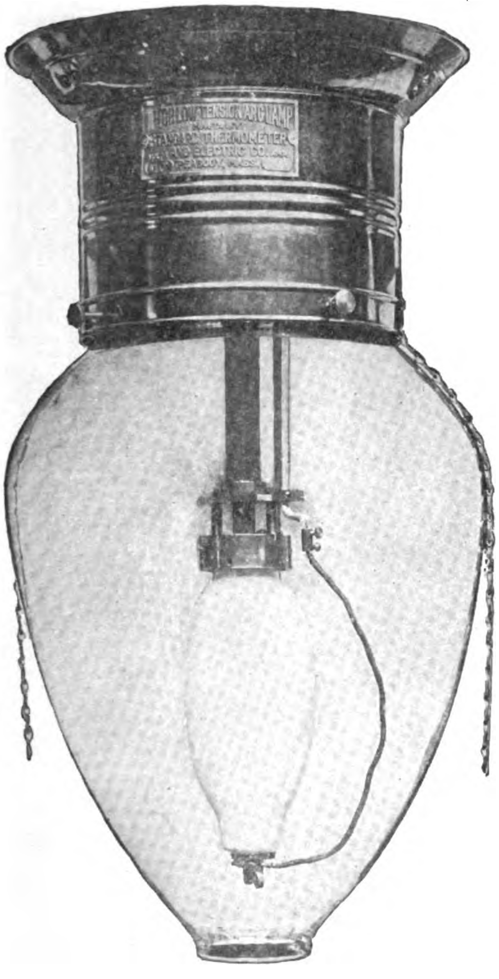
Western Union last week, on sales of 30,678 shares, went as high as 85¼ and closed at 84⅞. General Electric after a quiet week rested at 35, and American Bell Telephone remained as before at 224. Local securities in lighting, railway, etc., remain strong, but rather inactive.

TRADE NOTES & NOVELTIES

THE MIDGET ENCLOSED ARC LAMP.

ONE of the remarkable developments in electric lighting has been the recent enormous increase in the use of the enclosed arc lamp for interior illumination. Lamps intended for this purpose must of necessity be short, so as not to project too far down from the ceiling, and also call for the application of ornamental features not necessary with out-door lamps.

To satisfy both these conditions, the Standard Thermometer and Electric Company, of Peabody, Mass., have just brought out the Upton Midget enclosed arc lamp, which is illustrated in the accompanying engraving. The mechanism of this pretty lamp is extremely simple in construction. It consists of a single solenoid which operates a lever connected with a clutch. At the end of the lever is a dry-air dash-pot. The upper carbon is held in a brass tube by a suitable holder provided with brushes bearing against the interior of the tube. The clutch embraces the carbon at its point of entrance into the enclosed chamber of opal glass surrounding the arc, and is insulated to prevent the formation of an arc between carbon and clutch. A single movement of the lower carbon-holder unlocks it from the enclosure globe and permits the trimming of the lamp. The resistance coil, used for lamps on constant potential circuits, is mounted in the upper case above the solenoid.

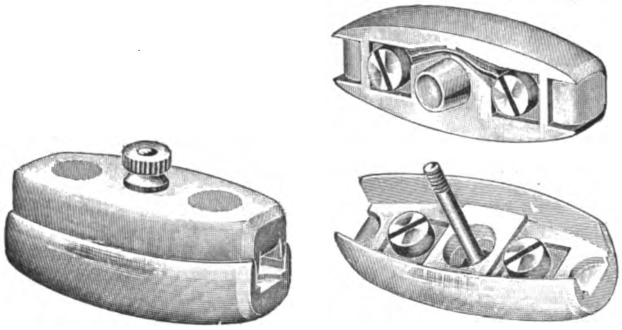


THE MIDGET ENCLOSED ARC LAMP.

The lamp, complete with the outer globe, is only 20 inches high, and without the globe, 18½ inches. A special form for show windows is made with concave or convex reflectors replacing the outer globe, to replace the ordinary group of incandescent lamps mounted in a mirror reflector.

BRYANT BUG CUT-OUT.

WE illustrate herewith a very neat and ingenious specialty recently placed on the market by the Bryant Electric Company, of Bridgeport, Conn. Figs. 1, 2 and 3 show their new bug cut-out in use and open for inspection. The construction is so readily understood from the cuts, which show the device full size, that no further elucidation is needed. Among the many advantages which obviously may be claimed for this specialty is the fact that it absolutely avoids short circuit. The fuse is placed in the cover instead of in the base, and it is not necessary to remove the connecting wires in order to replace a blown fuse. The device is small, compact, neat, well made and extremely reasonable in price.



FIGS 1, 2 AND 3.—BRYANT BUG CUT-OUT.

CENTRAL ELECTRIC CO.

The Central Electric Company advise us that the prospects for business are exceedingly promising. The inquiries for their numerous specialties are daily increasing, which gives evidence that their customers are providing for a lively trade.

It is quite evident that the Wagner direct connected alternating current ceiling fan motor, for which they are general Western agents, is bound to be a winner. It has many and unusually advantageous features which seem to appeal to prospective users with unusual force.

They are bringing out a new form of spark arrester made entirely of Russia iron, and adapted to be used in connection with most any form of arc lamp. Circulars fully describing this are being sent out and will be forwarded on application.

FIRE AT THE SPRAGUE ELECTRIC ELEVATOR FACTORY.

The new and costly shops of the Sprague Electric Elevator Company, at Watsessing, N. J., came very near total destruction on March 8 by fire. The main shops are nearly 400 feet by 100 feet, with an L nearly 200 feet long, and a separate power house about 100 feet long. There was nearly half a million dollars' worth of property endangered. The shop is a brick and steel gallery construction. The fire broke out about half-past two o'clock in the morning, in one of the main galleries, and spread very rapidly to the roof. The company put on three fire hose of its own, and would have got the flames under control very quickly but the water supply gave out. The fire was then fought from the overhead cranes with fire extinguishers, and by hose from the Bloomfield Fire Department. The flames spread along the monitor roof for a distance of about 160 feet to 200 feet. The damage by fire, smoke and water, the lower floor being flooded, is not very serious, and within forty-eight hours the shop was again in operation.

This company is busy installing elevators in the Queen's Insurance Building, the new Astor Hotel, and a number of other important buildings, but there will be very little delay, if any, in these equipments. The cause of the fire is as yet unknown. There has been a threatened strike in New York, and talk of its extending to the Watsessing Works, but it is not believed by the officers of the company that the fire was of incendiary origin, although it cannot be accounted for at present. The president of the company is Mr. Frank J. Sprague. Mr. John E. Searles is vice-president.

NEW APPARATUS OF THE WESTERN TELEPHONE CONSTRUCTION CO.

WE illustrate herewith several pieces of apparatus recently put on the market by the Western Telephone Construction Company, Chicago. Fig. 1 shows their 100-drop new improved type of switchboard. This board is remarkable for its compactness. It is of the same general style as the earlier boards manufactured by this company, but embodies many radical improvements in detail. The jacks and drops have been made larger and heavier, giving greater durability, and better electrical design. The circuit changer for switching the operator's telephone or generator into the circuit of two connected lines has been completely changed, the principal features of novelty being that the removal of eight screws allows the whole circuit changer to be slipped out of place and cleaned, without the unsoldering of a single connection. This cut shows the board "opened up." The upper part of the cabinet containing the jacks is so constructed as to swing outward, thus exposing at once the entire rear portion of the jacks and drops and their connection. The key table is shown turned upward, thus exposing the entire mechanism of the circuit changers to view.

Fig. 2 shows the power generator used for supplying the ringing current in telephone exchanges. The entire machine is mounted on a slate base, the pulley shaft being separate from the armature shaft, and connected thereto by a flexible rubber connection in such a manner as to prevent any undue jar or wear coming on the armature bearings themselves.

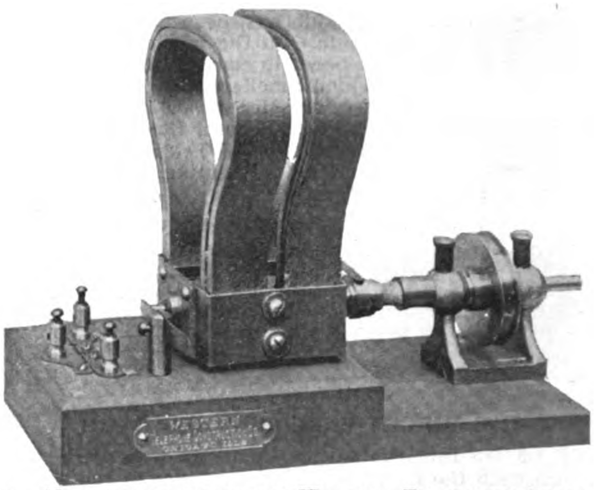
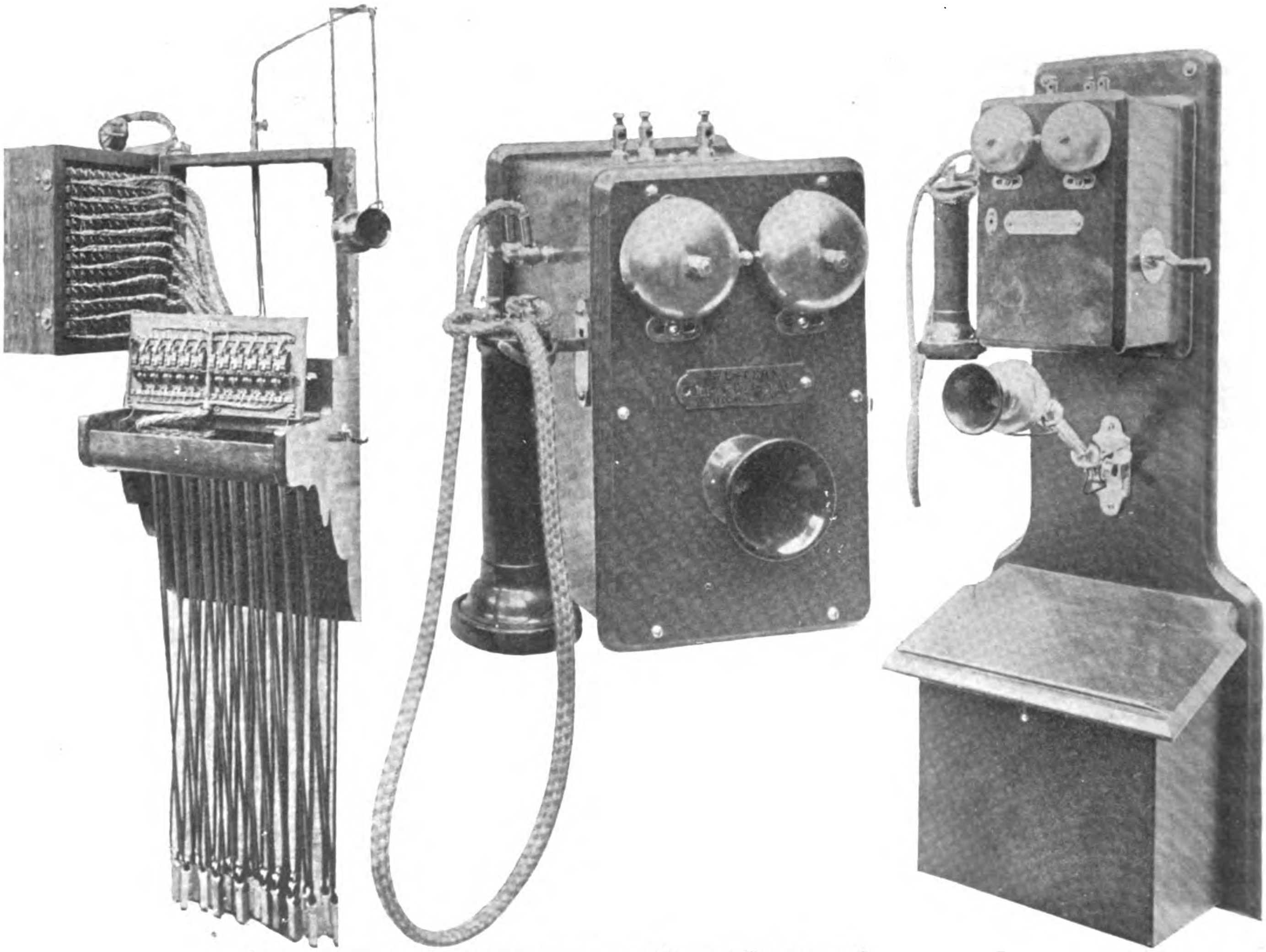


FIG 2.—NEW APPARATUS OF THE WESTERN TELEHONE CONSTRUCTION CO.



FIGS. 1, 3 AND 4.—NEW APPARATUS OF THE WESTERN TELEPHONE CONSTRUCTION CO.

Fig. 3 shows their Western Giant B telephone. This instrument is complete in itself, the box being no larger than the generator box on an ordinary telephone. With this type of instrument, the battery is placed in a closet, and the wires forming the local circuit run thereto from the transmitter. Fig. 4 shows their new rocker arm telephone. The transmitter is mounted upon a handsome nickel-plated arm with a knuckle joint at each end. So great is the latitude of motion allowed by this construction, that the transmitter may be completely inverted, thus forming a most efficient means of agitating the carbon granules. This instrument is provided with a powerful magneto-generator and call bell, and may be wound either for series or for multiple work. An automatic shunt-break is attached to the armature shaft, which effectively shunts the armature resistance out of the line at all times when the generator is not being used. The receiver is of the Western bi-polar type, and is extremely sensitive. Both of the latter instruments here illustrated are finished in either polished oak or walnut, and form a very handsome piece of furniture for any house or office.

THE CROSS OIL FILTER.

THIS filter has been manufactured by the Burt Manufacturing Co., of Akron, O., for nearly seven years and is in use by leading concerns throughout the world. They manufacture a complete line of from 3 to 120 gallons filtering capacity per day made out of iron, brass or nickel-plated copper.

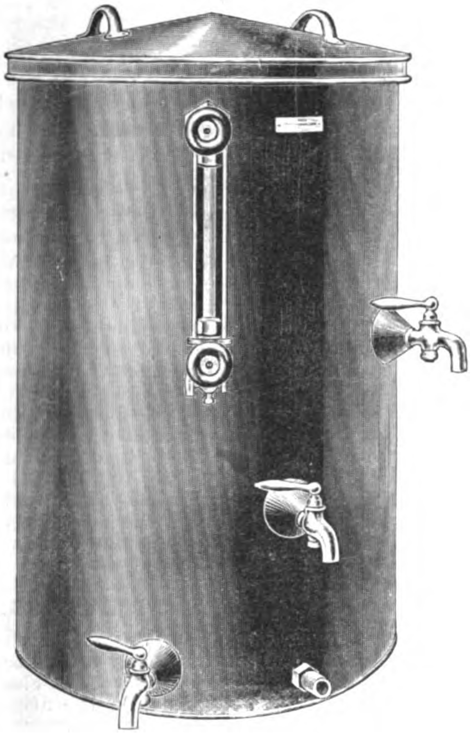


FIG. 1.—THE CROSS OIL FILTER AND PURIFIER.

The filter illustrated is made out of heavy galvanized iron, with polished brass fittings, gauge and cover, and nickel-plated rim. The bottom chamber E is filled with pure, warm water, which is heated by means of a steam pipe passing through the filter. Very little steam is required, and if the filter is kept in a warm place it will not be necessary to make steam connection at all.

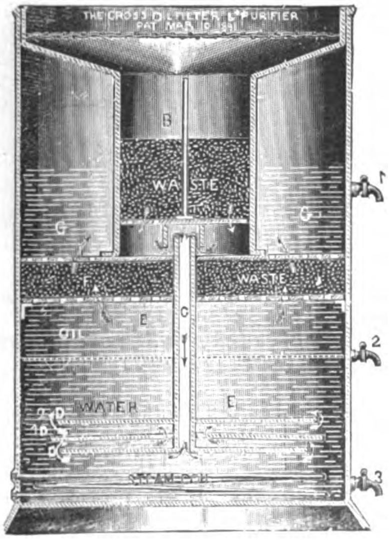


FIG. 2.—THE CROSS OIL FILTER AND PURIFIER.

The waste oil is poured in through top grating A. It then passes into chamber B, through the layer of waste, which collects all the heavier impurities, thence through the perforated bottom of the chamber B, down in the direction shown by the arrows into tube C, and from here into filter plate D, where the increased weight of the water has a tendency to keep the oil back in tube C. However the pressure of oil in chamber B forces it down and spreads it out over plate D, in a very thin film which constantly changes surface and grows thinner as it travels from the center to the circumference of plate D, thus exposing every particle of waste oil to the action of the water. It then flows upon plate D' and D", going through the same process in each case. When the oil leaves the filter plate D", it is in a finely divided state of separation and thoroughly mixed with water, which washes it out, and from which it separates by gravity all the remaining impurities which settle in chamber E, and can be removed through cock No. 3. From plate D" the oil again filters through the stratum of filtering material F, and from there it rises to chamber G, the reservoir containing the purified oil. It is then drawn off as required from cock No. 1.

"W-S" X-RAY PLANTS.

MR. JAMES G. BIDDLE, Drexel Building, Philadelphia, (sole agent for Messrs. Willyoung & Co.) has been very successful in securing a large number of orders for the now widely known "W-S" X-ray apparatus. The most expensive part of an X-ray outfit is the induction coil, and this very important piece, as made by Willyoung & Co., is remarkably effective and enduring. In addition to the adjustable condenser invented last year by Mr. Willyoung, a new improvement has been introduced in the "Ideal" automatic interruptor just placed on the market. It is so constructed that only about one-half the amount of current is required to energize a coil as the Apps or other forms of hammer head vibrators require. Furthermore, the "Ideal" interruptor does away almost entirely with sparking at the platinum contacts, and can be operated continuously without sticking. It can be connected to any direct current up to 110 volts, if the primary current is regulated by a suitable rheostat; but without necessity for rotary or mechanical break of any kind. The makers claim this to be the first automatic interruptor that can be safely connected to a 110-volt circuit in the manner indicated. Other parts of these equipments are equally meritorious as the induction coils, and interested parties should avail themselves of Mr. Biddle's offer to mail his new X-ray catalogue, No. 200, upon request. A few of the recent orders received by Mr. Biddle are from the Episcopal Hospital, Philadelphia; Jefferson Hospital, Philadelphia; German Hospital, Philadelphia; Girls' High School, Philadelphia; Emergency Hospital, Washington; West Penn Hospital, Pittsburg; Williamsport Hospital, Williamsport, Pa.; Catholic University, Washington; Hospital, Alton, Ill.; Hospital, Boise City, Idaho; College of Medicine, Cincinnati; Hospital, New London, Conn.; Hospital, Lancaster, Pa., etc.

AMERICAN MANUFACTURERS' AND EXPORTERS' EXCURSION TO SCANDINAVIA.—THE STOCKHOLM EXHIBITION.

Arrangements have been made for an excursion of American manufacturers and exporters to Denmark and Sweden, including the Stockholm Exhibition, to start from New York in May or June this year. The object of this excursion is for American manufacturers and exporters to investigate for themselves the facilities of opening trade with the northern part of Europe through the free port of Copenhagen. A stop of ten days will be made in Copenhagen, thence the excursion will proceed to the industrial exhibition in Stockholm, Sweden. Another stop of ten days will be made there, which will enable the participants to examine the industries of the Scandinavian countries, and thereby judge for themselves to what extent American products could be introduced in these countries.

The whole trip can be made in two months, and the ordinary expenses will not exceed $210, including first cabin on steamer from New York to Copenhagen and return (Thingvalla Line); first-class railroad to Stockholm and back; ten days' stay at first-class hotel (rooms only), both in Copenhagen and Stockholm.

The excursion will be led in person by Mr. George Kirkegaard, 28 State street, New York, who will gladly supply further information and illustrated pamphlet relating to the free port of Copenhagen.

The northern countries of Europe import considerable quantities of electrical apparatus and are well worthy the attention of Americal manufacturers. Mr. Kirkegaard is personally known to us and has already received a number of acceptances.

GRAPHITE FOR RESISTANCE PURPOSES.

For some years the Joseph Dixon Crucible Company, Jersey City, N. J., have been supplying graphite resistance devices in quite a large way to telephone companies, electric light companies, and electricians generally. The resistances have been so satisfactory and demand so promising that they have now added to that department of their works, dynamo and all necessary apparatus for testing purposes and are prepared to furnish graphite resistances in round or square rods, tuoes, spirals and other devices as wanted, of one ohm resistance of one million ohms resistance, as required.

THE FRECK TUBE CUTTER.

A FREQUENT operation in machine and repair shops is the cutting of tubes and pipes, yet much time is generally consumed in this work by doing it by hand or on machines ill adapted for it. To meet the special demand for a tube cutter, the Wm. Freck Company, of Chicago, Ill., have brought out the handy little tool shown in the accompanying engraving, Fig. 1. This machine will cut tubing from 2 inches diameter down, and any length from $^1/_{16}$ inch up. The tubing is laid down on the rollers, and resting on the V-shaped arm on gauge-rod, the cutter-wheel is brought down on the tubing by means of the lever, assuring a straight, clean cut with the greatest rapidity and ease.

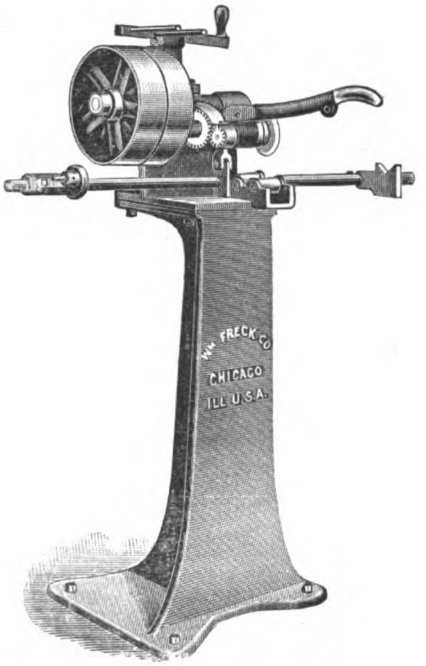


FIG. 1.—THE FRECK TUBE CUTTER.

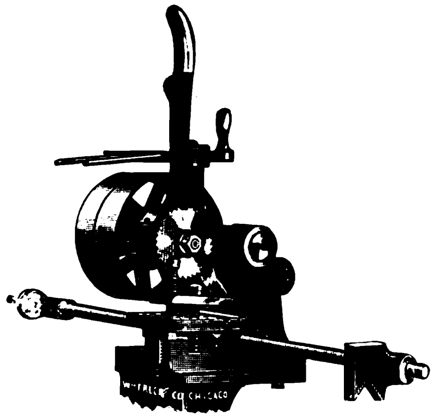


FIG. 2.—THE FRECK TUBE CUTTER WITH SAW ATTACHMENT.

The arm which carries the cutter-wheel is accurately fitted into the head and swings on the main shaft. This shaft is of steel, and forms a pinion at a distance where it rests against the head, transmitting power to the steel pinion, which carries the cutter-wheel by means of an intermediate spur-gear. A hand-screw with check-nut is provided so that cutter can be stopped at any required depth. The lever which raises and lowers the cutting-wheel is so constructed that it requires only a slight pressure when cutting, and when thrown back in an upright position, locks itself automatically, no springs being used.

The Freck Company also make a sawing and slotting attachment to fit this machine, to run a 4-inch circular saw for sawing brass, iron and steel bars and tubing, and for slotting any machine parts, screws, etc, Fig. 2. When sawing solid bars, a small weight hung in the hole on lever will make the saw feed automatically.

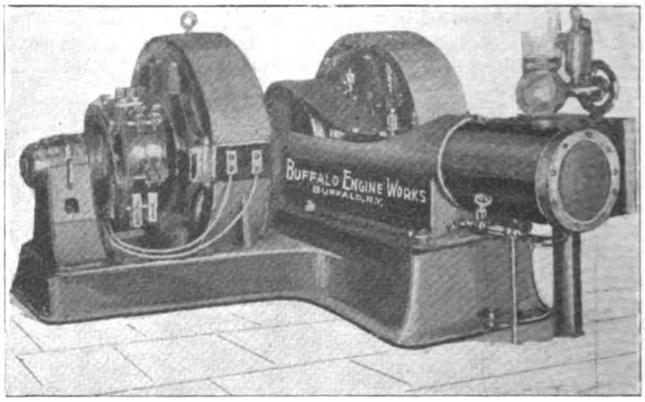
The machine is 50 inches high over all, takes 16x16 inches floor space, weighs 210 pounds.

ELECTRIC POWER IN MEXICO.

The Pelton Water Wheel Company, of San Francisco, Cal., have recently sent a power plant to Mexico, which has some features of unusual interest. The plant embraced two 67-in. three-nozzle Pelton wheels, having a capacity of 700 horse-power, running under a head of 100 feet. The station operates a jute factory located at Barrio-Nuevo, in the State of Orizaba, some 60 miles inland from the port of Vera Cruz. These wheels are connected to four electric generators and the power transmitted to the factory 1¼ miles distant. No line or counter shafts are used—every machine in the factory being run by a separate motor, these varying from 1 to 20 horse-power as required. Pelton differential governors are attached to the wheels, which afford an absolutely uniform speed under all variations of load. The most sanguine expectations of its projectors have been realized in the economical and reliable service afforded. When it is considered that some 30 per cent. of the power in a plant of this character is usually absorbed by shafting and belts, and that constant expense is necessary in maintenance, the advantages of such a direct connection where electricity is the means of power are most apparent.

THE BUFFALO ENGINE AND DYNAMO.

THE Buffalo Engine Works, of Buffalo, N. Y., whose steam engines are well known, have recently brought out an automatic high speed engine, specially adapted for electric lighting. This engine, which is illustrated in the accompanying engraving, combines the pleasing outline and the massiveness and solidity of structure so well known and recognized on their other machines. Simplicity of construction and large wearing surfaces, together with the best material and workmanship, add increased life to the machine.



THE BUFFALO ENGINE WORKS HIGH SPEED AUTOMATIC ENGINE AND DIRECT CONNECTED DYNAMO.

The construction of the governor is such that there is the minimum variation from light to heavy load. Perfect lubrication of the moving parts is secured by the most approved oilers and lubricators, while the waste of oil and its attendant discomforts are prevented by suitable guards and oil catchers. All direct-coupled engines are built on a heavy cast iron sub-base in line with the generator, thereby securing the permanent alignment of both engine and generator, while securing the utmost rigidity and the most pleasing design.

The Buffalo Engine Works have, until recently, confined themselves to building steam engines and refrigerating machines, but have quite recently taken up electrical work, doing a general construction and supply business, as well as manufacturing a full line of dynamos and motors and are prepared to install direct-connected dynamos.

The armatures of the two-pole machines are of the drum pattern; all others are ring cores. The latter are built up of discs about ½ mm. thick of iron showing least hysteresis, stamped out, and then annealed before building up. The cores are slotted to receive the conductors, and wound over all with one layer of soft square iron wire, thereby reducing heat loss in conductors to a minimum. The field cores are of wrought iron. The fact of the armature being slotted and wound over with iron wire after conductors are in place permits the armature core to run very close to the pole blocks, thereby reducing the air gap, consequently necessitating much fewer ampere turns in the field coil, and hence effecting a saving in energy in that direction.

The bearings are self-aligning, self-oiling and are so constructed as to be able to compensate for wear, and at the same time hold the armature central. It is absolutely impossible for any oil to creep or leak from the bearings, as they are so constructed that the oil must flow back to the well again. The arrangement is entirely new from anything now on the market.

Brush holders are also of an entirely new design, permitting of a very wide range of tension. The machines throughout embody all of the most recent improvements, including carbon brushes.

The Buffalo machines are built in sizes of from one to twelve kilowatts, in either two or four pole, and for sixteen and upwards six poles. Our engraving shows one of the machines direct connected to a Buffalo high-speed automatic engine.

It is the purpose of the Buffalo Engine Works to do a general electrical construction supply and manufacturing business. The proprietors are R. F. Strum, A. B. Hartung, C. J. Zacher, with Fred J. Cross, E. E., as manager. Mr. Cross has had a wide experience in machine designing and is considered to be one of the best designers of the day. All machines of his design are giving the utmost satisfaction. He has eleven patents protecting his designs and appurtenances.

ADVERTISERS' HINTS

CARLISLE & FINCH, 830 West Sixth street, Cincinnati, Ohio, are selling complete electric railways at $3.00. This includes car, track and bichromate battery.

THE GOODYEAR VULCANITE COMPANY, 353 Broadway, New York, manufacture hard rubber rod, sheet and tubing and make a specialty of hard rubber goods for electrical and mechanical purposes.

A. L. BOGART, 22 Union Square, New York, is advertising his No. 18 multiple porcelain burner, which, he states, is the only absolutely safe burner for electric gas lighting in theaters, churches, etc. Each burner is provided with an unbreakable nickel-plated steel tip, making their operation very reliable.

WARD LEONARD ELECTRIC COMPANY, Hoboken, N. J., direct attention to the marked advantages of their automatic circuit breakers, which have just been introduced.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., remind central station managers of the Holly system for the heating of all kinds of buildings by exhaust steam, enabling them thus to utilize what is otherwise a waste product.

RILEY BROS., 16 Beekman street, New York, carry a full line of magic lanterns and accessories. They manufacture the Riley kineoptoscope for the projection of living pictures, by which every movement of actual life is depicted on a screen.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., manufacture and deal in telephone supplies, including batteries, zincs, building posts, porcelain insulators, test connectors, carbon dust and salammoniac.

THE BRYANT ELECTRIC COMPANY, Bridgeport and Chicago, are supplying the Bryant "bug,' which has one nut only. The fuse is placed in the cap and it is not necessary to remove connecting wires to replace it.

THE WESTERN TELEPONE CONSTRUCTION COMPANY, Chicago, say their telephones speak for themselves.

K. McLENNAN & CO., 206 Dearborn street, Chicago, offer some more reports on the use of Gale's commutator compound, of which they are the sole manufacturers.

THE PHŒNIX INTERIOR TELEPHONE COMPANY, 93 Washington street, New York, offer to replace, free of charge, any transmitter that loses its adjustment, packs, or deteriorates in any way within two years from date of purchase.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, make a sixty-day offer on their No. 98 microphone. Full nickel finish and are good for one mile or one thousand.

THE ILLINOIS TELEPHONE SUPPLY COMPANY, 356 Dearborn street, Chicago, submit a list of prices on telephone outfits and supplies.

F. M. LOCKE, Victor, N. Y., is furnishing insulators for any current up to 50,000 volts.

NEW YORK NOTES.

THE STANDARD AIR BRAKE COMPANY, 100 Broadway, report an excellent inquiry for their brakes and a growing conviction among progressive managers that only power brakes are permissible with the modern heavy car and travel in crowded streets. Their list of sales grows steadily, and not the least striking part of it is the number of foreign orders with which it is decorated.

THE BULLOCK ELECTRIC COMPANY are already settled in their new quarters on the sixteenth—or is it the sixtieth?—floor of the new St. Paul Building, whence they look down on the busy world beneath, and derive new inspiration every minute from the activity manifest in every direction. The offices are roomy, cosy and convenient, and are hung with many pictures illustrative of Bullock motor installations and the work such motors do. Mr. R. T. Lozier and his brother have got up also some excellent stationery for the company, which is in quiet good taste, yet impressive and characteristic. They report business as good, and the outlook never better for motor equipments.

THE BROOKLYN UNION GAS COMPANY and the Brooklyn Edison Company are said to be investigating and locating electrolytic troubles caused by trolley leakage, with the object of bringing suit to recover damages.

McLEOD, WARD & CO., 27 Thames street, report a satisfactory business in all their lines, especially their Kinsman desk lamps and also their spark arresters.

A. & R. BOILERS.—The Abendroth & Root Manufacturing Company, 28 Cliff street, New York City, has through its St. Louis office secured an order from the Alexian Brothers for two Root improved water tube boilers, 150 horse-power each, to be installed in the new hospital in Chicago. The company has also secured the Schwarzchild & Sulzberger order for water tube boilers in the face of a close competition, for their packing plant in Kansas City. This order calls for 1,000 horse-power.

HENRY R. WORTHINGTON, manufacturers of steam and electric pumping machinery, have recently received a contract from the Newport News Ship Building and Dry Dock Company, amounting to $100,000, for pumps for the United States battleships Kearsarge, Kentucky, and Illinois. They are also building the pumps and pumping machinery for the United States battleship Alabama, now being constructed by the Wm. Cramp & Sons Ship and Engine Building Company. The contract for the pumps for this vessel amounts to $33,000. The company have just completed and delivered the hydraulic machinery for operating the turrets on the United States battleship Iowa. They have more recently received a contract amounting to $15,000, covering the pumps required for the armored cruiser being built by the Wm. Cramp & Sons Ship and Engine Building Company, for the Japanese Government. The Yoshi-No, another Japanese cruiser, is already fitted out with a full complement of Worthington pumps. The fact that with few exceptions all British and other foreign war vessels are equipped with these machines simply adds another testimonial to the high efficiency of the Worthington duplex steam pump.

THE NEW YORK TELEPHONE COMPANY will, it is expected, put a new building up at Gold street, near Fulton, where it now has extensive quarters.

THE GOVERNMENT PRINTING OFFICE in Washington has a fine electric power plant, described in a recent official bulletin, noted in our columns lately. It deserves mention that the motors are of Crocker-Wheeler Co.'s make.

HUDSON RIVER TELEPHONE COMPANY.—The report of the president shows that the receipts during 1896 were $299,999.59; expenses, $204,347.66, leaving as net revenue the sum of $95,651.93.

MONTREAL, CAN.—The contract for the electrical equipment of the Montreal Park and Island Railway Company's suburban lines has been awarded to Ahearn & Soper, Ottawa, Can. Westinghouse No. 38 B and No. 12 A motors will be used throughout.

NEW ENGLAND NOTES

THEODORE H. COLVIN, of Providence, R. I., has commenced work on his new foundry building. This building will be 102 feet wide and 180 feet long, and will be a complete and modern foundry building in every respect. The central portion, 50 feet wide, will be served with a 20-ton traveling crane, and at distances of about 25 feet in the length of the building will be placed 5-ton jib cranes swinging from the central portion of the building over the moulding floors in the wings, which extend along both sides of the building and are 25 feet wide. The entire frame work of this building will be steel. The roof covering is to be slate. The steel work is being furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

THE WASHBURN & MOEN MANUFACTURING COMPANY have just sold to the New York, New Haven and Hartford Railroad Company, for its new electrical equipment, at Berlin, Conn., a large number of their "Crown" rail bonds. These bonds are stranded, are above 300,000 c. m. capacity, and are to be applied underneath the rail, two bonds to each joint. The "Crown" bond is the newest thing in the market, being made in different shapes, so as to meet all conditions of rail bonding, and immediately engages the attention of every railroad man who sees it.

MR. CHARLES I. HILLS, of the Perkins Electric Switch and Manufacturing Company, has started on an extensive trip West, in the interests of his company. Mr. Hills will probably be gone from New York about six weeks, and will reach the Pacific coast before his return. Mr. Hills' numerous friends in the West will undoubtedly be glad to see him, and get the latest metropolitan news.

MR. J. H. EDWARDS.—The business of the Berlin Iron Bridge Company, of East Berlin, Conn., has increased to such an extent that Mr. Chas. M. Jarvis, who has been chief engineer of the company since its organization, has been obliged to resign to others the engineering department and give his entire time and attention to the business management of the corporation. The directors have therefore appointed to the position of chief engineer, Mr. James H. Edwards, a graduate of Cornell University, who has been with the bridge company a number of years, during which time he has been the chief assistant to Mr. Jarvis. Mr. Edwards is by education and experience well qualified for the new and important position to which he has been elected.

WESTERN NOTES

MR. O. C. LITTLE, of Menasha, Wis., associated with Mr. M. M. Schoetz, is the manufacturer of a pulley coating for which he has received several testimonials from central stations as well as many mills, factories, etc. Sample sheets of this saver of oil, fuel and belts will be sent on application.

THE ELECTRIC APPLIANCE COMPANY makes it a practice to keep its customers posted on any changes in market prices, and to this end it is the custom to publish at frequent intervals a bulletin of prices, on staple goods. Such a bulletin has just been issued, giving present market prices and a number of the Electric Appliance Company's well-known specialties. It contains valuable information to every purchaser of electrical supplies, and will be sent to the trade on application.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., say there was never a time in the history of their factory when they had so great a demand for the Laclede batteries as they are having at the present time.

MR. F. A. ROSS has been appointed general manager of the Stromberg-Carlson Manufacturing Company, of Chicago, in place of Mr. M. C. Wheaton, who recently resigned.

THE WESTERN ELECTRIC COMPANY have issued a pamphlet on fan motors, which is of a very descriptive and interesting nature.

THE METROPOLITAN ELECTRIC COMPANY of Chicago are agents for the Perkins incandescent lamps, and switches, and report a fine trade in this justly popular line of electrical goods.

THE CENTRAL ELECTRIC COMPANY reports that one of the good signs of the times is found in the fact of increasing sales of all kinds of construction and line material. This would indicate a strong probability of lively business when the season opens up.

THE ACME ELECTRIC MFG. CO. has been formed at San Francisco, Ca., by W. T. G. Schenck, L. St. D. Boylance, S. B. Peterson, F. J. Dyer, and M. S. Schenck. The capital stock is $50,000, of which $20 has already been subscribed.

MR. JOHN T. McROY, 915 Chamber of Commerce Building, Chicago, has issued for March a neat blotter advertising his terra-cotta conduit, and encloses with it a pretty card which gives some good points on the same material for subway uses.

FOREIGN NOTES.

THE COX LABORATORY.—Newspapers are to hand with reports of the unfortunate fire at the Cox Laboratory, St. Albans, England, where the Cox thermopiles were being made. The destruction appears to have been pretty complete, not only of the laboratory, but of some 600 of the generators awaiting shipment. There had been several exhibitions of the apparatus during the week, to the press and others, and it is possible that the circuits had been worked beyond their safety limit in showing the use of the current for even large work in light and power. The loss reaches probably $100,000. Steps for resumption of work were taken immediately. The English "Railway World," of March, has an interesting article on Mr. Cox's invention.

THE LA CAPITAL CO., of Buenos Ayres, Argentine Republic, South America, have let to parties in the United States contracts for the materials for a power station, the necessary equipment for the power in the station, and the roadbed and cars. The Berlin Iron Bridge Company, of East Berlin, Conn., have the contract for furnishing the skeleton steel work of the building and the roofs. The roof over the engine and dynamo room will be covered with corrugated iron lined with the Berlin Company's fireproof anti-condensation roof lining.

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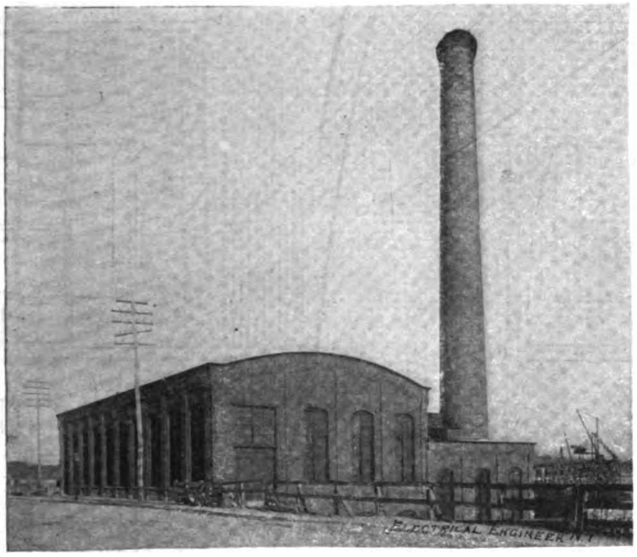
ELECTRIC TRANSPORTATION

THE DORCHESTER POWER STATION OF THE WEST END ST. RY. CO., BOSTON, MASS.

By H. W. WELLER.

EARLY last year the directors of the West End Street Railway Company foresaw that the rapidly increasing traffic of the Dorchester, Neponsett, Ashmont and Milton lines necessitated a more centrally located plant, where sufficient power could be economically provided, for the present and future needs of this portion of their territory, now being built over and settled at an astonishing rate.



General View of Dorchester Power Station, West End Street Railway Co., Boston.

LOCATION OF THE STATION.

After careful consideration a suitable plot of ground was purchased, located at Commercial Point, on Dorchester Bay, offering every facility for procuring ample water for condensation and for obtaining coal at tidewater. The work of preparing all the necessary plans and specifications was quickly put in hand, and, before spring opened up, the contracts were let, and early in April last the work was commenced and pushed rapidly to completion.

The plot has a frontage on Freeport street of about 300 feet, and the building is about 125 feet long, the engine room being next to the street, with the boiler room adjoining and in the rear. The stack is located behind the boiler room.

THE BUILDINGS.

The buildings are of the best selected hard-burned brick, with freestone trimmings, the foundations being of concrete and stone. The engine room floor being on a level with Freeport street, the front wall of the basement is built of granite, as a retaining wall, and is protected from the damp by a damp proof course of tar and pitch.

The roof is carried on arched iron trusses supplied by the Boston Bridge Company, and is of special fireproof construction, being a series of arches springing from truss to truss, the arches being of two layers of flat fireproof tiles laid in cement. This special roof construction was designed by Mr. Baker, and carried out under his instructions by Messrs. Guastavino, of Boston.

COAL-HANDLING APPARATUS.

Projecting out into the bay is the coal dock and hoisting and conveying machinery, designed and installed by the engineers of the West End Company. The coal is brought in barges to the dock, and hoisted by a 40 horse power duplex vertical engine to the top of the trestlework, where it is dumped into automatic self-dumping cars. The cars, on arriving at the inner end of the trestle, dump their load and return to the hoist. The cars and special rails were furnished by the C. W. Hunt Company, of New York.

The storage capacity of the dock is upward of 5,000 tons, which allows an ample store of coal being kept in case of continued frost in the harbor or any other unforeseen interruption of the supply. As the coal is brought into the fireroom it is weighed and entered in the daily log.

THE BOILER ROOM.

The boiler room is 122 feet in length by 51 feet in depth and of ample height. It is substantially built of selected hard-burned red brick, with granite water tables and freestone cornices, sills and trimmings. In it are installed two batteries of two 500 horse power boilers each, of the well-known Babcock & Wilcox type, making a total capacity of 2,000 horse power, and space has been left for the installation of another battery of 1,000 horse power in the future.

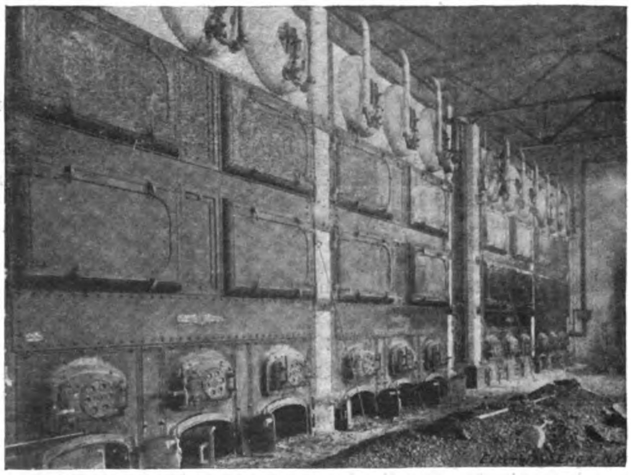
As shown in the accompanying illustration, each boiler has three 42-inch water drums, projecting through the front of the setting, each drum being protected by a 5-inch Ashton pop safety valve, set to blow at a pressure of 175 pounds. All the feed piping and connections are of extra heavy brass, and the water columns are of the Reliance pattern, fitted with high and low water alarms.

The feed water is taken into the front of each drum, with a duplicate system connected into the rear of each drum. To facilitate the removal of tubes, when necessary, large doors are located in the wall of the building, opposite the fronts of the boilers. These doors are hung vertically on chains and balanced with counterweights.

The smoke flue from each boiler is connected into one main flue, which carries the gases into a Green economizer of 1,000 horse power capacity, located in the boiler room opposite the stack and connected with it by a brick flue 12 feet square. A by-pass flue, with two dampers, is also provided for use when the economizer is shut down at any time. There is also a damper at each end of the economizer.

A novel feature in connection with this part of the plant is the provision of sufficient room above the economizer for removing defective tubes, and for proper inspection and cleaning. The top of the economizer is reached by three flights of iron stairway. The scrapers for keeping the tubes of the economizer clean are operated by an electric motor run from the trolley circuit. The scrapers are usually operated for about one hour each day.

A flue damper is also provided in the setting of each boiler. The draft is automatically controlled by the main damper in the stack, operated by a Spencer damper regulator. An indicator on the wall of the engine room shows the position of this damper at all times for the engineer's guidance. An underground tunnel, protected with iron gratings, passes underneath and across each boiler. All the ashes drop through these gratings into the tunnel, and are carried by the discharge from



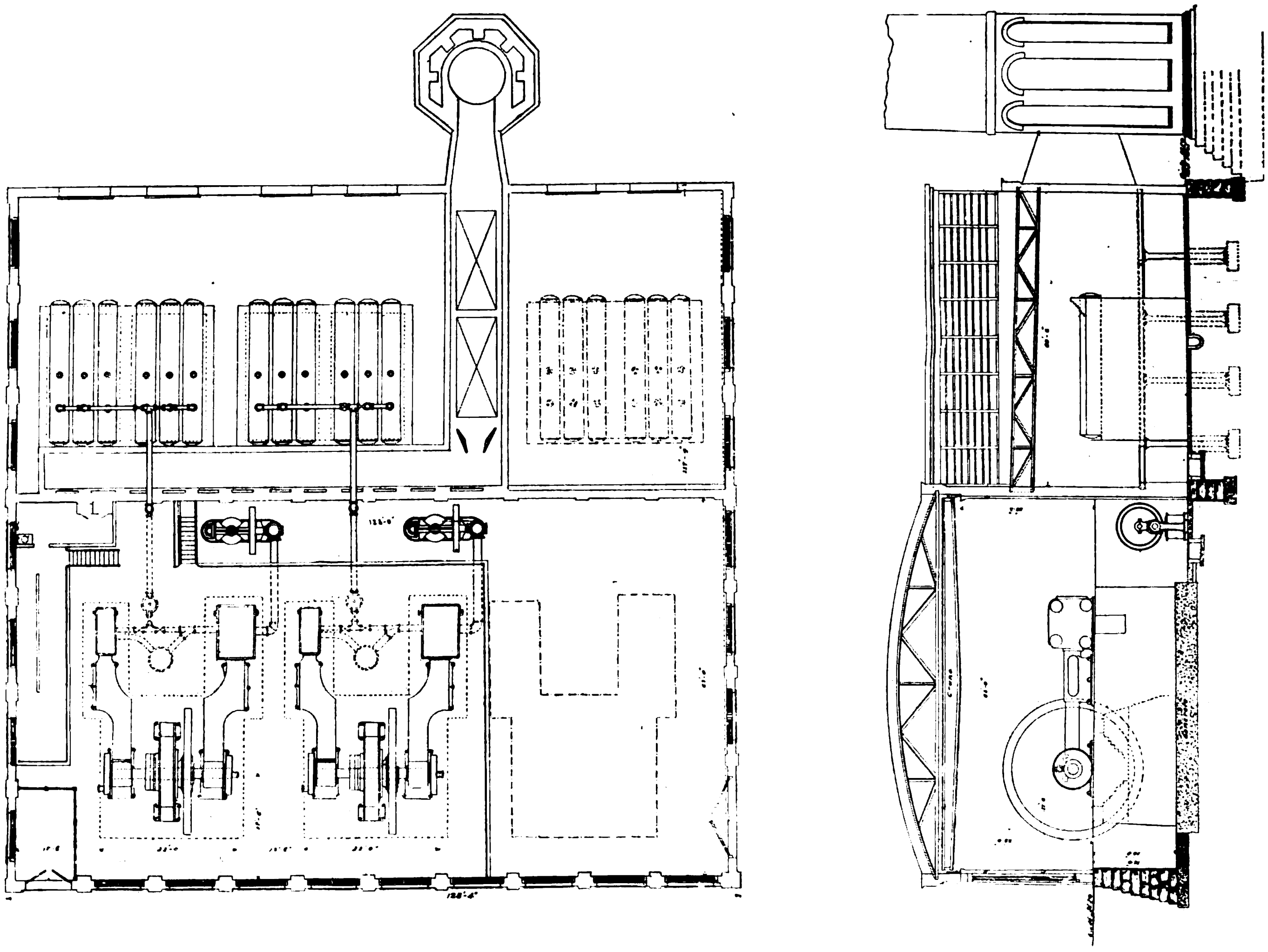
Babcock & Wilcox Boiler Room, Dorchester Power Station.

the condensers, which passes through the tunnel, out onto mud flats owned by the railway company, and which will ultimately be reclaimed and utilized.

The blow-off piping is carried in the rear of the boilers in a concrete trench, covered with floor plates of cast iron. The boiler room floor is of cement concrete, which forms a smooth and durable surface.

THE STACK.

The stack is of selected hard-burned red brick, with a 10-inch fire brick lining, for a height of 50 feet. It is carried to a height of 200 feet, and is octagonal in shape for the first 24 feet, with moulded corner brick, and a granite plinth of about one foot in thickness. From this point it is circular, and of an outside diameter of 20 feet, tapering toward the top, where it is 15 feet in diameter, and is finished off with a cornice and capped. The inside diameter is 10 feet. The stack is protected from lightning by four rods, one-half inch in thickness and projecting 6 feet above the cap. These rods are of copper and tipped with platinum.



Elevation and Plan, Dorchester Railway Power Plant, Boston, Mass.

The foundations for the stack are of cement concrete and capped with granite. The stack is of ample size to handle double the present capacity of the plant.

THE ENGINE ROOM.

The engine room is 122 feet in length by 63 feet in width inside, built of selected hard-burned brick, with freestone trimmings and sills. It is exceedingly well lighted, having 19 large sash windows on three sides, and on the fourth side, where it adjoins the boiler room, 10 smaller windows are provided, above the level of the boiler room roof, for ventilation. These swing on centers, and are controlled by hand-wheels from the engine room floor. Large double doors are provided on the front and on the end of the room.

The engine room floor is laid with 4-inch spruce planking on iron girders, and finished off with narrow strips of hard maple, polished and oiled. An open pit, guarded by brass railings, is left in the floor, as shown in the plan, over the pumps and condensers, to permit of their being seen at all times from the engine room.

In the engine room is installed a traveling crane of seven tons capacity, the tracks for which are iron girders built into the side walls of the building. The crane was manufactured and installed by the Boston Bridge Company, of Boston.

THE ENGINES.

There are two horizontal, cross-compound, direct-connected engines, built by the Rice & Sargent Engine Company, of Providence, R. I. The engines are duplicates, having cylinders 26-inch and 50-inch x 60-inch stroke. They run at 80 revolutions, and steam is supplied at 120 to 175 pounds, according to the time of the year and load. The centers of the high-pressure and low-pressure cylinders are 22 feet apart. The diameter of the shaft is 24 inches, reduced to 22 inches at the bearings, which are 3 feet 2 inches long.

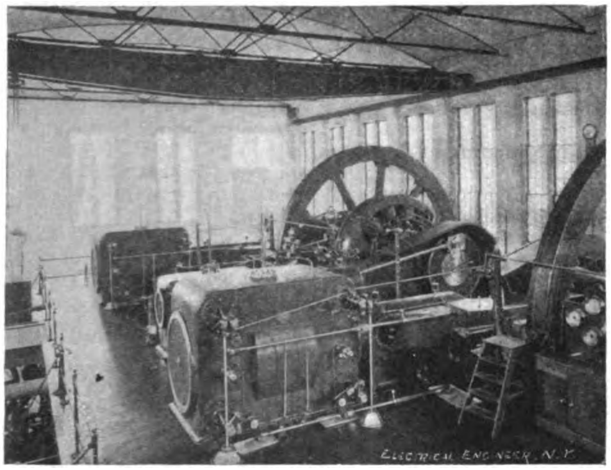
The fly-wheels weigh 120,000 pounds each, and were specially designed by the makers for safety. The rim is of forged steel, made in five segments, with interlocking joints, keyed together. There are ten arms, made of hollow steel castings. The hub of the wheel was forced on the shaft with a pressure of 350 tons, and has a flange which bolts to the armature. The engines are of massive design, and with extra large bearings throughout. The valve gear is the regular Rice & Sargent releasing gear. There is a re-heater receiver between the cylinders, and the piping is arranged so that either cylinder may be run alone, condensing or non-condensing. All piping is below the floor.

The engine and pipe connections are covered with magnesia composition, supplied by Messrs. Nightingale & Childs, of Boston. The foundations for the engines are laid up in hard red brick in cement, and finished off with granite capstones of about 12 inches in thickness. All valves are of Walworth, heavy duty, flange pattern, with outside screw and yoke and by-pass, and were specially designed and manufactured by the Walworth Manufacturing Company, of Boston. All main valves are controlled from the engine room floor. Iron stairways connect the engine room with the basement.

FEEDWATER HEATERS, PUMPS, Etc.

The basement floor is of cement concrete 15 feet below the level of the engine room floor, and is carried through on the same level as the floor of the boiler room and connected with the latter by two doors, one at either end. In the basement are located the condensers, feed pumps, heaters, etc.

The feed pumps consist of one Davis improved power pump, built by the Davis Company, of New Haven, Conn. It has four plungers, 6-inch diameter by 6-inch stroke, and is operated by a 15-horse power Edison bipolar 500-volt motor. There is also a duplex steam pump 6x8x12 inches of the Deane Pump Company's make. An additional method of feeding the boilers is provided for by the installation of two 3-inch injectors manufactured by Messrs. William Sellers & Co., of Philadelphia, Pa.; two feed-water heaters of a capacity of 600 horse power, manufactured by the Harrisburg Heater Company, of Harrisburg, Pa., are connected with the exhaust piping, and raise the temperature of the feed-water to about 128 degs. Fahr. before passing through the economizer, the feed-water finally entering the boilers at a temperature of from 200 to 220 degs. Fahr.



Dorchester Station, G. E. Generators and Rice & Sargent Engines.

THE PIPING.

The steam piping is laid out in duplicate, and specially designed and constructed for high-pressure work. It is extra heavy, with steel flanges, and all flanges are grooved and tongued and connected together with corrugated copper gaskets. The piping was designed by Mr. C. F. Baker, and erected by the engineers of the West End Company, under his supervision. All the fittings are of cast steel, made by the Penn Steel Casting Company, of Chester, Pa., and all the ells are of long turn pattern.

The main steam pipe is 10 inches in diameter, and the connections from each boiler are 8 inches in diameter. A 10-inch Stratton separator is installed between the main steam pipe and each engine to remove the entrained moisture from the steam.

The discharge from the separators is piped to the reheating coil in the receiver between the engine cylinders, and is then passed directly into the suction of the feed pump and thereby returned to the boilers. An automatic relief valve is provided in the line of the exhaust piping, to allow a free exhaust into the atmosphere in case of trouble with the air pumps or condensers.

The steam and feed piping is covered with the magneso asbestos sectional covering supplied by the H. W. Johns Company, of Boston and New York, and is neatly finished off with polished brass bands.

The engines are supplied with a system of oil drips and catch-basins, and the oil is carried by a gravity system of piping to the filter and tank, which has a capacity of 40 barrels. From this tank the oil is pumped up and again delivered by gravity to the different parts of the engines.

THE CONDENSERS.

The condensers were supplied by the Conover Manufacturing Company, of New York, and are of the vertical single acting independent, jet type, with air pumps 34 inches diameter by 14 inches stroke.

The engine operating the air pump is their regular trunk pattern, compound condensing, and is fitted with special Corliss valve gear. Steam is admitted at one end only for a full revolution, and eight to twelve expansions of steam are effected, according to the steam pressure. As the load on the condenser is practically constant, the cut-off is adjustable by hand, and the throttle governor controls the speed by furnishing the initial steam pressure in the cylinder, called for by the point of cut-off.

A special clutch arrangement is used to allow the valve gear to be operated by hand in starting. The oil is distributed by means of stationary cups and wipers.

THE GENERATORS.

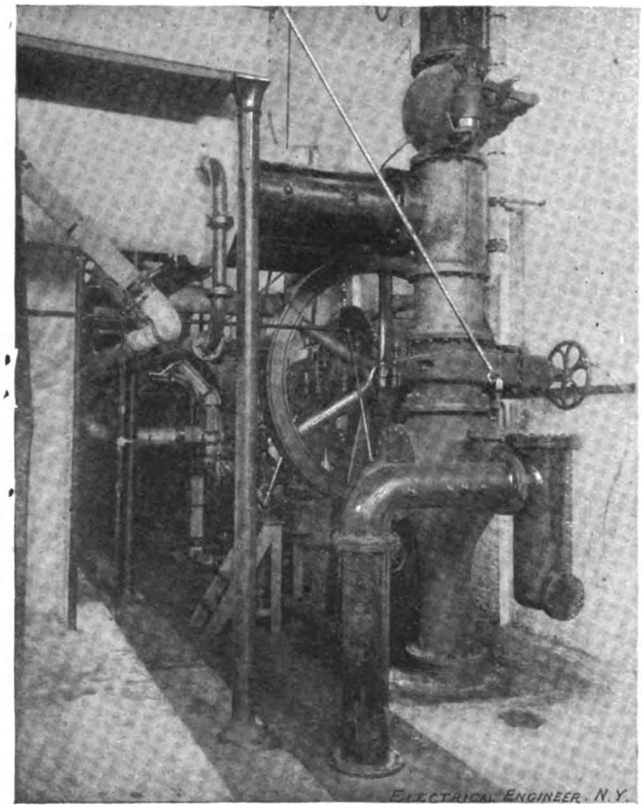
The generators are direct-connected, one to each engine, and are of the latest multipolar type, built by the General Electric Company. They are of 1,000 k. w. capacity each, and will carry a temporary overload of 40 per cent. if necessary. They are slightly over-compounded in order to raise the voltage during heavy loads. Space has been left in the engine room to provide for the installation of a third engine and generator of similar size whenever it becomes necessary.

A Westinghouse air pump is used to provide an air-blast for cleaning the generators and removing the dust from the armatures.

THE SWITCHBOARD.

The switchboard is on a raised platform at the north end of the engine room, and commands a view of the generators. At one end of this platform is the office of the chief engineer of the plant. The platform is reached by a set of iron stairs. Brass railings protect all stairways and also the platform.

The switchboard is composed of two dynamo panels and seven feeder panels, manufactured by the General Electric Company. The panels are of ornamental polished slate, and contain the usual main and feeder switches, automatic circuit breakers and lightning arresters, together with direct reading ammeters and voltmeters, furnished by the Weston Electrical Instrument Company, of Newark, N. J. There are also installed on the switchboard two Thomson (Type G) recording watt-meters to register the total output of each generator.



Dorchester Plant, Boston West End Road, Conover Air Pump and Condenser.

All circuit-breakers are fitted with electric alarm bells, which ring continuously as long as any circuit-breaker is open. In the office is installed one Bristol recording voltmeter, which records all fluctuations of the voltage; one Crosby recording steam gauge, and a tide gauge. The station is connected by telephone with the central power station at Albany street.

In the corner of the building, underneath the office and on the engine room floor, are provided toilet rooms and lockers for the engineers and electricians. Underneath, on the intermediate floor, are storerooms and bathrooms, and on the basement floor are toilet rooms and lockers for the firemen and coal passers.

THE DESIGNERS, BUILDERS AND OPERATORS.

The whole plant was designed and carried out under the personal supervision of the master mechanic of the company, Mr. C. F. Baker, who is an experienced mechanical engineer, and the result is an evidence of his skill and untiring energy. Mr. F. P. Sheldon, of Providence, R. I., was retained as consulting engineer.

The contractors for the foundations, buildings and stack were Messrs. Whidden & Co., of Milk street, Boston, and for the fireproof roof, Messrs. Guastavino & Co., of Albany street, Boston; while the Boston Bridge Company supplied the trusses and ironwork, and also the traveling crane.

The operation of the plant is in charge of Mr. H. Gough, as chief engineer, who also superintended the installation work. He is ably assisted by the assistant engineers, Messrs. A. Warner, A. Fletcher and F. Morse.

The writer takes this opportunity of thanking Mr. C. S. Sergeant, the general manager of the company, and the other officers for the many courtesies extended to him in the preparation of this brief description.

ELECTRIC LIGHTING

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.—II.

(Concluded.)

JOHN W. HOWELL.

Fig. 4 shows a lamp having a platinum plate 2¼ inches long and ¾ inch wide between the legs of the filaments, and a wire inserted in the vacuous space. I also used lamps having a similar plate made of glass, similarly placed. In both of these lamps, when the vacuum was high, no current was produced between the wire and the positive terminal when the wire was shielded from the negative leg; but shielding the wire from the positive leg made no hindrance to the passage of the current. The facts that no current flows when the galvanometer is connected between the negative terminal of the lamp and the inserted wire, and that a shield between the positive leg and the inserted wire has no effect upon the current, show that positively charged molecules are not emitted by the positive leg; while the screen effects just described show that the negatively charged molecules pass in straight lines.

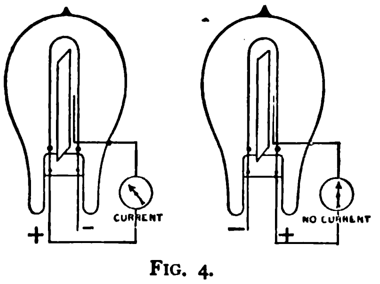


Fig. 4.

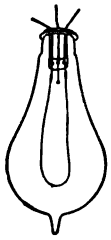


Fig. 5.

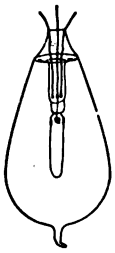


Fig. 6.

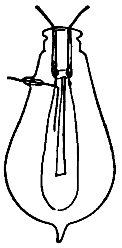


Fig. 7.

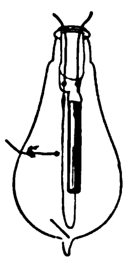


Fig. 8.

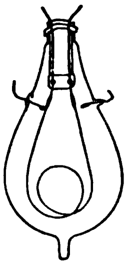


Fig. 9.

The facts, then, are these: The galvanometer indicates a current flowing, as we designate the direction of currents, from the wire to the negative leg; while experiments prove that the charged molecules which carry the current actually pass from the negative leg to the wire. These facts are entirely in accord with the results obtained by Crookes and others in their investigations of currents in high vacua.

If an alternating current is used to render the filament incandescent, the galvanometer will indicate a current with the connection made to either lamp terminal, because both are equally positive. The current thus produced is a uni-directional one in the galvanometer, and illustrates very well the uni-lateral conductivity between the incandescent filament and the wire.

The blue glow in lamps has long been associated in my mind with the condition of the vacuum which makes it a conductor. I observed several years ago, that at a high temperature .04 or .05 of an ampere, more current flowed through a lamp showing a good blue than through the same lamp, at the same voltage, when the blue had disappeared. I concluded that this extra current flowed through the vacuous space between the legs of the filament.

If a direct current about 20 or 30 per cent. greater than the normal current be passed through a lamp filament when the vacuous space shows a blue glow, the positive joint between the filament and the platinum wire gets red hot, while the negative joint remains cool. I have always considered this as proof that the resistance to the passage of a current through a vacuous space was chiefly at the surface of the positive electrode, as the energy was chiefly developed there. If an alternating current is used both joints get equally hot.

If a lamp be burned at normal incandescence with a direct current, when the vacuous space shows a good deal of this blue, the negative leg of the filament becomes coated with a carbon soot. This effect can be obtained in a few minutes if the blue is dense and the filament is run above a normal incandescence. This I have considered to be due to an electrolysis of a hydrocarbon gas in the lamp.

The lamps which show only a slight amount of this blue glow, if burned at normal incandescence, will not show this carbon soot perceptibly, and the blue will entirely disappear if the lamp is burned for a few hours. This blue is caused more by the character of the residual gas than by the degree of exhaustion.

In order to measure the currents which pass from one leg of the filament to the other across the vacuous space, I measured the current at a given voltage of a number of lamps; first when the lamps showed a good dense blue, before they were well exhausted, and again after the same lamps were well exhausted and showed no blue. Some 55-volt 24 candle-power lamps showed .4 of an ampere more on the first reading than on the second. All of this .4 of an ampere must have passed through the vacuous space, for the resistance of the filament remained practically unchanged or became a little lower during the operation.

I also measured the currents which passed across the vacuous space, when these currents were large enough to fuse the joint wire, and also when they were large enough to fuse both platinum leading-in wires. I found that from one to five amperes passed across the vacuous space and when the positive joint wire only was fused, and that when both wires leading through the glass were expanded so by the heat of the current that the glass was shattered, the current measured from 10 amperes to more than 25 amperes.

The lamp shown in Fig. 5 illustrates the fact that the heat produced at the positive joints by the "Edison Effect" current is not simply the result of a mechanical bombardment. This lamp was exhausted to show a good blue. The temperature of the filament was raised sufficiently to cause vacuum currents large enough to heat the positive joint red hot. The outer end of the middle wire was then connected to the positive lamp terminal. When this was done the positive joint became cool and the middle wire got red hot. This was repeated several times. The middle wire got hot enough to fuse the end, which was platinum. This indicates that most of the heat is caused by the charged molecules coming in contact with some conductor which will carry away their charge. The current was not measured in this experiment.

Fig. 6 shows the lamp used in a similar experiment. The middle wire carried a copper plate about 1 inch long and ¼ inch wide. This lamp was exhausted to show a good blue. An ammeter was connected between the middle wire and the positive lamp terminal. As the current was gradually raised, the vacuum current heated the copper plate until it was fused, as shown in the figure. The ammeter in this case indicated over five amperes flowing through the vacuous space between the negative leg of the filament and the copper plate.

I next tried a series of experiments to determine whether the current which passes through the vacuous space when the blue glow is present was the effect of charged molecules moving in straight lines only, from the negative leg, or whether this current would pass around a screen. For this experiment I used a lamp with a glass plate 2¼ inches long and ⅞ inch wide between the legs of the incandescent filament. It was necessary to raise the filament in this lamp to a very high temperature before the blue appeared, and then instead of appearing gradually, as it does in ordinary lamps, it appeared suddenly and in great abundance and the positive joint got red hot, so that it was necessary to reduce the temperature of the filament to prevent the fusion of the joint wire. As the temperature was reduced, the blue gradually decreased, as it does in ordinary lamps. In this lamp the blue appeared at 136 volts, and remained when the pressure was reduced to 109 volts, but would disappear between 109 and 101 volts.

My next experiment was with a lamp (shown in Fig. 7) having a platinum screen between the legs of the filament and a platinum wire sealed in the side of the bulb and projecting in the vacuous space, with its end bent so as to run parallel with one leg of the filament for about 1 inch between the filament and the platinum plate. When this filament was heated to about a 2½-watts-per-candle temperature, the vacuum current did not pass around the screen and no blue showed in the vacuous space. That leg of the filament being negative which was on the same side of the screen as the wire which was sealed into the bulb, I connected the galvanometer between this wire and the positive lamp terminal. The galvanometer showed a strong current. On breaking the galvanometer circuit, blue appeared on the positive joint and in the bulb. I repeated this several times. It occurred when the temperature was considerably below the temperature necessary to start the blue around the screen.

In each case, connecting the galvanometer between the wire and the positive terminal would cause blue to appear about the inserted wire and the negative leg, and breaking the galvanometer circuit would cause blue to appear on the positive joint, and in the vacuous space about the positive joint, and about the negative leg of the filament.

With this same lamp I observed that when the filament was at a temperature not sufficient to start the blue, if I touched the positive terminal with one finger, and the inserted wire with the other, the blue immediately appeared in the vacuous space about the positive joint and the negative leg of the filament.

These experiments demonstrate that in lamps exhausted so as to show a good blue, the charged molecules have some difficulty in starting their passage from one leg to another around an obstacle, but maintain their passage after it has been once established. Also, that their passage around an obstacle is easily established by starting a flow of charged molecules from the negative leg through a small unobstructed part of the vacuous space, to an inserted wire which is connected to the positive terminal, and then breaking the positive terminal connection.

To determine how large a current could be made to flow around an obstruction in lamps exhausted to show a good blue, I used a lamp shown in Fig. 8, having a glass tube about the negative leg, and the wire sealed in the side of the bulb, running parallel with the positive leg for about 1 inch. I connected an ammeter between the inserted wire and the positive lamp terminal, and raised the temperature of the filament until a dense blue appeared in the vacuous space, and about the wire and the end of the glass tube. The temperature of the filament was raised until the vacuum current fused the platinum wire which was sealed into the bulb. When this occurred, the ammeter indicated 2¼ amperes, and remained at this reading one or two seconds.

Any of the lamps in which the condition of the vacuum is just right, showing the blue glow, will show a current in a galvanometer connected between the wire inserted in the vacuous space, and the negative lamp terminal, but in all cases this current is small. One-half milliampere is the largest current I have observed under these conditions.

I next tried some experiments with lamps like the one shown in Fig. 9, which has two wires sealed in opposite sides of the bulb, which project inward to a point near the filament about ¼ inch above the joints. This lamp was exhausted to show a good blue. The galvanometer was connected between the wires which were sealed in opposite points of the bulb. No current was indicated until the temperature of the filament was raised quite high, and the blue glow was quite intense.

Under these conditions the galvanometer indicated a current of .1 milliampere.

I have made experiments upon two lamps containing bromine vapor. One of these lamps which contained bromine enough to depress the barometric column 1/20 inch, showed no "Edison Effect" when the potential was run up as high as 170 volts, using 110-volt lamp.

The second lamp had very much less bromine vapor in it, and showed a very slight "Edison Effect." This lamp acted very peculiarly. When first tried it gave an "Edison Effect" which changed very little in value between 105 and 146 volts. At 120 volts, the vacuum current showed a deflection of the galvanometer of 14 scale divisions, while at 128 volts it showed a deflection of only 12 scale divisions. I observed this several times. This was quite a large reverse change, as the current at 146 volts only increased enough to give a deflection of the galvanometer of 16 scale divisions. This change was observed on several days, but it was less marked each time it was tried, until it finally disappeared.

The question naturally arises, What causes the blue glow in the vacuous space? The glow is luminous, and luminosity can only come from matter; consequently, we conclude that the vacuous space, when blue shows, is filled with luminous molecules, and as these molecules are not of themselves luminous, we must seek for the cause of their luminosity.

We have seen that the negatively charged molecules liberate considerable energy on coming in contact with a body that conveys away their charge. We have also seen that when the blue glow is present there is a considerable flow of charged molecules through the vacuous space, and that the naturally rectilineal movements of these molecules are disturbed.

We also know that molecules are emitted from the positive leg about as plentifully as from the negative leg, although these molecules do not carry a positive charge.

The conclusion seems to be that the blue glow is a manifestation of the energy developed by the meeting of the charged molecules with other molecules which take away part or all of their charge.

Well exhausted incandescent lamps which have burned a long time show a black deposit on the inner surface of the bulb. In lamps with thick, stiff, single-loop filaments, in which the two legs lie in the same plane, a light line may be observed in the black deposit, which is caused by the shielding of this line by one leg, from the molecules emitted by the other leg. This line shows with about equal clearness opposite both legs, indicating that carbon molecules are constantly emitted from both legs, equally and in straight lines.

In lamps which have been imperfectly exhausted, the black deposit sometimes appears in patches, symmetrically placed with reference to the carbon. I regard these figured discolorations as indications of disturbances in the rectilineal paths of the molecules, and of the influence of the magnetic field upon the disturbed molecules.

The activity of the molecules carrying current across the vacuous space seems to depend more on the temperature of the filament than on the potential difference between the legs, 40-volt lamps showing about as strong effects as 140-volt lamps. The energy they exhibit in one direction seems to be very much greater than we would expect from molecules actuated by a potential difference of only 40 or 50 volts. The action of these molecules in carrying electricity in one direction only, may be an indication of the nature of the action between molecules in solid conductors carrying currents, rather than an illustration of the action of statically charged molecules.

MUNICIPAL LIGHTING REPORTS.

BY GEORGE S. THAYER.

THE recent municipal number of The Electrical Engineer contains a very instructive example of the methods of gathering statistics intended for the information of town councils. The report recently made to the city of South Norwalk, Conn., is a little out of the ordinary run in the amount of detail. Voluminous, impartial and apparently complete, it must be considered a failure if presented in its present shape to men unacquainted with the factors which enter into the cost of running a central station.

A comparison of the report with that of Horatio A. Foster on the data collected by The Electrical Engineer a couple of years ago[1], shows the reason for the apparently excellent showing made. Not only do the cities as a rule neglect interest, but they quite uniformly neglect the day of reckoning which is sure to come when the equipment is worn out or reaches such a condition that the entire plant needs to be rebuilt or remodeled in order to adapt it for economical operation under changed conditions, conditions which could not have been foreseen at the time the plant was installed. A business man who does not know what it is costing him to do business may succeed, but the chances are against him. The same is true in electric lighting, private or municipal. When some of the large central stations find it necessary to set aside 10 per cent. per annum as depreciation it seems strange that there should be such a tendency to neglect this item. If the plant is paid for, interest cuts no figure at all. If a man buys a home to save paying rent, in figuring up his saving he most certainly offsets the interest on the money invested, whether or not he has paid for it. There is no reason why a city should not look at interest in the same light.

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[1] See "Electrical Engineer," Sept. 15, 1894.

If the influence of these reports were confined to the place in which they were written the injustice to private plants would not be so great; but unfortunately such is not the case. They are quoted by dissatisfied citizens whose towns are supplied by private plants. The result is bad feeling between the parties concerned and often the reduction of the price of street lighting to below the real cost. Unless the station manager is prepared to expose the errors in these claims, every such report becomes a standing menace to his plant.

The editor of a local paper here fought with might and main a few years ago against the price received by the writer's plant for street lighting, quoting as his authority a table published in the Review of Reviews giving some costs of lighting under municipal ownership. I am told that he made a strong point of the fact that Marshalltown, Iowa, 35 miles west of here, operated 64 2,000-candle-power arcs all night on moonlight schedule for $14 per year, the plant being independent of the water works. A new contract was obtained at a lower price with a pretty general impression that there was big money in it for the plant. Other stations have had similar experiences.

The general conviction at the last meeting of the Northwestern Electrical Convention seemed to be that the remedy for these methods of estimating costs in municipal plants is to get at the real facts and give them the widest publicity; in the words of the politicians, conduct a campaign of education. The average town is willing to be fair in its treatment of its electric lighting company. They do not understand why everything over operating expenses is not profit, and they are strengthened in their belief by the system of accounts adopted by cities which own their plants.

The reports of municipal plants show upon analysis that the cost of furnishing current is subject to wide variations. Especially is this so in plants under 200 horse-power. This includes the majority of municipal plants. The cost of labor bears but little relation in small plants to the station output, which may vary 50 per cent. either way, affecting little outside of the coal pile.

But after all the worst feature of the municipal lighting management is the almost universal underestimating of expenses when looked at from a business standpoint. I want to take up one of the plants in this report, not as a sample of city plants, but as one which presents the difference between the reported and the actual cost.

The case is that of Lisbon, a small town in Eastern Iowa. The plant consists of one 100-horse-power Buckeye engine and one 1,000-light Fort Wayne alternator, running 14 2,000-candle-power street, 8 2,000-candle-power commercial arcs, and 500 incandescents. Another item of 1,400 incandescents is apparently a typographical error[2].

The annual income comes within $125 of meeting operating expenses. They are evidently well pleased with the showing they made. Their mayor adds, among other things: "A more foolish thing a city could not well do than to give away a franchise for a lighting plant." The cost of the plant is not stated, but I understand it is $15,000. Allowing 5 per cent. interest on the investment, or the interest on the bonds and depreciation on a 15-year basis, their arcs are costing them $133 a year. Even with depreciation on a 20-year basis the cost is $107 per year. These figures are for a midnight arc.

That town will be quoted as running 14 arc lights at an expense of $125 per year, a little better record than that of Marshalltown, and the private plants in that section of the country will be reminded of the fact when their city contract is about to be renewed. There is no doubt that the plant is economically operated and private consumers get their lighting at lower rates than they would under private ownership. But the report is wholly misleading. The plant has been in operation about two years, and repairs as yet are nominal. It will not always be so.

The experiences of two towns in this State are interesting, as showing the final outcome of this policy. Several years ago Leon, a county seat in Southwestern Iowa, decided to put in a plant of its own. At the end of the second year they pointed with pride to a surplus that was accumulating. Last year the citizens voted to shut down and sell it rather than to make the necessary repairs. They found the city had no power to dispose of the plant without action by the Legislature. Audubon came to the same conclusion in regard to its plant, and had actually turned it over to the purchaser, who began operating it. At last reports, they had not found a way to transfer their respective interests.

In view of the fact that many other towns have had similar experiences, it seems strange that none of them found their way into the South Norwalk report. There are some thirty municipal plants in this State, the majority of which are in small towns where there is no private plant. Most of them have been built within the last five years. They are therefore in the period where they make the most favorable showing as regards operating expenses, the item which goes as "cost" of lighting!

As a central station man, I have little to fear from municipal plants. Our citizens are under the impression that we are making money hand over fist. Our rates compare very favorably with those of the neighboring municipal plants. We expect to prove by their reports that we are not. To do this, however, we must have something more than the usual statement that it costs so much to run light in a certain city plant. If city plants can show such remarkable results as are claimed, I want to know how they do it and apply the same methods to my own plant. If they cannot, I am still the gainer, because we are not placed under the odium of robbing our customers by abnormally high rates.

The electrical fraternity is watching with some interest the steady climb in the reported cost of arc lighting in Detroit. Mayor Pingree gave out the figure last summer as $65 per annum. Later on some city official gave it as $75, or near that. According to the last convention of the American Society of Municipal Improvements, the cost was $84.70. Where will it stop?

There is no reason why a city cannot operate its plant as cheaply and save the profit that private ownership would require except the difference between what American politics might be, and what they really are. As long as the best citizens are adverse to holding office, so long will municipal affairs be managed by second-rate business men, with corresponding results. There seem to be indications of a change in the sentiment towards municipal ownership as time goes on, and the true cost of operation becomes apparent. Some of the former advocates have changed their minds on the subject, and we have the statement from Mr. W. J. Buckley, of the Fort Wayne Electric Corporation, a gentleman who has had extensive experience in city plants, that he has come to the conclusion that municipal ownership does not pay.

Bell Plaine Electric Company,
Bell Plaine, Iowa.

MISS HIGHTOWER "PRESSED THE BUTTON."

A special dispatch from Barnesville, Ga., says: The electric lights were turned on to-night at 6 o'clock by Miss Willie Hightower, who was selected by Mayor G. E. Huguley to start the machinery. Every citizen has been watching the work, anxious for the time to come to turn on the lights and to make a big night of it for Barnesville, and a big demonstration was made. Crowds went to the plant, while the streets of the city were lined with people.

Miss Hightower invited a party to accompany her to the plant in a carriage. The city council and city officials were all there, and Mayor Huguley made a speech concerning the enterprise, pluck and energy of the city, which has all the modern conveniences, and then introduced Miss Hightower, who responded in a most happy style. She said: "In the beginning God said 'Let there be light,' and swift, obedient to His command, the roseate hues of creation's dawn gladdened the divine heart of Him who spoke as never man spake. Then the morning stars sang together in the rhythmic music of the spheres. This evening, under the quiet stars, while expectation waits on tiptoe to catch a glimpse of the electricity of the skies, harnessed to wires, we would delay this momentous, but happy, consummation just a moment to pay a short tribute to the enterprise, energy and laudable public spirit of our wide-awake mayor and council. Our little city is already abreast with the most aspiring, and the electric plant is a shining memorial to Barnesville enterprise. My thanks are specially due Mayor Huguley for the honor conferred upon me, and it is highly appreciated. May we all ever more walk in the light, the beautiful light.

"Hail, holy light!
Offspring of heav'n first born.
God Himself is light."

Miss Hightower then pressed the button; the lights instantly flashed over the city, and a yell went up for Mayor Huguley, the city council, Miss Hightower and electric lights. Miss Hightower's party then repaired to the home of Mr. and Mrs. J. W. Hightower to an eleborate 8 o'clock dinner.

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[2] See a further report from Lisbon, The Elec. Engr. March 17, 1897.

ROENTGEN RAYS

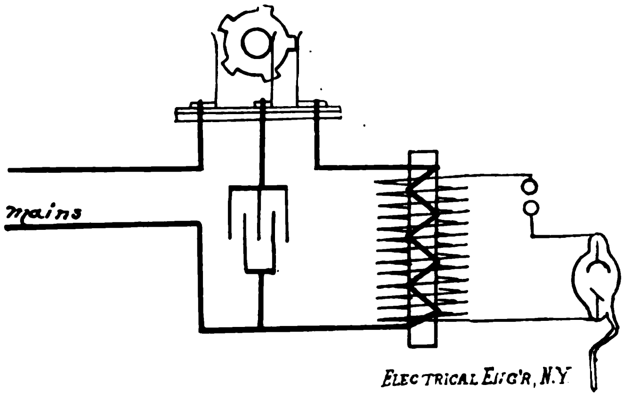
A POWERFUL MEANS FOR OPERATING X-RAY TUBES WITH AN INDUCTION COIL.

BY CHARLES L. NORTON AND RALPH L. LAWRENCE.

We have been using in our laboratories for the last few weeks a method of operating X-ray tubes with an induction coil, that possesses some novel features. Our experience had led us to entirely discard all other induction coil methods as being much inferior to the static machine. The most troublesome feature of the ordinary apparatus is the break in the primary circuit, no one of the various forms having proved equal to continued service of 110 volts. Storage batteries are troublesome, and neither efficient nor convenient for this work.

If a condenser be charged from the lighting mains at 110 volts or 220 volts direct, and then disconnected from the mains and discharged through the primary of an induction coil, there will be in the primary of the coil a current of short duration which will rise to its maximum with great rapidity, aided by the reaction of the secondary, and will then fall slowly, being retarded by its own reaction. This is the ideal condition to give a undirectional discharge of great potential at the secondary.

If now by means of a commutator we can connect the condenser alternately to the mains and to the coil, and if the terminals of the secondary be brought near enough to one another, there will be a spark at its terminals for every discharge of the condenser through the primary. By mounting the commutator on the shaft of a small motor, we charge and discharge the condenser 200 times a second, thus getting a perfect torrent of sparks.



Arrangement for Generating Powerful X-Rays.

Using a Ritchie 6-in. coil, with its primary winding replaced by one of thirty turns of wire of No. 8 B. & S., and discharging through its primary a 25-microfarad condenser charged from the outside wire of the three-wire lighting system at 220 volts, we get at the secondary terminals a torrent of sparks about six and one-half inches long, accompanied by a loud scream of such a pitch as to indicate that there are about 250 discharges per second.

The connections are indicated in the accompanying diagram.

The insulation of the primary and secondary from each other and from the core, and even of the consecutive turns of the primary from one another, is of great importance. The use of a glass tube to contain the primary, immersed in oil, has proved efficient. It is highly essential that the iron core should be finely divided, as a single piece of iron wire one-quarter of an inch in diameter causes a diminution of 75 per cent. in the discharge. The coil will work without the iron core, but not as well as with one of fine wire.

Connecting to the terminals of the coil a focus tube with a spark gap in series, we find that the tube emits powerful X-rays. An exposure of one second is sufficient to give negatives of such small objects as coins in a purse, and five seconds gives a negative of the hand which is sufficient for the purposes of examination of the bony structure by a surgeon, while twenty seconds gives a negative which is the best we have ever seen. Forty-five seconds gives an over exposure. But it is not the speed so much as the sharpness and delicacy of outline that is most worthy of attention.

Examination with the fluoroscope shows exactly the details of the bony structure of the trunk, the action of the heart, and the outline of the lungs and liver.

The resistance of X-ray tubes of the focus type may be varied at will by running them on the coil in the proper direction. A tube of rather low resistance, if connected to the coil in the usual way, with the spark gap on the cathode side, will increase in resistance quite rapidly to the point where the platinum anode becomes red hot and X-rays are given off powerfully. The increase is most rapid with closed spark gap. Beyond this point the change, although an increase, is slow.

It is very often the case that a tube, which has been run for some time on the coil, when removed and allowed to cool, will increase in resistance to such an extent that it will be impossible to use it again satisfactorily on the coil. If, however, the tube now be connected to the coil, making the concave electrode anode, and allowed to run a few minutes, the resistance will be reduced. A slight warming with a Bunsen burner will facilitate matters. The action of the coil in raising and lowering the vacuum in tubes is very similar to that of static machines. The power with which a tube will emit X-rays depends very much on the adjustment of the spark gap.

The method appears to require apparatus of simple construction, and of such ease of manipulation that it may serve well in the hands of physicians, and others not especially skilled in the manipulation of physical apparatus. It is a method independent of the atmospheric conditions, and can be used wherever electric lighting mains are accessible.

Rogers Laboratory of Physics,
Mass. Institute of Technology, Boston, Mass.

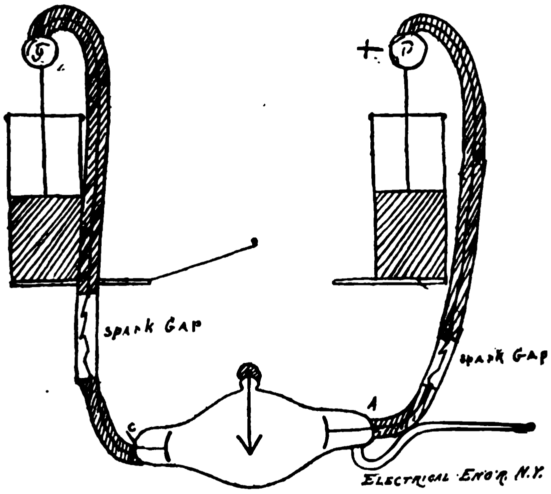
(The authors have sent us photographs of a purse with coins taken in a one-second exposure, and also of a hand exposed for twenty-three seconds. Both of these equal, and in some respects exceed, in excellence of detail any radiograms which have thus far come under our notice. No reproduction could do them justice.—Eds. E. E.)

X-RAYS BY STATIC ELECTRICITY.

BY O. C. WELBOURN, M. D.

It being designed that this article should be as short as is possible, to be practical, no attempt will be made to give observations or arguments through which the conclusions given were reached. The more important parts will be placed under appropriate heads to facilitate description and comprehension.

The Static Machine.—This should be strongly made, smooth running and capable of high speed.



Spark Gap Arrangement for X-Ray Production.

An electric motor is much better than hand power and a glass protecting case is almost essential, unless the machine is to be used in a very dry atmosphere.

A 10-inch spark is sufficient e. m. f. for any purpose and a 6-inch does nicely for all parts of the human body except the trunk. The careful operator will see that the bearings are well oiled and the brushes, combs, revolving plates, etc., are in proper position.

Spark Gap Connections.—If the Crookes tube be connected by a well insulated wire to the internal armatures of the Leyden jars, the switch connecting external armatures being open, and a proper length spark gap, inclosed in a glass tube, inserted at both anode and cathode ends of the tube, as shown in the accompanying illustration, X-rays will be produced as steadily as by any induction coil that I have had the pleasure of witnessing, and they will be very efficient for fluoroscopic use. Sometimes the external armatures of the Leyden jars continually discharge through the wooden base and it is necessary to remove them, making connections directly to the poles of the machine. Close the switch and you will have a slightly more intense ray, at the instant of the discharge of the jars, which is very efficient for skiagraphic purposes. By grounding the anode wire a relatively higher vacuum tube can be used. The length of spark gap depends, of course, upon the degree of vacuum in the Crookes tube, but as a rule should be twice as long at the cathode end as at the anode.

Crookes Tube.—The most satisfactory tube that I have used is a Thomson double-focus tube, made by the New York and Ohio Company. I have used it for over three hours continuous running without heating, and over one hundred hours in all, without any perceptible change of vacuum, and just a trace of blackening.

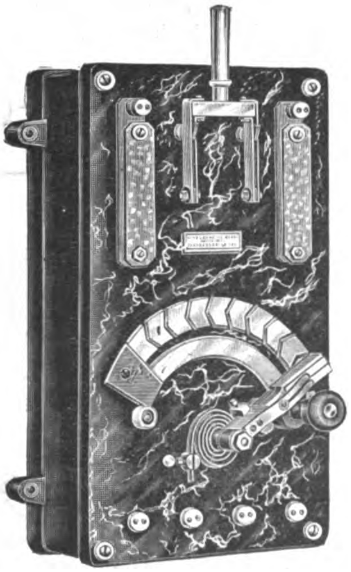
Dry Plates.—In my experience, a slow, dry plate takes about as quickly as a very sensitive one, and one is not bothered with foggy plates. Develop and fix in the usual manner

It is not easy to over-develop when the negative is to be used for printing; but in surgical work it is sometimes well to rinse and place in a weak "hypo" as soon as the image begins to fade. It is then ready for immediate inspection and the image will be found sharp and clear.

A great many persons have been exposed to X-rays as I thus produce them—some for an hour and a half—and not one has had the slightest inflammatory action follow.

THE C & C MOTOR STARTING BOX.

In order to meet the rules of the New York Fire Department relating to electrical installations, the C & C Electric Motor Company has recently brought out a novel motor controlling box, illustrated in the accompanying engraving, This neat apparatus embodies a high and low resistance starting box, together with a double pole knife switch and fusible cut-out, also mounted on the marbleized slate plate forming the front of the box. The resistance consists of coiled wire open to the air.



The C & C Motor Starting Box.

The pivoted contact bar is made up of two parts, one forming the contact arm proper, and the other, with which it is loosely connected, serving as the iron armature of an electromagnet placed on the other side of the slate. The contact arm is pivoted on one pole of this magnet, while the other is placed at a slight radial distance therefrom, and acts as a stop for the iron armature, which strikes against it when the resistance is all cut out.

The magnet which controls the arm is wound differentially, one of the windings being in series with the armature, while the other is in series with the shunt field. Closing the main switch and moving arm to the right, connects the field of the motor and cuts out the armature resistance. This increases the motor speed, and the maximum is reached when the iron arm strikes the stop and is held there by the magnet. The windings of the magnet are arranged so that under normal conditions the winding in series with the shunt field overbalances the other until the predetermined overload limit is reached, at which point the increased current in the latter neutralizes the magnetic effect, and releases the contact arm. An open circuit produces the same result. This starting box may be operated with or without the overload feature.

It will thus be seen that this starting box not only starts the motor, but also protects it from damage by overload or current interruptions. One of these type F. starting boxes is furnished with each C & C motor.

WATER-POWER FOR TRANSMITTING ELECTRICITY TO WINSTON-SALEM, N. C.

Arrangements have been completed for the electrical development of water power on the Yadkin River, near Winston-Salem, N. C. The Fries Manufacturing and Power Company, of Winston, is promoting the development, and has engaged Messrs. C. R. Makepeace & Co., of Providence, R. I., to prepare plans and superintend the work. Mr. H. E. Fries is treasurer. The company expects that at least 1,000 h. p. will be delivered over the wires into Winston-Salem not later than August 1 of this year. The distance the power will be transmitted is fifteen miles. The present development will be for 2,000 h. p., and at the price which the company expects to be able to sell the power its use will, it is claimed, be very general in Winston-Salem. The Messrs. Fries are interested in several cotton mills at Winston-Salem, and these mills will be the first manufactories to use the power when it is ready for service.

A CALIFORNIA ELECTRIC POWER SCHEME.

A corporation to be known as the Southern California Power Company has been organized with a capital stock of $1,000,000. The principal stockholders are Henry Fisher of Pittsburg, Pa., and H. H. Sinclair, president and manager of the Redlands Electric Light and Power Company. The present place of business of the corporation is Redlands. The purpose of the company is to develop power from the Santa Ana River by taking the water out at the junction of Bear Creek and Santa Ana River, carrying it in a cement ditch and tunnels about four miles, thus securing a fall of 1,000 to 1,100 feet, and then running the water again into the stream. The power will be transmitted by pole line, seventy-five miles to Los Angeles, there to be used for lighting and railroad use. It will be the longest line and the highest voltage (30,000 volts) in use in the world. The line will run through San Bernardino, Pomona, Ontario, and Pasadena, and will be able to supply all the power needed in these towns. Work will begin in the Santa Ana cañon as soon as the surveys are completed, which will be about April 1. It is proposed to deliver power in Los Angeles by January 1, 1898. A good deal of successful electric power work has already been done in the vicinity.

THE FRESNO TRANSMISSION.

The success of the operation of long distance electrical transmission is perhaps best gauged by the opinion expressed by the company operating the plant. An extract from a recent letter regarding the operation of the Fresno, Cal., long distance transmission may be interesting to our readers. It was written by Mr. John J. Seymour, President of the San Joaquin Electric Company, operating the San Joaquin River by Fresno transmission, to the General Electric Company, which installed it: "It affords me great pleasure to write you regarding the successful operation of the long distance transmission plant installed for our company. The entire plant as furnished has been in actual practical operation for a period of several months. The thirty-three miles transmission has given us no trouble whatever. Our load at present consists of 145 arc lights and 5,000 incandescent lights and 410 h. p. in motors, the latter including 180 h. p. for the Sperry flour mill and 75 h. p. for the city pumping plant. All of the machinery doing this work has worked with perfect success from the start. The incandescent lights have most of them been newly wired in, thus enabling us to properly balance the load and the regulation has given us no trouble whatever. During extensive tests it was impossible to find more than two volts' variation between any lamps on the system. Lights so furnished seem to me to be better than incandescent lights usually furnished in San Francisco and other cities of the State."

LETTERS TO THE EDITOR

UNDERGROUND TROLLEYS AS A PREVENTION FOR ELECTROLYSIS.

AT the recent Gas Exhibiton held in this city there was shown a group of exhibits which to a thoughtful insurance underwriter should have given rise to very serious reflections as to the final outcome of the much-mooted question, What shall we do with the overhead trolley sytem?

The exhibits referred to were a collection of gas and water pipes removed from streets through which overhead trolley systems of electric traction are in use. The evidence presented by them should prove beyond peradventure, that something should and must be done to stop the present dangerous practice of ground returns, as used by nearly, if not quite, all the present roads in operation.

The citizens of this city have recently read of the efforts of the Third Avenue Railway Company through its lawyers to prevent the Metropolitan Railway Company from extending its system of underground trolleys, using as one of its reasons (for opposing the permit by the city to the company to so extend the underground system) that the trolley system would cause electrolysis, etc., but it is to be hoped that any such rot as this will avail nothing, and that not only will the mayor permit the proposed extensions, but that he will suggest the removal of the now dangerous overhead trolley system that has obtained a foothold in the upper part of the city, and try and have a system of underground traction substituted.

PHŒNIX.

New York.

ELECTRICAL ENGINEERING ON CONVERTED STEAM ROADS.

I NOTICE in The Electrical Engineer of March 10, a communication bearing on some of the electrical engineering work of the New York, New Haven and Hartford Railroad. I also notice a report of President Clark's address before the Connecticut Legislative committee on railroads, in which he discovered that competent electrical engineers were at variance as to whether the current passed through the conductor or on the surface. Also that contrary to all prophecies by engineers (his own included, I suppose), there was less leakage on the Nantasket trolley line than on most street railways, and that in this respect the third rail experiment was a decided success.

As the power station No. 1 was open for inspection to interested parties, I had the pleasure of looking over the plant during its first and second seasons and was deeply impressed with the thorough understanding of the steam and electrical problems as demonstrated by the electrical department of the road. For instance, copper and iron seem alike to be used as magnets on the common circuit breakers on the switchboard. This is certainly an advance in this line of instruments. Again, at a time when no trains were in service, which happened quite frequently, the wattmeter still ran its merry course, showing, of course, "no leakage." That there was no leakage on the third rail, can, no doubt, be attested by residents of Hingham and by dumb animals, as well, who, if they would speak, could tell the effects of a difference of potential, even if they could not state whether the current went through, or on the outside of this wonderful third rail, the acme of electrical railway practice.

Returning to the trolley line: I was very much surprised at the turns and twists in the special figure of 8 wire, but it is wonderful how well the wire was put up if all the wire was received on the small four-foot reels which I noticed. Again, I observed that no proper alignment of the trolley wire was possible with the form of cross-arm used.

Remove these and other defects in construction and I see no reason why the highest speed should not be obtained satisfactorily with the overhead trolley. It seems strange, as remarked by "Electrical Engineer" that a railroad of such high standing should not employ the best electrical talent in the country. ANOTHER ELECTRICAL ENGINEER.

Boston, March 17, 1897.

THE RECENT CHANGES IN THE PATENT LAW.

WE call your attention to the fact that certain changes are made in the United States Patent Laws by a recent act of Congress, the main provisions of which will go into effect January 1, 1898.

Particularly we call attention to the radical changes made in Section 4887 of the Revised Statutes affecting the interests of those taking out, or desiring to take out, foreign patents. The section, as revised, reads as follows:

"Section 4887. No person otherwise entitled thereto shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented by the inventor or his legal representatives or assigns in a foreign country, unless the application for said foreign patent was filed more than seven months prior to the filing of the application in this country, in which case no patent shall be granted in this country."

It will be seen that the long-standing requirement that "every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent," is to be abolished, so that under the new law inventors can apply for their foreign patents without waiting for the allowance or arranging for the issuance of their corresponding United States patents. On the other hand, there has been added a limitation whose effect is to cause a foreign patentee to forfeit his right to a United States patent unless he files his American application within seven months after the filing of his application for foreign patent for the same invention.

As the amended section of the law will not go into effect until January 1, 1898, and will not "apply to any patent granted prior to said date, nor to any application filed prior to said date, nor to any patent granted on such application," those having foreign patents for inventions not yet patented in the United States of America still have opportunity, until the first of the coming year, to protect such inventions in the United States under the old provisions of the law.

HOWSON & HOWSON.

Potter Building, New York City, March 12, 1897.

NEWS AND NOTES.

SUGAR FROM CORNSTALKS BY ELECTRICITY.

Considerable curiosity is shown as to the organization of a new sugar company, as reported in the newspapers, with a capital of $50,000,000, all of which, it was said by persons in a position to know, is intended to be used immediately, otherwise the company would not at once have paid the State the full fee of $10,000 on that amount of capital named for the privilege of organization. An effort to conceal the real purpose of the corporation was made by alleging that the only object was to make use of the products of cornstalks, such as corn-pith cellulose for car wheels, etc., but the main object of the company, it is said, is to manufacture sugar by a patent electrical process invented by Mr. Marsden, not only out of cornstalks, but out of other raw material not specified, and that some of the well known sugar refiners are really interested in the company. It has been demonstrated that sugar can be made out of cornstalks, and if the Marsden process for doing so by electricity proves to be an economic success as well, it may be a new departure in the sugar refining industry. The inventor of the electrical process is Mark W. Marsden, and the corporators of the company are Richard C. Ellis, John McCormick, Peter H. Evans, and James A. Clark, all of Philadelphia, and John R. Williams, of Merchantville, N. J. One of the provisions of the articles of incorporation is that no stockholders shall have the right to examine the books, vouchers, etc., of the company, except by resolution of the board of directors. "Electric Sugar" is a phrase of ill-savoring repute owing to the frauds perpetrated some years ago by those who claimed to be making sugar that way.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico	per year.	$3.00
Four or more Copies in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies		.10

[Entered as second-class matter at the New York Post Office, April 9, 1888.]

VOL. XXIII. NEW YORK, MARCH 24, 1897. No. 464.

ELECTRIC POWER IN MANUFACTURING ESTABLISHMENTS.

THERE is no more conservative class of individuals than the owners of manufacturing establishments who cling to old and well tried methods with a tenacity that has been the despair of many an inventor. Even when one of their more enterprising brethren has ventured to lower the bars and has achieved success by improved methods, others have been slow to follow of their own accord and have indeed in many cases been driven towards the new idea by the stress of competition. The adoption of improved machinery for turning out product has in the majority of instances involved the mere abandonment of old and perhaps worn-out devices and has not, as a rule, called for so radical a change as to require a remodeling of plant, but it must be admitted that the suggestion of a change of motive power, the prime source of all shop activity, cannot but strike the average manufacturer as a thing hardly to be thought of. And yet, in spite of the momentous nature of such a change, we know of no idea which has been seized hold of and grown in favor so rapidly as has the substitution of electrical for mechanical or belt transmission in manufacturing establisments of all kinds. We are well aware that the percentage of electrically driven establishments as compared with those of the old type is still small, but the aggregate capacity of the electric motors now running machinery in shops and manufacturing establishments, not to speak of mines, amounts to many thousands of horse power.

The time that has elapsed since the new system of machine driving has gone into use is now sufficiently long to afford an answer to the question, Does electric power in manufacturing establishments pay? It is this query, in fact, which Prof. D. C. Jackson, of the University of Wisconsin, has made the subject of an admirable and concise paper read before the Western Society of Engineers.

In order to get at the facts he submitted a series of questions to a large number of manufacturing establishments throughout the country, varying in the extent of the electric power applied, from 50 to over 1,500 horse power. The results of his inquiry are embodied in his paper.

Prof. Jackson discusses the subject under two principal heads: (1) Comparative first cost; and (2) comparative operating expenses. Under the first head Prof. Jackson's information goes to show that the original introduction of electrical transmission in a new establishment which has its own independent and complete power plant, is always considerably greater than the first cost of mechanical transmission, such as by gears, shafting, belts, etc., even taking advantage of the fact that the higher efficiency of the electrical plant permits of a reduction in the total capacity of the steam plant when electricity is used. This being the case, we are at once brought face to face with the fact that the electrical equipment must effect an annual saving to pay a profit on its extra first cost, or it has no reason for its existence. The latter consideration, of course, applies with special force to the cases of established concerns, where old machinery must of necessity be abandoned, with consequent additional loss.

It will thus be evident that electric motive power was not ushered into the world of hard practice on a path of roses. What then are its merits that have caused it to thrive and increase in the face of that great damper upon enthusiasm, higher price? These must be looked for under the head of operating advantages, and Prof. Jackson has divided them into various classes. Taking up first the annual expense for fuel and attendance, Prof. Jackson quotes from the replies received by him from representative establishments many highly interesting letters which would take too much space to give in detail. Many, unfortunately, give only general results owing to lack of records, but those that do quote figures present, in the majority of cases, a most gratifying, in fact, an astonishing record of economy. Thus, for example, one concern notes a fuel economy of 33⅓ per cent., on a plant no larger than 185 horse power. Other concerns report increased economy, but without giving definite figures. We note, however, that one concern having an electrical power plant aggregating 1,537 horse power, has "no appreciable difference" in fuel cost, although no records have been kept. From internal evidence, we judge that the electric plant forms only a part of the power equipment of this concern, and as no records were kept the information imparted can hardly be of much practical value. Coming to the annual expense for repairs, and frequency and extent of failures, the record is still more encouraging. One concern notes a saving of 25 per cent.; another of 75 per cent. Breakdowns are extremely rare; one concern notes only two in five years, and these are now absolutely guarded against by duplicate armatures kept on hand. Another establishment whose plant was laid out by a competent electrical engineer, and is in charge of an electrician, has never had a breakdown. This same establishment, however, seems, curiously enough, to be under the impression that its electric power plant shows no economy over mechanical transmission, as it is so extensive as to require an electrician to look after it, who also has charge of the lighting plant! Prof. Jackson sums up the considerations above treated as follows: "It is safe to say that there is an overwhelming feeling in favor of the use of electrical transmission in preference to the various forms of mechanical transmission on the combined score of economy of operation and a reduced annoyance and expense through delays caused by failure of transmission apparatus. In nearly every case for which exact figures were given, a sufficient direct saving was shown to make large returns on the increased first cost of the electrical equipment."

When we come to the matter of convenience, Prof. Jackson's inquiry proves the almost universal experience that in establishments turning out a product of bulky or heavy articles, the electrical equipment adds materially to the shop efficiency. On the other hand, in establishments where the product is in small articles and where cleanliness is important, the electrical equipment adds to the shop efficiency more largely through cleanliness.

The experience in all establishments which have come under the notice of Prof. Jackson leads him to conclude that for plants using not less than 100 horse power the electrical transmission is so much more satisfactory and economical that it is a misfortune for a new manufacturing plant, unless under very exceptional conditions, to be constructed with any type of transmission other than the electric. Prof. Jackson also discusses another important point bearing on the question under review and that is, the subdivision of power at the machinery. Thus it seems to be the general consensus of opinion among those who have operated electric power plants, that all large tools, such as use from 5 to 7½ horse power, and over, should be supplied with individual motors, while small tools or machines requiring less power should be grouped and driven from motor-driven shafts. These groups should ordinarily be arranged so that a motor of not less than from 3 to 5 horse power capacity is required, and not more than from 10 to 15 horse power.

It might be claimed that it required no testimony to prove the superiority of electric shop transmission at this late day. None the less, we consider Prof. Jackson's inquiry and his deductions therefrom among the most valuable, practical data on this subject that has come before public notice for a long time past.

HARMONY UNDER THE NEW HAVEN ELMS.

THAT the relationships between managers and men in industrial enterprises can remain pleasant through long periods, is evidenced by the recent little affair at New Haven, Conn., when the Street Railway Company gave its employés the third annual banquet. The reports in the local papers show it to have been an extremely enjoyable occasion, one episode of which was the gift to President Corey, by the men, of a handsome silver and gold tobacco box. We cannot help feeling that the road is well run by General Manager Dodge, and that the interests of the stockholders and the public are alike protected. When we find Superintendent Mather speaking to the toast of what he wants in 1897, and Mr. S. E. Thompson telling why he is kind to the ladies, we realize that harmonious influences are at work to make the operation of the road worthy of New Haven as the home of Yale University, and a model for other systems. As one of the men remarked, they would rather stand the sleet and snow beating in their faces, than some of the hard things said about them by the public in thoughtless criticism; and we opine that the public when it sees the whole force working together to give good service, and sensitive to praise or blame, will realize that every honest effort is being made to treat it well.

SUB TROLLEY FOR NEW YORK CITY.

THE development of the street railway situation in New York City is being followed with much interest, and is worthy of attention. It has been a kind of triangular fight, the Metropolitan Company wanting to run on certain lines by electricity, the people on Eighth avenue trying to force them to operate also on that thoroughfare, as well as on the Sixth avenue; and the Third Avenue Company trying to block the whole business by preventing the railway commission from granting its sanction. The Metropolitan Company has now wisely agreed to make its Eighth avenue sub-trolley line continuous, so that one of the sets of disputants is placated; and if the street railway companies would now only get together and "pool their issues," the whole thing could be settled without further trouble. Be that as it may, New York is certainly going to see a large and costly trial of the sub-trolley method. The argument that the open conduit is unhealthy has been disproved, although, of course, an open conduit is not as desirable as a closed one, and a cable conduit is less desirable than either. The stories about electrolysis due to sub-trolley or conduit systems are also such as hardly to need repetition. We must confess our wish that one of the lines could have a full equipment of the closed conduit method, so that its operation might be tested and watched as compared with the open type.

STREET RAILWAY ACCIDENT SUITS.

ONE of the lawyers of the street railway companies in Brooklyn said last week that the roads there had been distributing, in the unlitigated settlement of damage claims, more money than all the charitable institutions of the city put together. There certainly has seemed to be a terrible number of accident claims and cases, over the Bridge, and it is even said they form four-fifths of the entire litigation before the courts. On the Supreme Court calendar there are over 150 damage suits pending against the Nassau Electric road and over 200 against the Brooklyn Heights road. New cases enter upon their initial stages at the rate of thirty a month. But it may be questioned whether courts and juries will go on forever awarding large sums, and, while at one time the absence of many possible precautions did open the way to heavy mulcting, every time a company adds to its equipment that which shows it to be anxious for the safety of those in its cars or on foot in the streets, it gains an amount of public and moral approval that has a definite cash value when it has to meet charges of carelessness. To the old adage that "He is thrice armed who hath his quarrel just," may be added the comment that the company is most vulnerable that obviously makes no effort to insure itself by means of modern, scientific appliances.

The curious interrelation between the various branches of electricity has just been brought out by a case in Baltimore, in which a man asked $3,500 for injuries received by his arm while on a car. Rather than bother with a law suit, the company offered him $100 to compromise the claim. He refused to accept that, and the company therefore contrived to take a radiograph of the arm. The picture showed the bones to be intact, and when the bandages were removed the marks on the skin were found to have been made artificially with acid. The claimant thereupon offered to take $25, but the company is now waiting to be sued.

THE BUCKET SHOPS.

WITH reference to our editorial comment last week on the stock ticker situation, we now note that the N. Y. Stock Exchange has given notice to withdraw its quotations from the Gold & Stock Company, or, in other words, the Western Union Telegraph Company. The reason given is breach of contract of a flagrant character, but we fail to see how the company or any other company can meet the conditions which would require the quotations to be bottled up. Some of the courts may have decided that the quotations are the private property of the exchange; other courts do not think so, and it is obviously desirable that quotations should be given the greatest publicity.

If, as alleged, "express" quotations have been sent out to bucket shops by private wire, that is an offense which, when proved, can be punished with very severe penalties. It seems to us, putting the matter broadly, that it is the duty of the Western Union Company, as a common carrier, to treat all comers alike, and then the duty of the legal authorities to suppress the bucket shops or any other stock dealing institutions that are illegal.

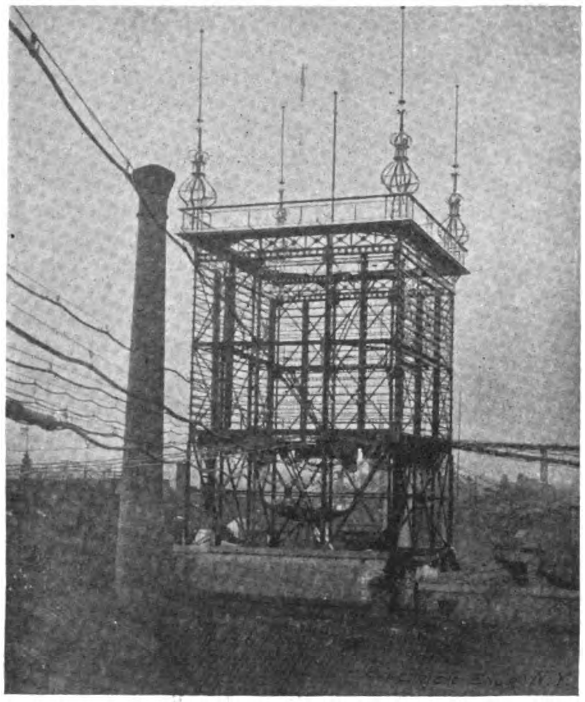
THE workhouse committee of a county in one of the Western States is very much enamored of a project to put in a small gasoline engine "with dynamo attachment," so that they can "generate enough current to light the house, pump water and saw wood." The price of the new apparatus is put at only $300, and the committee are the more favorably inclined toward the plant because "it is represented that it would cost only two cents per day to operate it." We recommend them to close at once with the offer, under a guarantee. They probably will never get anything better until the time comes when, as Dr. Lodge intimates, one man by just turning a crank may light a whole city. Many of the municipal plants, however, appear to be already on that economical basis.

THE Western Union Telegraph Company is, as we all know, a big, bloated, water-soaked, resistless monopoly that owns the earth, but once in a while it finds there are limits, and, like Charles the First, meets John Hampden. Out in Mason City, Iowa, a difference arose lately between the company and its local landlord. No agreement being reached, the haughty landlord pitched all the company's tables, furniture, instruments, etc., out into the street; and there doesn't seem to be anything for the helpless, hundred-million-dollar company to do but pick up its goods and chattels and find another lodging with a more placable owner. It is now whispered that the landlord does not favor prohibition.

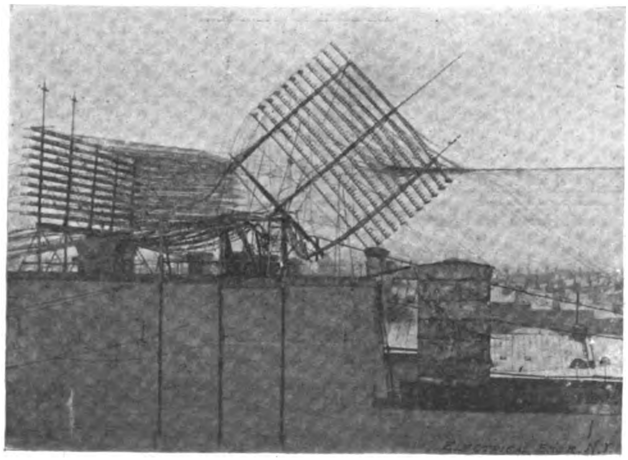
TELEPHONY AND TELEGRAPHY

HAVOC AMONGST OVERHEAD TELEPHONE LINES AT STOCKHOLM, SWEDEN.

One of the most notable and talked-about exchange systems in Europe is that of the General Telephone Company, at Stockholm, Sweden. The rates are low, the number of subscribers is large, and the results appear to have been quite satisfactory, due in large measure to the energy and ability of Mr. H. T. Cedargreen, the managing director, who is well known to many American telephonists. But while this exchange has often been held up as a general all-round model for American imitation, there would appear to be some shadows in the picture, and information recently received in this country would go to show that the low rates carry with them the dangers of a cheap service. It appears that a storm swept over the city of Stockholm, with snow and wind, early in January. In less than an hour 3,000 lines were thrown out of service. The big tower fixture on the central exchange shown in one of our illus trations lost 1,377 of its lines in the storm's "fell swoop." A curious condition of wreckage of another large fixture is also shown, while in a third view a startling scene of damage is presented. The leverage of the wind, acting against the fixture and wires, actually lifted the roof of a large apartment house several feet from the walls of the building and the weight being thrown over on one side, crushed that in; whilst the roof on the near side is held up like a huge eyelid that could not be closed.

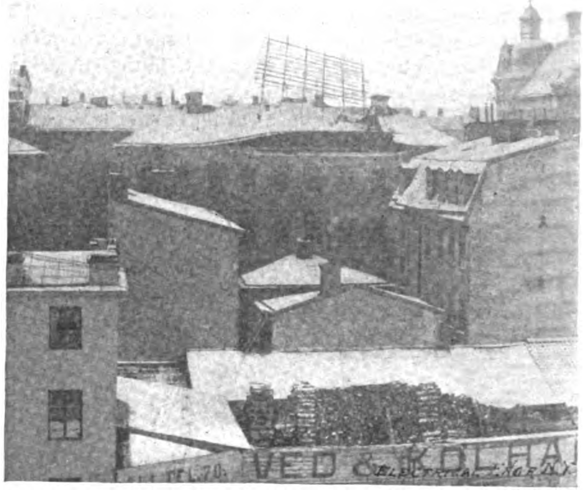


Telephone Tower, Stockholm, Sweden.



Wrecked Telephone Roof Fixtures, Stockholm, Sweden.

The effects of the storm extended also for some miles around the city, and other photographs show pole lines down in every direction. The net result was that it took six weeks to repair the damage, and that for a great many of the subscribers telephone service during that long time existed only in name. The repairs have also been extremely costly, and the company is now confronted with the problem of the large expense of going under ground. The pleasant superstition that all the telephone wires in Europe are underground is gently dissipated by such incidents as this, and it is certain that no city of 275,000 inhabitants in the United States is so far behind as Stockholm in placing its telephone wires out of sight; or, if having them still in sight, could not get its service into condition again after disaster in much less than six weeks. But the problem confronting the General Telephone Company of Stockholm is its low rates, which do not permit the large new investment necessary to guard against such serious interruptions in the future, and which would have to be considerably advanced to make the outlay fairly remunerative.



Roof Lifted by Broken Telephone Fixture, Stockholm, Sweden.

SALE OF THE INDEPENDENT TELEPHONE SYSTEM IN ROCKLAND COUNTY, N. Y.

An interesting little chapter of contemporaneous telephone history is disclosed by the announcement of the sale of the "independent" Rockland Telephone and Telegraph Company, of this State, to the New York Telephone Company (Bell system). The argument that the low rates so often quoted for good service are not possible finds its proof again in this instance, while some of the other factors in the situation cannot be overlooked. The Rockland Company, operating in a large and prosperous section of the State, has been in existence three or four years and has done excellent work, but Mr. W. H. Russell, its treasurer, states that its rates of $2 and $3 per month were too low. It had its principal exchange at Nyack on the Hudson, and three branch exchanges at other points in the county, and its list of subscribers varied from 60 to 75, there being 63 at the time of the sale. It had about 18 to 20 miles of pole line, excellently built by a man who was familiar with telephone line construction, and its service was well kept up. The subscribers were bunched two or three on a line, and were well taken care of, but the main trouble seems to have been the inability to get connection outside the county, with New York City and other places with which it was desirable to have communication. There were no "independent" companies with which to exchange business, and the company was thus cooped up, to feed on its own vitals. Many of the subscribers, to whom this "extra territorial" connection was a necessity, had to keep the Bell service in their places of business and were thus under a double expense, although their chief reason for patronizing the Bell system was to have ready access to the facilities of the long-distance service, both up and down the Hudson, reaching now no fewer than 32,000 telephone subscribers in this territory alone.

The Rockland Company, finding that it was steadily losing money and patronage, opened negotiations with the New York Telephone Company, and has now sold out at a price which shows a serious loss on the original cash investment. The company had no watered stock, and was carefully run, but conditions and low rates were too much for it. In taking possession, the New York Telephone Company has stated that it will make no advance on its present rates for telephone subscribers in exchanges of similar size, but will charge only from $30 to $50 a year for its service. The toll charge from Nyack to New York City is 35 cents, and there would appear to be considerable business to be transacted in view of the fact that Rockland County furnishes the city with a large quantity of its purest natural ice.

TELEGRAPH CODE FOR DEAF-MUTES.

A Texas doctor thinks it is time what he terms "the crazy-looking gesticulations" of the old deaf-and-dumb system should be discarded, and a clearer and more intelligent method introduced. He proposes that in all deaf-and-dumb institutions the training and education of the scholars shall be based on telegraphic system, without the voice, and, in a great measure, without gesticulation. As a first step the pupil is to familiarize himself with the symbols of the ordinary telegraph code. Instead of instruments, however, he will use, in giving the indicating signs, certain movements of the lips and mouth and the index finger. In telegraphy there are but three symbols—a dot and two dashes of different lengths, or a small dash and two long ones. Communications in any civilized language can be expressed by a combination of these symbols. In the suggested system a pucker of the lips would express a dot, and a separation of the lips to the required degree would indicate the dashes. At each end of a word a slight movement of the right hand or right index finger is given; at the end of each sentence a touch of the lips with the index finger. "Yes" is implied by a nod, "no" by a shake of the head, and "I don't understand you" by a blink of the eyes, etc. The preliminary training on this system is first to give object lessons, so as to convey the true meaning of each word. After the pupil has made some progress a grammatical construction of the language can be ventured upon. The author of the system contends that in this way a pupil can be educated to a high standard much more quickly than under the old method. He believes it would not take long to make the system even graceful. This practice of the muscles of the face would not interfere with or mar the expression of the emotions. A smile or a frown would retain its natural meaning. A communication could be given without attracting special attention, and the infirmity of the subject could often be concealed. The system would virtually give speech to the lips of the deaf and dumb. —Boston Transcript.

THE TELEPHONE WAR IN MICHIGAN.

A dispatch from Grand Rapids March 6 says: The telephone war is waxing hot in this State, and it will be carried to an extermination either of the new independent companies or that of the old Bell company. In this city the new company has over 100 subscribers, while the Bell, which long monopolized the telephone business, has been reduced to about 900, and it gives free service to all residents. A new exchange has just been opened in Detroit with 1,500 subscribers, which will be increased to 3,000 before May 1, and the same conditions exist in other cities in the State. A company has been organized with William L. Holmes of Detroit as president, to connect all the independent exchanges for a State service, and this work is being rapidly pushed. Wires radiate from this city to Lansing, Muskegon, Holland, Ionia and Hastings, and a line is being pushed north as rapidly as possible to Traverse City and Petoskey.

In Detroit lines are being extended to all points within a radius of twenty-five miles, and a State line is being built eastward to Jackson and Kalamazoo, and also to Lansing, to connect with the line to this city.

The Bell company already has lines from this city to Detroit and to many other points in the State, and is paralleling the new line northward to Petoskey, with Mackinaw as the objective point.

In all the towns where independent exchanges have been established rates have been cut, and as rapidly as the State lines are ready for business the State rates tumble from 25 to 50 per cent. The war will be particularly fierce this summer.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—II.

MODERN TYPES OF CELLS OF AMERICAN, ENGLISH, FRENCH AND GERMAN MANUFACTURERE.

BY JOSEPH APPLETON.

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DURING the past ten or twelve years there have been a great many storage batteries invented and put on the market, most of them being introduced with much enthusiasm, their inventors, or sponsors, claiming wonderful and often impossible results. Nearly all these cells have been manufactured under one or other of the two general methods described in the previous article, the majority of them being alike except in detail of construction and manufacture. As our object is to treat of modern storage battery practice, we shall only consider generally those types which have played the principal part in the industry and have attained some degree of commercial success.

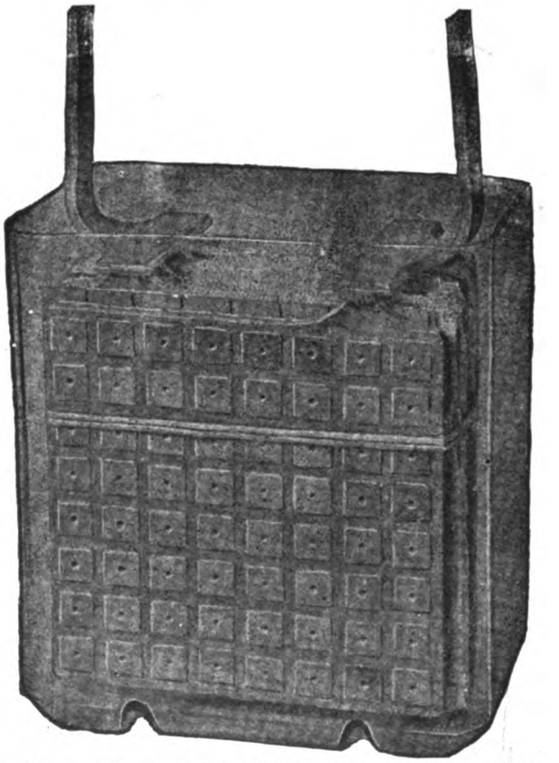


FIG. 1.—TYPE "E", 9 PLATES, IN GLASS JAR. ELECTRIC STORAGE BATTERY CO.

For a long time the charge and discharge rate of a cell was fixed at ten hours; this was called the "normal rate," and meant that the cell must not be discharged in less than ten hours, and that the same time must be allowed for charging. This necessarily restricted the use of storage batteries, for if a large current was wanted from them, even for a short period, it required the battery to have a normal rate equal to the maximum discharge wanted. This necessitated a very large battery and consequently a too expensive one to be commercially practical.

This was especially the case in central station and railway work, where large currents are required for comparatively short periods of time. Storage battery manufacturers realized that if a cell could be made which would stand this class of work without sacrificing durability, it would open up a very large field for their apparatus, and it is in this direction that the chief improvements have been made during the last few years.

Modern practice calls for a cell which can be safely discharged in from one to three hours, the former rate being generally specified for central station work, with the capability of a much higher discharge rate for a few minutes. The rate of charge is generally limited to five hours. It will readily be seen that this rating increases the value of a storage battery from the engineer's point of view, and at the same time decreases the cost per kilowatt. The present cost of storage batteries for central station and similar work is less per kilowatt than that of modern generating machinery.

The principal manufacturer of storage batteries in America is the Electric Storage Battery Company, of Philadelphia. Besides this company there are several others which manufacture various types of storage cell among them being the Electro-Chemical Storage Battery Company, of New York; the American Battery Company, of Chicago, and the Willard Electric and Battery Company, of Cleveland.

In England there are the following companies: The Electrical Power Storage Company, which was one of the earliest in the field, which has always controlled there the patents under which the pasted type of plate is made, their principal patents having, however, recently expired; also the Chloride Electrical Storage Syndicate, the D. P. Accumulator Company, the Crompton-Howell and Epstein Companies. In France the Société Anonyme pour le Travail Electrique des Metaux, manufacturing under the French patents of the Chloride Electrical Syndicate of England and the Electric Storage Battery Company, of America.

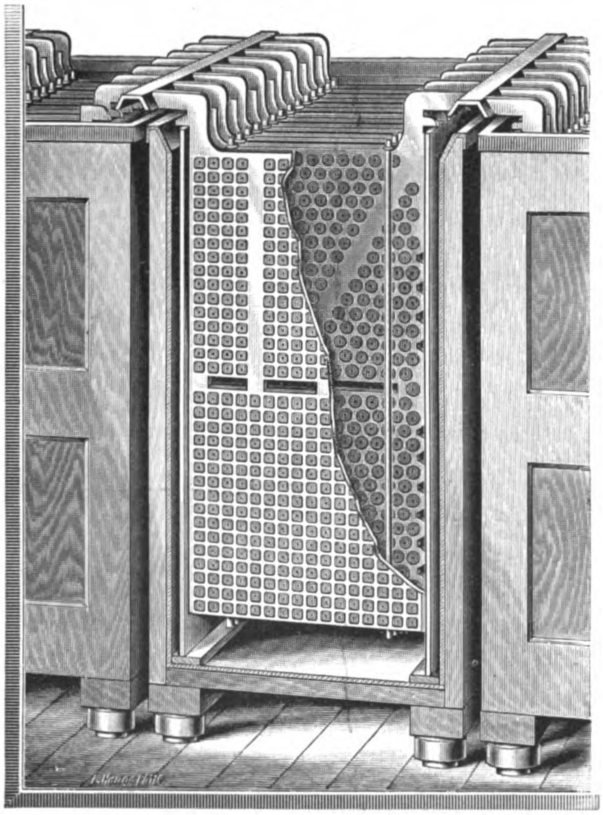


Fig. 2.—Central Station Cell. Electric Storage Battery Co.

In Germany, the Tudor Company is the principal manufacturer, working under license from the Electrical Power Storage Company, of England, and patents of their own. Germany may really be called the home of the practical storage battery, as the Tudor Company was the first to demonstrate its value for central stations and similar work of extensive character.

There is no doubt that the storage battery industry, both from the manufacturers' and users' point of view, is now on a better basis in America than in any other country.

This may appear strange after the condition of affairs which formerly existed, yet when the real facts are carefully examined it is apparent that this country offers a greater field for the use of storage batteries than any in Europe, and consequently as soon as a reliable battery was available without the prospect of an accompanying law suit, American energy set about to fill the demand.

The manufacture of storage batteries to-day is not confined to the production of one type of cell, but includes as many types as there are conditions of service. For example, it is obvious that for central station and power work, where a battery is wanted which will stand up under excessive discharges for short periods, and which can be charged economically in a short time, the type of cell must needs be different from that used in isolated plants, where large capacity and comparatively slow discharge rates are required. Again for storage battery traction and motor vehicles, a battery of light weight with large capacity is needed, durability not being such a desideratum.

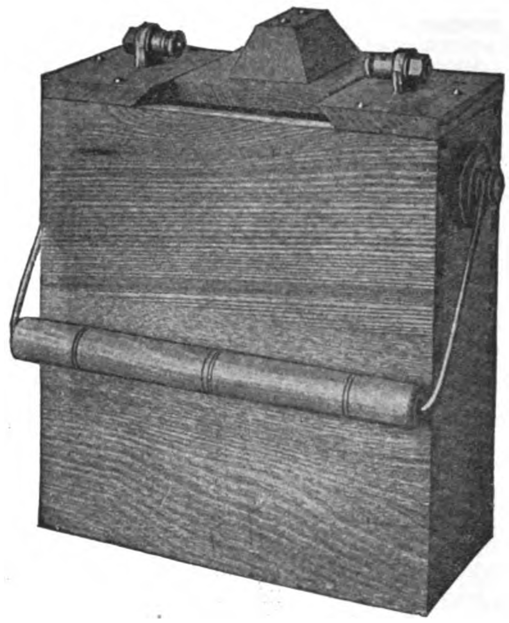


Fig. 3.—Portable Cell. Electric Storage Battery Co.

It would be impossible to give in these articles complete tables and data of all the cells manufactured by the various makers; a brief description of the size and different types must suffice.

The Electric Storage Battery Company of America are probably better equipped than any other company in the world to supply the demands for various types of storage batteries. This company manufactures cells for all purposes and of all sizes, the capacity ranging from 5 ampere hours up to 20.000 amperes. The smaller sizes, up to about 500 ampere hours are furnished in glass jars, and for portable use in hard rubber boxes, while the large sizes are supplied in lead-lined wooden tanks.

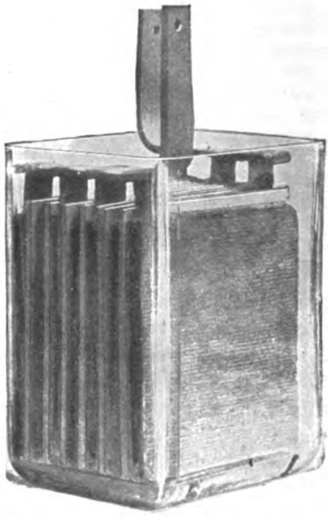


Fig. 4.—Electro-Chemical Storage Co.'s Cell.

Fig. 1 shows a cell of their standard type "E" 9, in glass jar, suitable for general lighting work, with the plates joined respectively to lead straps which form the + and — poles of the cell. The capacity of this cell is 160 ampere hours, having the following discharge rates: 20 amperes for 8 hours, 28 amperes for 5 hours, 40 amperes for 3 hours, 80 amperes for 1 hour. Fig. 2 illustrates one of the larger central station type of cells in lead-lined wooden tank, containing 15 "H" plates, having a capacity of 2,240 ampere hours, with the following discharge rates: 280 amperes for 8 hours, 392 amperes for 5 hours, 560 amperes for 3 hours, 1,120 amperes for 1 hour.

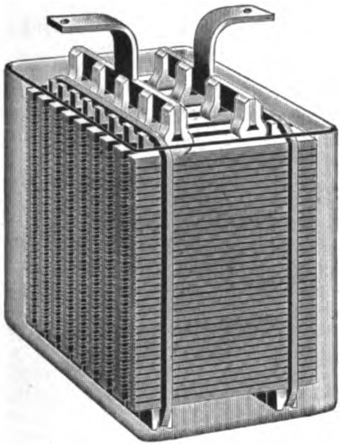


Fig. 5.—American Battery Co.'s Cell.

This type of cell is made up to 20,000 ampere hours capacity, having a maximum discharge rate for one hour of 10,000 amperes. The plates are supported on sheets of glass, resting on the bottom of the tanks and are connected to lead bus bars, the joints being made with a weld effected by means of a hydrogen flame, the only process which will ensure a clean and perfect contact. This method will be fully described later on.

Fig. 3 illustrates the portable type of cell; here the plates are mounted in a hard rubber-containing jar, which in turn is placed in a hard wood box to prevent accident from breakage and to render it easily handled. The cells are covered with a lid secured by a sealing compound, allowing the necessary ventilation, but preventing the spilling of the electrolyte. These cells are made with capacities ranging from 10 to 200 ampere hours, and comprising one to five cells in each box giving 2 to 10 volts, according to the number of cells. They are used for supplying current to phonographs, kinetoscopes, carriage lamps and for similar purposes.

Fig. 4 illustrates a cell manufactured by the Electro-Chemical Storage Battery Company, of New York. It is of the Planté type, the plates consisting of grids having grooves on both sides, to give large surface area.

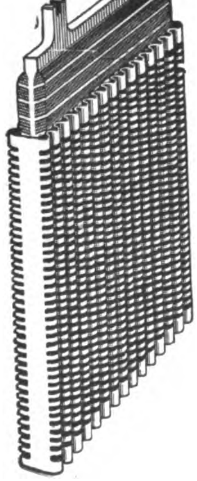


Fig. 6.—Willard Storage Battery Plate.

Fig. 5 shows a cell manufactured by the American Battery Company, of Chicago, type N 4, in glass jar; its capacity is 180 ampere hours with discharge rates as follows: Slow rate, 14 amperes; normal rate, 20 amperes; high rate, 40 amperes. The special features of this cell are large surface area due to the special construction of the plates which are made from pure rolled lead grooved on both sides.

Fig. 6 illustrates a plate of the Willard type, manufactued by the Willard Electric and Battery Company, of Cleveland.

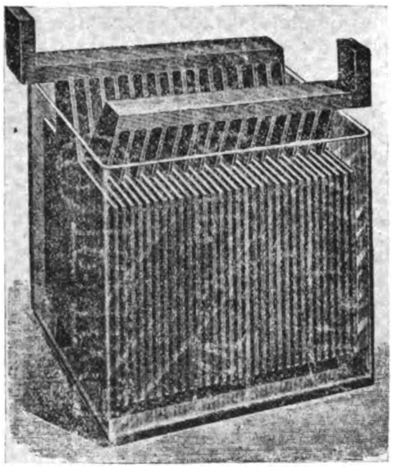


Fig. 7.—The Faure-King Cell.

The Electrical Power Storage Company, of England, adhere to the pasted type of plate which has always been the chief feature of their work, and have recently introduced a new cell called the Faure-King type. This cell is illustrated in Fig. 7. The chief advantages claimed for this type are increased capacity and discharge rates, for the same surface area of plates as compared with their older types.

This cell is very light and can be discharged at very high rates for short periods. The illustration shows a cell of the lighting type having 31 plates mounted in glass jar, their capacity being 1,300 ampere hours with discharge rates as follows: 145 amperes for 9 hours; 295 amperes for 3½ hours, with capability of higher rates for short periods. This cell is also manufactured for central station and traction work, a special design of cell being made for auto-cars and motor vehicles.

The Chloride Electrical Storage Syndicate, of England, manufacture a large variety of cells. Fig. 8 shows their central station type of cell in lead box. These cells can be discharged at high rates without injury.

The D. P. Accumulator Company of England manufacture cells of the Planté type, which have met with great success in private installations and similar work, durability being one of their principal features. Fig. 9 shows this type of cell.

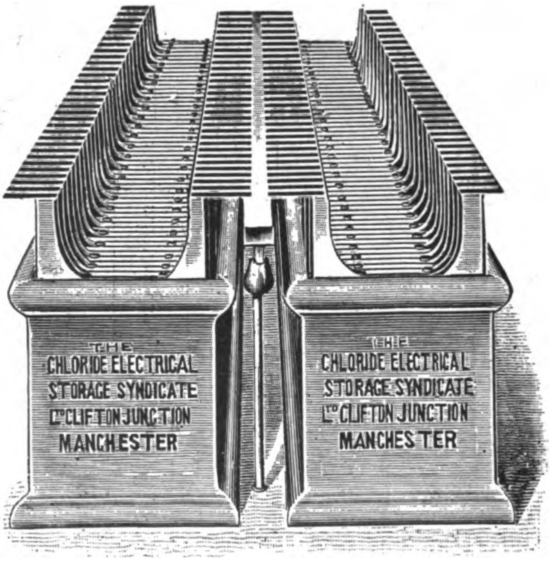

THE CHLORIDE ELECTRICAL STORAGE SYNDICATE LTD CLIFTON JUNCTION MANCHESTER
THE CHLORIDE ELECTRICAL STORAGE SYNDICATE LTD CLIFTON JUNCTION MANCHESTER

Fig. 8.—Manchester Chloride Cell.

The Tudor Company of Germany classify their cells in the following manner: 3 to 10 hour discharge rates and 1 to 3 hour discharge rates. The range of capacity is very large, extending from 30 ampere hours up to 12,000 ampere hours.

Fig. 10 illustrates one of their central station types. In this class of cell the positive plates are built up of small sections about six inches square, mounted in a lead or alloy frame; the sections being attached to the frame by a lug at the top. This method enables a positive plate of large size to be constructed without the liability to buckling which occurs in all large plates of this description which are made in one piece. This company is equipped for the manufacture of both pasted and Planté types of plate, using the one best suited to the requirements. As previously stated, this company was the pioneer for storage battery installations in central stations, and the first plants of this character in America were carried out by them. These will be described and ilustrated later.

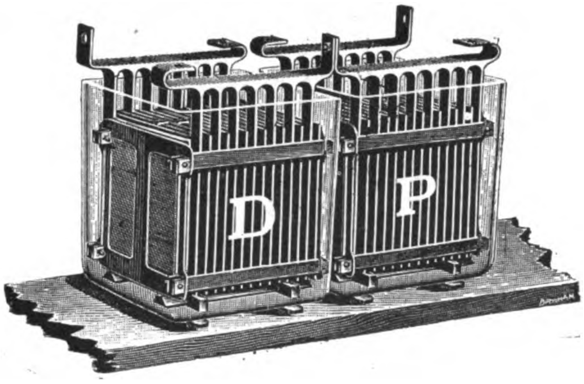


FIG. 9.—ENGLISH D. P. CELL.

The storage battery of to-day is a practical and mechanical piece of apparatus. Engineers have come to the assistance of the chemist, the result being a well designed and constructed apparatus, free from the weak points which were inherent in all early types of cells, and which necessitated the constant attention of a skilled doctor or nurse. This fact alone has done much to create confidence in the minds of electrical engineers, and to wipe out the memory of the early and disastrous results.

Every one who had any connection with storage batteries, in former years, will remember the trouble caused by buckled plates, insufficient separation, unreliable and corroded connections, and general debility of the apparatus. The writer well remembers bringing over from England to this country, in 1886, a new cell which was expected to do wonders, and, in fact, was a remarkable cell in many ways, but was constructed in such a fragile manner that he was compelled to keep the plates wrapped up carefully in soft packing, never letting them go out of his sight, and watching them in his cabin during rough weather for fear they might not stand the knocking about which any ordinary piece of baggage would stand with impunity.

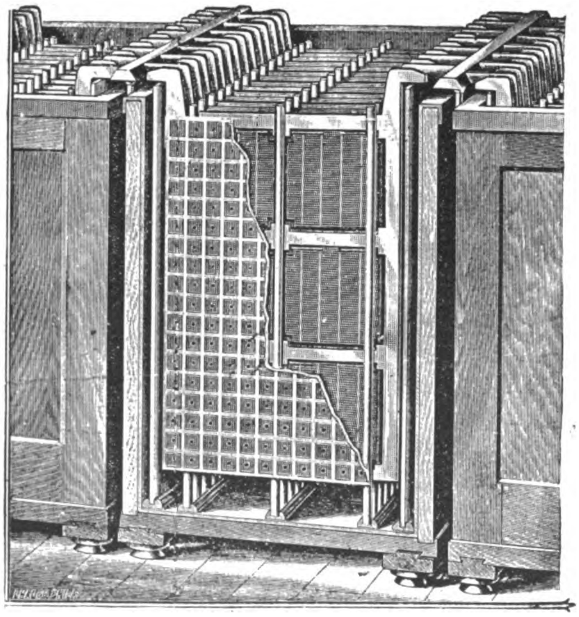


FIG. 10.—GERMAN TUDOR CELL, CENTRAL STATION TYPE.

This is now a thing of the past. The storage battery of to-day, being well able to take its place alongside of other modern and improved machinery, compares most favorably with the same as regards cost of operation and maintenance. On this point we may quote the following remarks from a communication read before the American Institute of Electrical Engineers on Nov. 20, 1895, by Mr. C. L. Edgar, vice-president and general manager of the Edison Electric Illuminating Co., of Boston, who were the pioneers in this country in the use of storage batteries on a large scale in central stations, having had them in operation since April, 1894.

"Having satisfied ourselves in the beginning that with a given amount of capital we could do more work with the battery than without it, we by actual practice came to the conclusion that we could by the same means do this same amount of work more cheaply.

"The fixed charges of running a battery room are very small as compared with those of a steam station, and there would not be any material increase of fixed expense between one large battery located in a central point, and half a dozen small ones distributed throughout the city.

"Our company has used the first battery 20 months, and one of double its capacity for six months, entirely too short a time to come to any conclusions about the depreciation, but it has given us ample time to satisfy ourselves as to the economic value. It is sufficient for me to say that if a need should arise to-morrow for additional capacity, either at our main station, at either of the annexes or in any new part of the city, within reasonable distance of our center of distribution, we should consider the question along the lines which I have just indicated. We should eliminate entirely from the discussion, the question which has distracted the public mind for so many years, and decide it entirely upon its merits, placing the battery side by side, and on an equality with other modern and improved apparatus."

About one year after expressing the above opinion, the Boston Edison Company installed a third battery in an annex station for the purpose of opening up a new district.

PERSONAL

WILLARD E. CASE.

Willard E. Case.

So much attention has been drawn to the thermo-electric work of Mr. Willard E. Case that a brief biographical sketch of that gentleman will be interesting to many of our readers. He was born at Auburn, N. Y., in 1857, educated in public schools and by private tutors, graduated from Hamilton College Law School about 1880, and was admitted to the practice of law in this State. His tastes ran strongly, however, in the direction of physical study and research, particularly in the domain of electricity, and he very soon began to devote his energies wholly to the work of that character. He was not long in reaching results of a striking nature, and in 1886 he read a paper before the Royal Society in London on a new means of converting heat energy into mechanical energy, demonstrated by a battery of his own invention. Among other papers was one read before the American Institute of Electrical Engineers in 1887, which also attracted much notice, and is to be found in the Transactions, on a new form of carbon consuming battery. His paper read recently at Columbia University before the New York Electrical Society showed that his mind and work are still directed in pursuit of the solution of the same problem, and has been noted in a great many papers and periodicals in all parts of the country.

Mr. Case has had all the advantages that come from the enjoyment of large wealth, and is a good type of the men not so common here as in Europe who devote a large part of their means and leisure to scientific investigations, which may lead on to practical results, but, in any event, is followed up for its own sake. Mr. Case is a citizen of Auburn, though spending much time in New York or in Europe. He has just given, in memory of his father, the late Theodore P. Case, a Public Library Building to the city of Auburn, and has also created a fund to establish a Scientific Library in the building. Mr. Case is a member of the American Institute of Electrical Engineers.

FRED J. CROSS.

THE subject of this biographical sketch, Mr. Fred J. Cross, is the manager of the electrical department of the Buffalo Engine Works, Buffalo, N. Y. He is a Polytechnic School graduate, and has been in the electrical field since 1885. He has made a specialty of the design of electrical apparatus since 1891, and has several patents. At the present time, no fewer than three factories in Canada are building from his designs, and reference has already been made elsewhere in these pages to his work in this country. He is thus not only well informed theoretically but competent practically. Mr. Cross is also a frequent lecturer on electrical and other engineering topics, and is only 32 years of age.

Fred. J. Cross.

A FERRARIS MEMORIAL.

A committee has been organized under the presidency of Senator Count Rignon, mayor of Turin, Italy, to erect a fitting memorial to the late Senator, Prof. Galileo-Ferraris. It is proposed to erect the memorial in the Royal Industrial Museum of Turin, and to make the subscription an international one. Contributions can be forwarded to this office or direct to Sig. Cav. Lappata, treasurer of the city of Turin, Italy.

MR. W. F. WELLS.

Walter F. Wells, assistant superintendent of the Brooklyn Edison Electric Lighting Company, was the guest of honor on Wednesday night, March 10, at a dinner given at the Clarendon Hotel, that city, by a number of his fellow workers. Mr. Wells will leave the Edison company on April 1, having accepted the position of superintendent of the Manhattan Electric Lighting Company of New York. The dinner was in the form of a parting testimonial and assumed a very material character when Ethan Allen Doty, president of the Edison company, presented Mr. Wells with a handsome diamond stud. After the dinner the party saw "The Girl From Paris" at the Herald Square Theater. The party was composed of Ethan Allen Doty, R. C. Peabody, W. W. Freeman, A. N. Nielsen, W. F. Wells, Charles F. Perry, John F. Outwater, John Wolff, C. V. Driggs, John Flint, R. S. White, Theo. Guillaudeu, William J. Reast.

MR. W. J. KURTZ IN LUCK.

A special dispatch of March 10 from Indianapolis says: William J. Kurtz, president of the Kurtz Telephone Company, operating telepone exchanges at Decatur, Ill., New Albany, this State, and other points, besides seeking franchises for exchanges in a number of Indiana towns, has received notice that by the death of Gottlieb Kurtz, a bachelor uncle of Stuttgart, Germany, he will receive several million dollars, he being the sole heir. Mr. Kurtz is already wealthy. He will send a representative to Germany to look after his interests.

DR. HENRY MORTON, the veteran president of Stevens Institute of Technology, has been nominated by the trustees of Princeton University for the degree of L.L. D. The degree will be conferred next June. The other gentlemen thus distinguished are Rev. Dr. Theodore L. Cuyler, ex-President Cleveland, Governor General the Earl of Aberdeen, and the Hon. John L. Cadwalader, who are in good company.

THE STOCK MARKET

A SLOWLY RISING MARKET.

With Congress and Crete out of the way, it is evident that general conditions would be much better than they are, as the tendency to improve slowly is quite marked, while the tendency to get nervous and rattled is still one of the besetting weaknesses of the investor and merchant.

Under the strain of uncertainty the stock market continues dull, neither strong nor weak, in an alternating mood at best. Western Union has been slightly lower, probably because the deprivation of the stock exchange quotations for the tickers would deprive it of a source of large and profitable business. During the past week there were sold 23,404 shares down to 83¾, after reaching 86½. General Electric on 7,102 shares ranged from 35⅝ to 34⅜. The price for American Bell Telephone went off one dollar to 223, but the sales were only 287 shares. The chief event in local company securities is the offering of $6,000,000 of bonds of the West Chicago Street Railway Company, at 5 per cent.

SOCIETY & CLUB NOTES

AMERICAN INST. ELEC. ENGINEERS.

At the meeting of the Institute to be held March 24, at 12 West Thirty-first street, New York City, at 8 P. M., a paper by Dr. Karl E. Guthe will be read by Prof. H. S. Carhart, of the University of Michigan, entitled: "The Influence of Heat Treatment Upon the Magnetic Properties of Hardened Steel."

N. E. L. A. CONVENTION.

Mr. C. O. BAKER, Jr., master of transportation, announces that the trunk line association have granted a rate of fare and one-third, for the round trip, on the certificate plan, from all points in its territory to Niagara Falls, for delegates and members of the National Electric Light Association attending the twentieth convention to be held June 8, 9, 10, 1897.

LEGAL NOTES

WESTERN ELEC. CO. vs DOLGEVILLE TELEPHONE CO. JUDGMENT ENTERED.

In the case of the Western Electric Company against the Dolgeville Telephone Company judgment has been entered in the office of Clerk Doolittle, of the United States Court, at Utica, N. Y., of one cent nominal damages and costs against the defendant. The costs were taxed at $243.34. E. A. Brown, of Dolgeville, was attorney for the defendant, and C. A. Brown, of Chicago, for the plaintiff. The action was begun in April, 1895, for infringement of patents on switchboard, or exchange apparatus, used by the Dolgeville Company. It was set down for trial at the term in Albany last January, but no one appeared for the defendant, and a decree was entered in favor of the plaintiff. At Judge Coxe's Special Term on February 16 a motion by defendant's counsel to vacate that decree was granted on condition that defendant pay $150 within twenty days to defray the expenses of plaintiff's counsel. The payment was not made, and the matter was brought to an end by the entry of judgment as above stated. The decree also enjoins the plaintiff from using the exchange apparatus in question during the life of the patents, which are declared valid. Theodore H. Roth is president, and W. S. Armstrong secretary and treasurer of the Dolgeville Company.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 16, 1897.

Alarms and Signals:—

ELECTRIC CALL AND CALL ANSWERING APPARATUS. E. H. Owen, C. N. Williams and F. H. Donaldson, Garvanza, Cal., 597,075. Filed Sept. 14, 1896.

Possesses a plurality of visual-signal devices susceptible of being independently operated when an electric circuit is completed by operating a push button.

BURGLAR ALARM. M. P. McDermott, Auckland, New Zealand, 578,893. Filed Aug. 7, 1896.

The movement of a door, window, etc., completes a circuit.

WATER INDICATOR AND ALARM. G. W. Cooley & H. F. Logee, Minneapolis, Minn., 578,725. Filed August 15, 1895.

Details of construction.

Batteries:—

ELECTRIC BATTERY. H. N. Farley, Warwick, N. Y., 578,867. Filed April 11, 1895.

A single cell "gravity" battery having the elements so disposed as to produce a plurality of currents.

Batteries, Secondary:

BATTERY. S. J. Martin, Detroit, Mich., 579,001. Filed May 27, 1896.

In a secondary battery, an electrode, consisting of a series of perforated tubes attached to and surrounding a central core, the tubes adapted to contain the active material.

PASTE FOR ELECTRIC ACCUMULATORS. R. Linde, Berlin, Germany, 578,881. Filed Feb. 24, 1896.

A filling paste for electric accumulators in which the lead oxids are contained combined with a bitter principle.

ACTIVE MASS FOR ELECTRIC ACCUMULATORS. S. Hammacher, Berlin, Germany, 578,870. Filed June 27, 1895.

Consists of basic phenylates of lead mixed with the oxids of lead.

CHARGING SECONDARY BATTERIES. I. Kitsee, Philadelphia, Pa., 578,823. Filed Nov. 2, 1895.

Employs a number of incandescent lamps connected in series, each pole of each lamp being connected to a conducting plate adapted to receive the terminal of one pole of a battery set.

STORAGE BATTERY. C. T. Barrett, Brooklyn, N. Y., 578,710. Filed May 4, 1896.

A cell, consisting of a plate of pumice stone, to which the peroxid material is applied in combination with a confining envelope of lead, having openings for the admission of the acidulated fluid.

Connectors, Conduits and Insulators:—

INSULATOR. H. H. Luscomb, Hartford, Conn., and W. F. D. Crane, Orange, N. J., 578,825. Filed Oct. 24, 1896.

Consists of a body provided with means for attachment to a support and having arms that project upwardly from opposite sides of the body near the top, fingers loosely connected with and movable between the arms, a part of the fingers being adapted to support the wire and a part of the fingers being caused to embrace the wire by the action of the weight of the wire.

Dynamos and Motors:—

ELECTRIC MOTOR AND DYNAMO. W. S. Horry, Gloucester City, N. J., 579,062. Filed June 15, 1892.

Comprises means for producing rotating field poles, means for producing rotating armature poles in the same direction and speed as the field poles, and rotating the armature in one direction for energizing the field and armature coils, and means for controlling the speed of rotation and reversing the direction of the field of force.

CONSTRUCTION AND REGULATION OF ELECTRIC MACHINES. T. H. Hicks, Detroit, Mich., 579,059. Filed Feb. 23, 1895.

Means to prevent sparking.

DYNAMO ELECTRIC MACHINE. G. A. Scheeffer, Peoria, Ill., 579,012. Filed April 30, 1892.

Of the inductor type.

Electro-Metallurgy:—

TANK FOR TREATING ALLOYS, ETC. F. A. Thum, Newark, N. J., 578,953. Filed June 25, 1896.

Comprises an electrolytic tank anode cells with permeable bottoms; carriages constructed to support the anode cells when immersed into the tank and adapted to be moved horizontally; one or more cathodes placed upon the bottom of the tank, and suitable electric connections for the electrodes.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. T. E. Adams, Cleveland, Ohio, 579,032. Filed Oct. 1, 1896.

Enclosed arc lamp.

Measurement:

ELECTRICITY METER. A. Raps, Berlin, Germany, 579,079. Filed July 25, 1896.

Consists of a suitable direct reading electrical measuring instrument, an oscillating balance and a registering wheel.

Miscellaneous:—

MEANS FOR PROTECTING ELECTRIC MACHINES FROM HEAT. J. P. B. Fiske, Alliance, Ohio, 579,051. Filed Jan. 12, 1895.

Employs a housing enclosing the machine, the former having openings in the ends, a fan located in one of the openings being carried by the armature shaft of the electric machine.

ELECTRIC ELEVATOR. S. D. Strohm, Philadelphia, Pa., 579,024. Filed April 4, 1896.

The opening of a landing door breaks the circuit, stopping the car.

TEMPERATURE CONTROLLING APPARATUS. S. Green, New York, 578,984. Filed June 16, 1896.

Relates to thermostatic regulation of temperature of buildings heated.

ELECTRIC CLOCK-SETTING EMCHANISM. C. M. Crook, Elgin, Ill., 578,976. Filed January 11, 1897.

Details of construction.

TELEGRAPH FIRE HOSE. J. Buchtel, Portland, Ore., 578,716. Filed April 14, 1896.

Provides a telegraph hose adapted for use in connection with a central controlling station and signal apparatus, so that by means of the signal the operator at the controlling station can cut the water on or off.

ELECTRIC CARRIER APPARATUS. H. M. Neer, Springfield, O., 578,939. Filed July 25, 1896.

Package and change system for store.

Railways and Appliances:—

ARRANGEMENT FOR CLOSING OR OPENING BARS AT RAILROAD CROSSINGS. H. Biermann, Breslau, Germany, 578,853. Filed April 6, 1896.

Comprises a rail in three insulated sections, an alarm connected to the outside sections, and an electric motor controlling the gate connected to the central station.

RAILWAY CROSSING SIGNAL. C. Selden, Baltimore, Md,. 578,840. Filed February 11, 1897.

Designed for single track railroads and adapted to be operated by an approaching train.

RAIL BOND FOR ELECTRIC RAILWAYS. T. J. Tighe, Brooklyn, N. Y., and S. W. Childs, Natick, Mass., 578,829. Filed October 9, 1896.

Consists of two metallic conductors, one on each side of the rail, and having inwardly projecting ends and means for drawing the ends into a single hole in the rail securing them.

Regulations:

REGULATOR FOR ELECTRIC MOTORS. R. M. Hunter, Philadelphia, Pa., 579,063. Filed May 22, 1894.

Comprises an electric circuit and power motor arranged in the circuit, and a counter electro-motive force regulator wholly independent of the field of the power motor and arranged in a shunt circuit about the entire power motor.

CONTROLLER FOR DYNAMO ELECTRIC MACHINES. C. E. Woods, Chicago, Ill., 579,028. Filed January 15, 1896.

Designed for use in connection with power motors. Details of construction.

ELECTRICAL CONTROLLING APPARATUS. B. C. Van Emon, San Francisco, Cal., 578,954. Filed May 22, 1896.

Comprises a reversible motor and a triple reversing armature circuit switch, mounted and turning on a axis, solenoids to move the switch either way and reverse the motor.

CONTROLLING MECHANISM FOR ELECTRIC MOTORS. F. R. Bacon, Milwaukee, Wis., 578,707. Filed December 21, 1896.

Details of construction.

Switches, Cut-Outs, Etc.:—

LIGHTNING ARRESTER. W. K. Freeman, Fort Wayne, Ind., 578,981. Filed July 5, 1895.

For use on lines carrying heavy currents.

CIRCUIT BREAKER. H. P. Kelly, Philadelphia, Pa., 578,150. Filed April 7, 1893.

Employs a breakable strip included in the circuit, and mechanical means controlled by the circuit for mechanically breaking the strip without previously fusing it.

Telegraphs:—

REPEATER. C. W. Leiser, Carlinville, Ill., 578,997. Filed April 1, 1896.

Comprises two relays provided with armature levers, each having two spring contacts, two stationary contact points for each armature lever, two batteries connected with the main lines and with the forward stationary contacts of the relays, and the electrical connections, whereby signals made on one line will be repeated on the other.

Telephones:—

TELEPHONE-SWITCHBOARD PLUG. F. E. Bossong, Watseka, Ill., 579,036. Filed September 16, 1896.

The same plug is used to receive the called number and to ring up the desired subscriber.

TELEPHONE TRANSMITTER. W. J. Moore, Elmer, Mich., 579,003. Filed May 25, 1896.

Relates to the "cup" part of the transmitter.

MULTIPLEX TELEPHONY. S. W. Holman, Boston, Mass., 578,992. Filed May 31, 1893.

Employs at each end a telephone, each terminal of which is connected in multiple with the two conductors of one original circuit through the two windings of a differentially wound electro-magnetic coil.

CUT-OUT AND AGITATOR FOR DUST TRANSMITTERS FOR TELEPHONES. S. B. Rawson, Elyria, O., 578,771. Filed June 14, 1895.

Consists of a dust transmitter on a joined arm, a battery wire connected to the arm and movable therewith, the bell connections having fingers in position to be engaged and thrown into circuit by the arm in one position, and the transmitter having a finger connected to the battery circuit and in position to be engaged by the arm when in another position.

OBITUARY

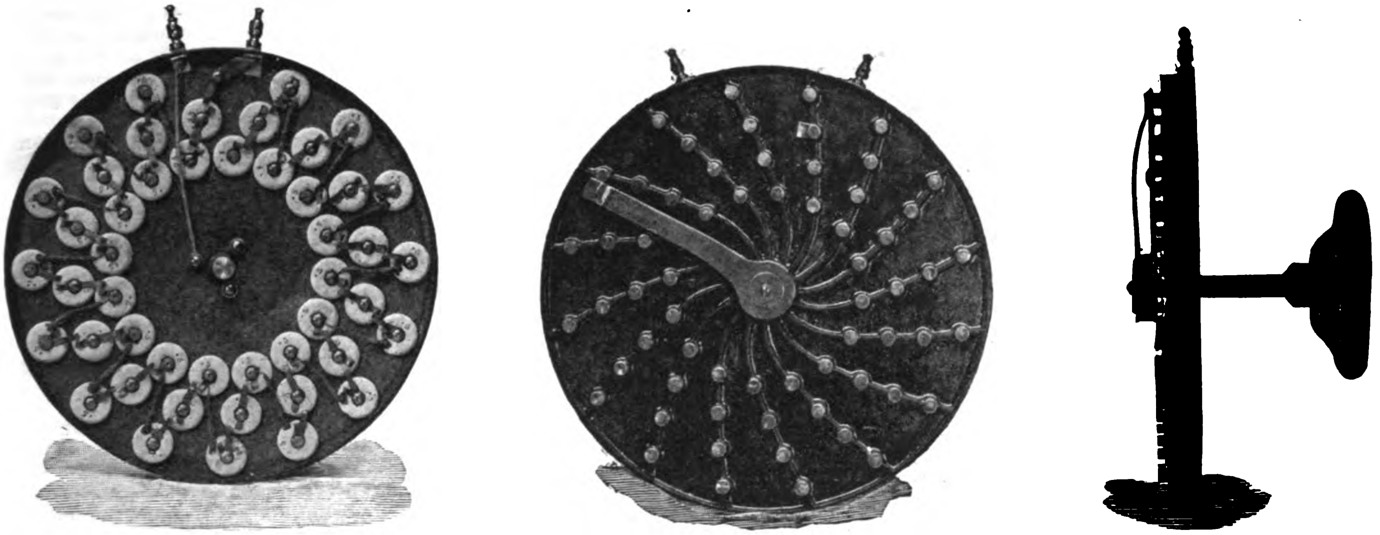
HON. J. SHANAHAN.—The death is announced of this gentleman at Tribes Hill, N. Y. He was well known as a canal official and a private contractor. At the time of his death he was president of the Cayadutta, N. Y., Electric Railroad and the Fonda, Johnstown and Gloversville Railroad.

COL. A. J. RUSSELL.—The death is announced of this gentleman, who was one of the pioneers in introducing the Edison system of electric lighting, and of late has been connected with the commercial use of the phonograph.

TRADE NOTES & NOVELTIES

THE "UNIVERSAL" FIELD RHEOSTAT.

It is well known that enamel rheostats are by far the most compact for a given capacity, are entirely fireproof (meeting all demands of the insurance requirements), have high insulation and are essential to the up-to-date switchboard. As heretofore constructed enamel rheostats have usually had all the resistance in one envelope of enamel attached to a cast iron plate, thereby making all the imbedded resistance a single unit which, if it failed in any part, destroyed the value of the entire plate, creating an expensive repair. Also because of this method of construction purchasers have been compelled to select for their needs from the standards established by manufacturers, or pay an extra price and be subject to considerable delay in getting supplied. As is well known, no two dynamo manufacturers make machines of similar capacity which have the same field resistance, and all manufacturers make changes continually in the windings and proportions of the dynamos they produce; therefore, without an infinite number of sizes, no manufacturer can carry in stock rheostats that supply just the external resistance required in each case.



Figs. 1, 2 and 3.—The "Universal" Field Rheostat.

In an endeavor to overcome these objections, and at the same time preserve all the advantages of the best that has been procured, the American Electric Heating Corporation have brought out a line of dynamo field rheostats, which, it is believed, will demonstrate that they have accomplished the desired results.

The rheostats consist of circular cast iron plates, in a number of divisions and resistance of the rheostats. These discs are of uniform size, but vary between wide limits in resistance and ampere capacity. The cast iron supporting plate is provided with suitable holes, which permit a single bolt to clamp the connections, discs and plate firmly together, and the bolt heads form the contact points over which the usual movable arm rotates. By this method of placing the resistances, one or more rows of contacts may be arranged, thereby distributing the resistance over a greater surface of a given size plate than has been the practice where all the resistance is located outside the circle of contact points. In the event of injury to any part of the circuit, it would require but a few moments' work of the dynamo tender to locate the fault, remove or cut out the defective part and continue the use of the rheostat.

The possibility of burn-outs is very slight and cost for repairs nominal. No disc can ever have more than its predetermined load, and the factor of safety allowed is large. Each customer can have exactly the rheostat required for his dynamo. Special rheostats within the limits of sizes made can be furnished at once. By reason of there being but a few sizes of plates required to meet all demands, but an infinite combination of resistances, no delay need occur in filling orders, for the average rheostat can be assembled in an hour, and it is a simple matter to keep an assortment of resistances complete.

All field rheostats for mounting on back of switchboard are made so that the holes drilled for one will answer for any size; so if it was desirable at any time to change from one size to another, it would involve no change in the supporting bolts or their location.

Quite an important feature is that if by carelessness an excessive overload is applied and allowed to remain to the point of causing a burn-out, no serious harm could be done; for at most but two or three of the discs could be injured. The connections are such that the field circuit cannot be opened if the arm fails to make contact.

STEEL POLES OF THE NATIONAL TUBE WORKS.

One of the largest iron and steel plants in the world, organized for the purpose of turning out a high grade special product, is that of the National Tube Works, at McKeesport, Pa. The company have been in business over 40 years, beginning originally in Boston and moving to the banks of the Monongahela about a quarter of a century ago. At the present day their plant extends along the river a full mile, and, in round numbers, some 10,000 men are employed in making up, from the raw material about 250,000 tons annually of pipe and tube, in iron and steel, particularly the latter. An idea of the scope of the company's vast operations may be formed from the fact that a mile of cars of coal invades its yards daily, and that the output ranges through 1,000 sizes of pipe and tube. The National Tube Works early recognized the coming importance and predominance of steel, and have a magnificent steel plant making a beautiful quality of high grade mild steel, all of which is practically used up by themselves. In other respects also the works are self-supplying, and thus the company enjoy great advantages when it comes to making prices in times of close competition. In the line of steel trolley poles the company have been very successful, having made sales to some of the largest railways in the field, and they have addressed their attention to meeting all the exceptional conditions involved in trolley line strains due to wind, weather and work. These poles, as well as those for lighting purposes, fully sustain the reputation of the time-honored "Diamond B," and "Boston Tubing" brands. The utmost care is taken in the preparation of the goods, and literally every ounce of material is under test, metallurgical, chemical and mechanical from the moment it enters the works till the hour it leaves for use. The different departments of the working features of the establishment are divided as follows: National Tube Works, Monongahela Furnaces, Monon-Forge and Iron Works, Republic Iron Works, Monongahela Steel Works and National Transportation Company. The company maintains sales offices at Boston, New York, Pittsburg, Chicago, St. Louis and is now establishing itself in like manner in London, England. The officers are: D. W. Hitchcock, president; A. F. Luke, secretary and treasurer; E. C. Converse, vice-president and general manager, Horace Crosby, assistant general manager, and F. R. Upton, sales manager. The National Tube Works Company is capitalized for $11,500,000, all paid in.

THE EMERSON 1897 MODEL INDUCTION CEILING FAN.

The Emerson Electric Manufacturing Company, of St. Louis, Mo., the pioneers in alternating fans, are this spring bringing out their 1897 model induction fans, both for ceiling and desk ventilation. These fans contain a number of improvements on the older models and make the fans thoroughly up to date. The accompanying engraving, Fig. 1, shows the ceiling fan complete, and Fig. 2 gives a detail view, showing its construction, the general appearance and design of the 1897 model being extremely graceful and artistic.

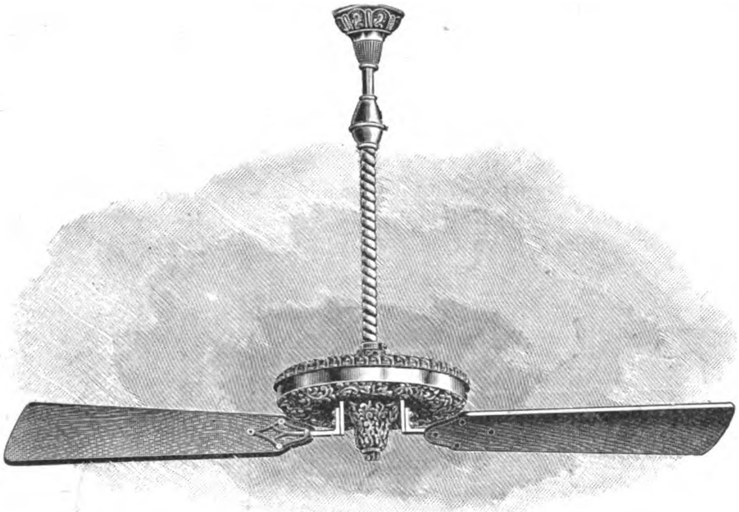


Fig. 1.—Emerson Alternating Induction Ceiling Fan, 1897 Model.

In general construction the motor is merely a "wheel within a wheel," the outside wheel (the field) being stationary, while the inside wheel (the armature) revolves on a large solid shaft on a ball bearing, immersed in a cup of oil. There is no moving wire, no commutator, no brushes, no reduction gear of any kind, no friction wheels and no wearing parts whatever, except one large solid bearing, and this revolves at only 150 to 210 revolutions per minute. It is claimed to be the ideal ceiling fan and to be far ahead in simplicity and construction even of the best direct current motors.

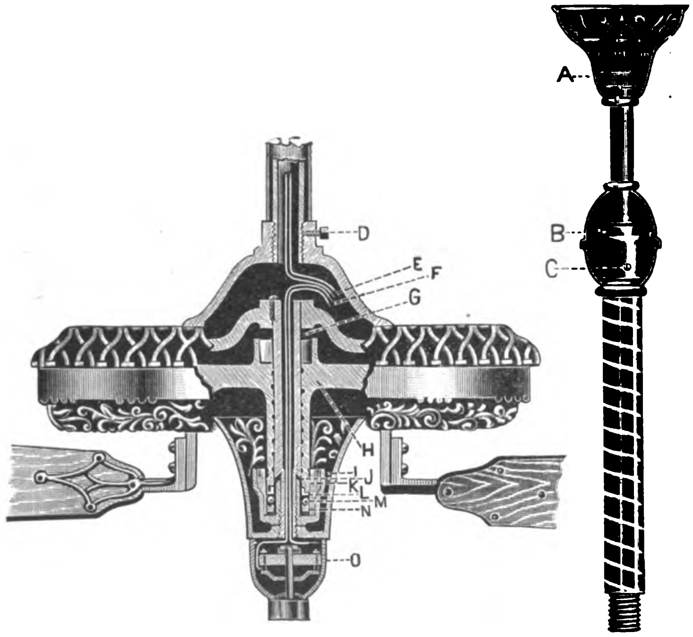


Fig. 2.—Emerson Alternating Induction Ceiling Fan, 1897 Model.

The standard finish is nickel plate but is furnished in brass plate, oxidized copper or any finish desired.

The bearing, as shown in Fig. 2, is merely a long upright shaft, with an oil cup screwed on the bottom; and on this shaft the armature revolves, resting on a ball bearing, M. The balls are standard hardened steel balls, which run on hardened steel ways, and are immersed in oil.

On this motor there is only one bearing to oil and only one place to oil it, and it is believed there will be only one time it will ever need oiling, and that is when it is started at the beginning of the season. The oil cup I is filled up to the point K, as shown. This should supply sufficient oil to last an entire season. By a unique device about one-half of the oil is carried up to the top of the shaft, thoroughly lubricating the same every time the motor is started, and runs down again when the motor is stopped, insuring perfect lubrication until the oil is actually used up.

The fan blades are large and have a wide sweep, and revolve at about 210 revolutions at full speed, but on account of its much greater speed, the angle is considerably less, to give the same results. The regulation in breeze is obtained by the switch, and the speed can be cut down to about 150 revolutions, by moving to a point one-half way between "on" and "off."

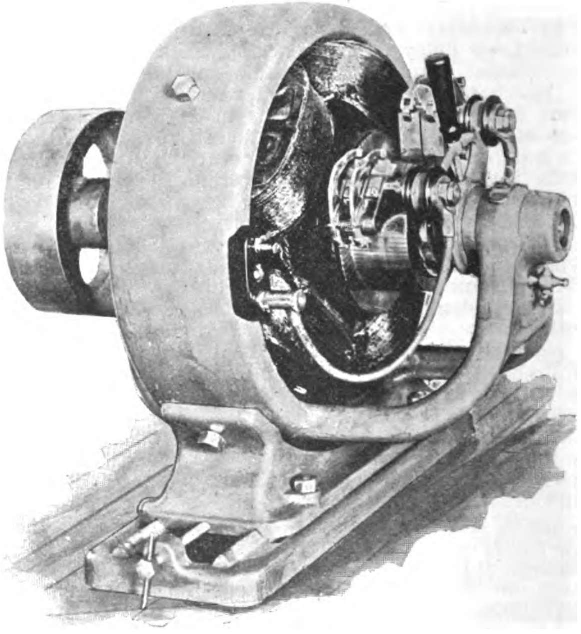
The switch O at the bottom of the motor performs two distinct purposes—to stop and start the motor, and also to regulate the speed. To start the motor, the switch is turned to the right till it touches the stop, and the motor will start itself promptly and run at about 210 revolutions per minute on 125 watts. To stop it, the switch is turned to the left as far as it goes, when the current is cut off. To run slow speed, the switch is moved half way between these two stops, after putting full on to start it and bring it up to speed, and the motor will run 150 revolutions per minute on 100 watts. By reason of the angle of the blades this makes a fine, gentle breeze.

The Emerson Company claim to have the only complete line of alternating current fan motors in the world, having eight distinct types, two each of 12-inch and 16-inch fans, for 16,000 alternations; one each of 12-inch and 16-inch fans for 7,200 alternations, and one each of ceiling fans for 16,000 and 7,200 alternations, and also claim that each of these types is the most efficient of its kind.

THE AHLM-EDWARDS ELECTRIC CO., MULTIPOLAR DYNAMOS AND MOTORS.

THE feasibility of electric power distributed to customers in small units has created a demand for motors especially adapted to such purposes.

Fully recognizing this fact, the Ahlm-Edwards Electric Co., of Medina, Ohio, have placed on the market a motor which in every respect meets the requirements for a machine of this class. By use of their patented adjustable base, whereby the motor may be fastened to the wall or ceiling, as well as to the floor, a large saving in floor space is attained. The motor is shown in the accompanying engraving.



The Ahlm-Edwards Dynamo and Motor.

For use in small isolated plants or private houses, the Ahlm-Edwards Electric Company manufacture a line of dynamos of moderate capacity which are designed with a special view of being driven from small steam, gas, or gasoline engines. Their plants of this kind have proved to be a commercial success wherever in operation, and the demand is rapidly increasing.

All dynamos and motors manufactured by the Ahlm-Edwards Electric Company are absolutely sparkless at all loads, as the greatest care has been taken in the relation between the speed, copper and iron, as well as their general mechanical design. The position of the brushes is the same for any load or overload that is ever met with in practice.

The shape and cross-section of the frame are carefully designed so as to avoid all stray or leakage magnetism, and a special grade of cast iron is used.

The magnet cores are made of cast steel, the pole faces of which are especially designed so as to evenly distribute the magnetic flux in the air-gap, and which serves to maintain a steady commutation field.

The bearings have bronze linings, and are provided with unusually large oil-wells and self-oiling arrangements.

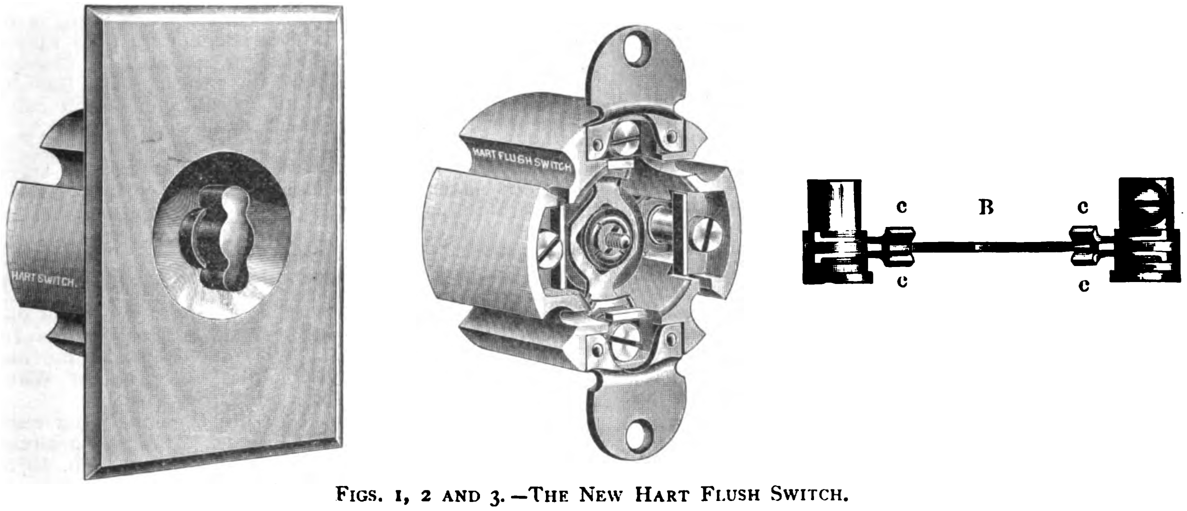
The armature core is built up of .016-inch-thick double-annealed sheet-iron discs which are well insulated by a coating of japan before being assembled. All the armature coils are interchangeable, and to insure safety against burn-outs, etc., they are wound, shaped, and insulated by hand before being placed upon the core. To prevent short circuiting or flashing over from brush to brush, an unusually large number of segments are employed, and sufficient brush surface to ensure cool running, even under considerable overload. Only drop-forged bars are used; and for insulating, the best India mica. All bars are interchangeable, and can easily be replaced.

The magnet coils are insulated and wound with the utmost care, and are all subjected to 6,000 volts alternating current before leaving the factory.

All the motors are provided with radial brush holders, which feed the carbon automatically, and when once set the brushes need no further attention.

SNAP SWITCHES—THE NEW HART TYPE.

WE have received the following interesting and timely article from the Hart & Hegeman Company, of Hartford, Conn.: The rapid increase in the number of incandescent lights during the past few years, has created a growing demand for appliances for controlling them and facilitating their use. One of the most used of these appliances is the snap switch, for placing the means of control of the lamps on an electrolier or elsewhere, within easy reach of the hand. Not many years ago, almost any sort of a thing that would, with more or less manipulation, light and extinguish the lamps, was considered good enough, regardless of its mechanical construction or its appearance upon the wall. Of late years, however, the demand has been for a more ornamental as well as a more durable and reliable article. Consequently snap switches have been greatly improved in their construction. This, however, does not apply to that class of switches whose only merit is their low price, and which are not in competition with the higher grade of switches.



Figs. 1, 2 and 3.—The New Hart Flush Switch.

The selection of a snap switch for use on a certain piece of work is frequently not given the importance that it deserves and it is regarded as one of the minor and unimportant details of construction, whereas it is one of those important details which should be settled by the selection of that switch which comes the nearest to fulfilling all the requirements of safety, durability, and convenience.

The chief requisites of a snap switch are quick and positive action when the actuating member has been turned or moved a predetermined distance, and, the locking of the automatically moving parts against accidental displacement, after such action has taken place. Equally important are the contacts, or that portion of the switch to which the terminals of the circuit are attached, and which serve to carry the current, by means of the switch plate, to corresponding contacts to which the terminals of the lamp circuit are attached. The contacts should have large contact area relatively to the amount of current to be carried, and should have a strong pressure upon the switch plate, or driven member of the switch. The large area is necessary to prevent "cutting" between the switch plate and contact surfaces, due to long use and neglect combined. The pressure is necessary in order to insure the permanency of the rated carrying capacity of the switch. If a light pressure is used, no cutting will probably occur; the switch will move freely, if the mechanism is reasonably good, and, for a time, it will carry its rated capacity of current without heating. In a comparatively short time, however, the surfaces depended upon to make contact, will tarnish and collect dust, and their conductivity will be impaired to such an extent that the switch will heat, and become worthless.

Aside from the fact, that the carrying capacity of a given area is regulated by the pressure, the pressure is also necessary in order that there may be sufficient friction to keep the contact surfaces in a proper condition to carry the current safely. Another cause of trouble is this, that if a switch plate, or its equivalent, "makes" contact by a movement the reverse of that by which it "breaks" contact, it is liable to carry back on the contact surfaces, the non-conducting metallic oxide formed by the repeated rupture of a circuit.

The form of contact which more nearly fulfills the above requirements, is that of the so-called "knife switch." This contact should be formed by two or more pieces of tough and elastic metal of good conductivity, held rigidly by one end, while the free ends press upon opposite sides of the switch plate, as in the usual type. These pieces should be of sufficient thickness to instantly carry off the heat produced by the rupture of the circuit, and prevent unnecessary burning at the point of rupture. While the contacts of the knife switch are desirable, its non-automatic action is objectionable, when used on comparatively small currents by the average user. Currents of large capacity are supposedly handled by persons of judgment, and with knife switches, in which a spring is used to assist the "throw." Under such conditions they answer the usual requirements.

From the foregoing facts it would seem that the switch best adapted for everyday use by everybody, on small currents, say, up to fifty amperes, is one in which the switch plate is carried automatically and surely into contacts which make contact at all times and under all conditions, and one which breaks the circuit rapidly and with equal certainty, simply by the turn of a handle, leaving nothing to the possible carelessness of the operator.

The manufacturers of the well-known Hart switch, recognizing the present requirements as to quality in all the details of construction, are bringing out a new line of switches which seem to embody all the essential features of a good switch. The flush switch illustrated in the accompanying engravings is a sample of the new line. This switch, in addition to heavy and durable mechanism and contacts calculated to stand severe service, is also "indicating." When the switch is "ON" the handle stands as shown in Fig. 1, and at right angles to that position when the switch is "OFF," the movement of the handle being continuously to the right by quarter-turns, with no possibility of its stopping in any intermediate position. The handles of all the switches of the same capacity are interchangeable without affecting the indicating feature. The same rule applies to switches in gangs. The handles are of the self-adjusting type heretofore used on Hart switches.

Fig. 2 shows the ten-ampere double-pole switch with finished face-plate removed, showing the mechanism and contacts enclosed by the base, which is one piece of porcelain. This base is provided with channels for the wire, the bared ends of which are clamped under binding screws, accessible from the face of the switch after it is put in position in the wall. This feature greatly facilitates the installation of the switch, and especially of switches in gangs. Any switch in a gang may be connected up or disconnected and removed without disturbing the others.

Fig. 3 shows the type of contact used. Each binding post is provided with a pair of spring bronze clips, c. Each end of the switch plate, B, is carried between a pair of these clips by the strong and instantaneous action of the switch mechanism. The connection thus made is practically perfect. The double-pole switches are double-pole, double-break and double-contact. Single switches and gangs of all sizes are carried in stock, with face-plates of any of the standard finishes. Any special finish can be furnished promptly.

A line of iron wall frames, and iron switch boxes for use with iron armored conduit, is also provided. No flush switch should be placed in a plastered wall without the use of such frame or box, or, its equivalent, to provide a secure attachment for the switch and to prevent the plaster from crumbling around the edges of the opening.

The Hart & Hegeman Manufacturing Co. feel that in producing this new line of flush switches they are taking one more step in the right direction, viz., the maintenance of and improvement in the former good construction of the "Hart Switch," and they are confident that the already large number of users of that switch will be increased.

"MASCOT" DRY BATTERIES.

THE first dry cell that attracted any attention in this country was the "Gassner" and a few thousand cells of that type were imported and sold at a very high price. The enterprising house of J. H. Bunnell & Co., with its usual foresight, believing that an efficient dry cell would find a ready sale, promptly put one on the market and they are, undoubtedly, the pioneers in bringing out the first practical, American made, dry battery.

The excellence of this battery, together with the able manner in which it was handled, soon made it an acknowledged commercial success. Notwithstanding the fact that it was handicapped with a heavy royalty, the Bunnell & Co.'s battery, on account of its acknowledged superiority, has continued in the lead and its sales are estimated to have reached about a million cells.

Messrs. Bunnell & Co. have recently extended and improved the facilities for making their "Mascot" dry cells, and the quality of these cells is guaranteed to be the best for strength, durability and recuperating powers; and the low price at which they are now being quoted would seem to justify the prediction that their Mascot Dry Cell will soon supersede wet cells for all open circuit work.

McEWEN ENGINES AND THOMPSON-RYAN DYNAMOS.

The McEwen Engine Company, of Ridgeway, Pa., have recently installed two 75-kilowatt Thompson-Ryan generators direct connected to two 14 x 15 center crank McEwen engines, in the Cambridge Springs Sanitarium, Cambridge, Crawford County, Pa. They have also furnished for the Hart Memorial Library, at Troy, N. Y., a 30-kilowatt direct connected plant.

Among the railway plants recently installed is one for the city power house of the Ithaca (N. Y.) Street Railway Company. The engine is a tandem compound condensing, 12½ x 25 x 20 inch stroke. The McEwen Works are busy on numerous orders.

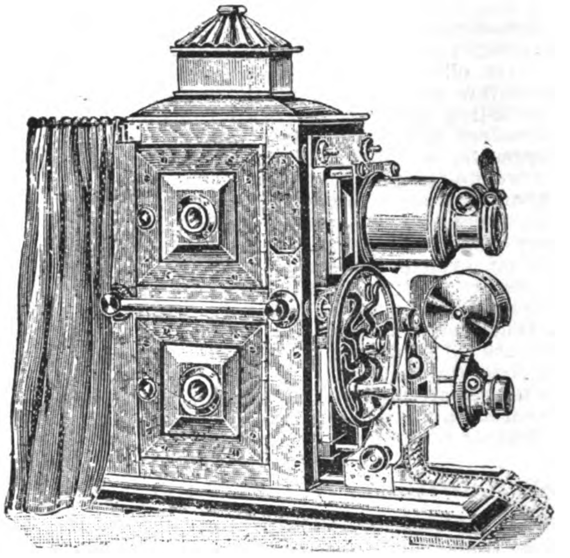
WHAT ELECTRIC ELEVATORS WILL CARRY.

It is recorded of the Sprague electric elevators in the Siegel-Cooper "Big Store," that the ten main passenger elevators averaged during the opening week 100,000 passengers, making 2,500 round trips, or a total of 94½ car miles per day. The plant was barely ready at the time, but there were no mishaps. The record is, it is said, without an equal.

THE MONARCH PROJECTING LANTERN AND KINEOPTOSCOPE.

Messrs. Riley Bros., 16 Beekman street, New York, are having a very satisfactory demand for their stereopticon magic lanterns, especially their Monarch double-projecting lanterns with kineoptoscope attachment, as shown in accompanying engraving. The kineoptoscope attachment is a most ingenious invention. In connection with the stereopticon animated photographs, living and moving pictures, in fact, every movement of actual life is depicted on the screens. The Edison standard films can be used in this apparatus, which is so well constructed as to allow the films to pass through freely without the least danger of injury.

The double apparatus here illustrated will take any ordinary lantern slide and is largely in use now for illustrating lectures, curtain effects, etc. The lower part of the stereopticon is used as the animated picture part and the top for throwing on the titles of films, etc. Experience has shown that Messrs. Riley Bros.' hand-feed electric lamp is the best and cheapest to operate in connection with their apparatus.



The Riley "Monarch" Projecting Lantern and Kineoptoscope.

It is light, portable and simple, taking, it is claimed, only one-tenth of the time required for getting ready lime light apparatus. By means of an adjustable rheostat it can be adjusted for from 500 to 2,000 candle power.

Messrs. Riley Bros. carry a large and full line of stereopticons, magic lanterns, lantern slides, films and all accessories. They have agencies established in many cities of the United States. Catalogues of their goods will be mailed to any address on application.

THE WATERBURY FINE-WIRE DRAWING MACHINE.

AMONG the many interesting exhibits shown in operation at the recent 25th anniversary of the Stevens Institute of Technology, was a fine wire drawing machine manufactured by the Waterbury Machine Company, of Waterbury, Conn.

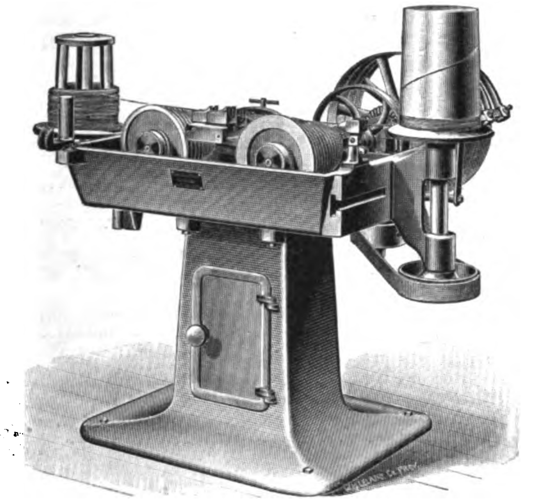
This machine, illustrated in the accompanying engraving, was designed by Mr. W. D. Pierson, a Stevens graduate, and is intended for drawing wire from No. 14 to No. 40 B. & S. gauge. Starting at No. 14 with copper or brass wire, the machine will draw continuously to No. 26, and from 26 to No. 40. With iron or steel wire the start is at No. 18 and the wire is drawn continuously to No. 30. The machine is also well adapted for drawing platinum, silver, solid and gold-plated wire. The machine will work ten dies or less, and both steel or diamond dies can be used, either separately or together, as preferred. The threading up is very simple, requiring but little time.

The wire being carried from the reel is passed through the first die, held in the die-holder between the drawing cones, and lapped once around the smallest step of the cone nearest the block, then carried back under the cones, then through the next die, and so on until the required number of dies are threaded.

The lubricating device is one of the principal features of the machine. The tank under the cones is filled with lubricant, and a centrifugal pump forces it through a hollow bracket and into the die-holders, which are provided with brass cocks to regulate the flow of liquid. In this way the dies are kept cool and clean, and the cones are also kept lubricated.

By means of adjusting screws in the several die boxes, the water is thrown against the inner surface of the die, keeping it clean and cool. The bracket which carries the block can be moved along so as to accommodate blocks of varying diameter, and also allowing the block to be driven in either direction.

The block is adjustable as to size and speed. Being driven by a belt from the underside, it can be run in either direction and at any speed. The drawing cone nearer the block is composed of sections securely keyed to the shaft, and each portion of these sections which is subject to wear and on which the wire runs, is covered with a hardened steel ring. This desirable feature is a recent improvement. The other cone is composed of sheaves revolving loosely on the shaft, the speed being governed by the travel of the wire.



THE WATERBURY FINE-WIRE DRAWING MACHINE.

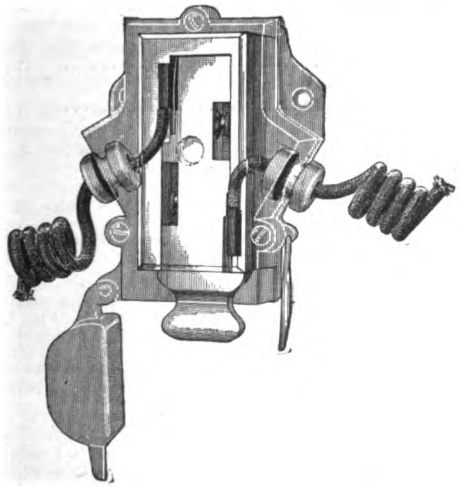
As a matter of convenience for the operator, the machine is geared so that for whatever size block is used, by putting that same diameter pulley on the vertical block shaft, the speed of the block will always be correct.

In the construction of this machine special attention was devoted to making it strong and rigid, as well as convenient to handle, and a workman can operate a number of these machines at the same time. The gears are all cut and the bearings babbitted, the best metal being used. The machine is provided with tight and loose pulleys 18 inches diameter and 4 inches face.

The Waterbury Machine Co., also manufacture a variety of other continuous wire drawing machinery both for large and small sizes.

FRANCE & JONES FUSE BOX.

MANY engineers and central station managers, and especially those who have had experience with high potentials, condemn the use of double-pole fuse boxes, on account of the possibility of short circuits; also the use of fuse boxes attached to transformers on account of the possibility of short circuits across the frame of the transformer, thereby throwing a whole section out of service until trouble is located, but are now recommending the use of dummy transformers protected by single-pole fuse boxes, separate from the transformer, and also the protection of each main by single-pole boxes.



FRANCE AND JONES FUSE BOX.

As in this case, trouble will locate itself, and to meet the above requirements Messrs. France & Jones, of Tacony, Pa., have placed upon the market a new fuse box, which has many advantages. All terminals are encased and held in position by grooves in the porcelain, thereby doing away with the screws, which often become loose and give trouble, such as short circuits, loose terminals, etc. This way of holding the terminals also avoids the necessity of having holes through the porcelain for the screws to pass through, which, in many cases, are the cause of short circuits and leaks through the frame of the box.

As shown in the accompanying illustrations, the leading-in wires pass in through porcelain bushings and are soldered to the terminals, avoiding all trouble from loose connections. The construction of the plug is such that it is impossible to arc from terminal to terminal through the blowing of a fuse. To replace a fuse it is not necessary to handle the box. As the small wire or catch on the right is pushed to one side, the lid drops, and the handle of the plug is exposed and can be pulled, the fuse renewed and plug returned to the box.

ADVERTISERS' HINTS

THE CONOVER MANUFACTURING COMPANY, 26 Cortlandt street, New York, have recently installed their apparatus in the Dorchester station of the West End Street Railway Company, Boston. They state their condenser is the only one sold under a duty guarantee.

F. N. ROEHRICH & CO., 108 Fulton street, New York, make a specialty of designing manufacturing plants and special machinery and are at all times pleased to enter into correspondence with interested parties.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., recommend Dixon's traction belt dressing as the best thing for slipping belts and preserving the life of the leather.

THE LINK BELT ENGINEERING COMPANY, Nicetown, Philadelphia, supply all classes of link-belt machinery, including coal and ashes handling plants, elevators and conveyors.

DIEHL MANUFACTURING COMPANY have opened an office at 192-194 Van Buren street, Chicago.

THE CONNECTICUT PIPE MANUFACTURING COMPANY, West Haven, Conn., state they are the original patentees and manufacturers of cement-lined ducts. They contract for the complete engineering and laying of subways.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., are advertising their well-known alternating current ceiling fans and fan motors made in a variety of styles and to suit all voltages.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, are just now directing attention to their stock of railway supplies and specialties.

THE COX THERMO-ELECTRIC COMPANY, LTD., St. Albans, England, whose laboratory was recently destroyed by fire, have already secured temporary quarters and will receive orders for their generators, subject to delay.

HARVEY HUBBELL, 33 Organ street, Bridgeport, Conn., is manufacturing improved tapping machines, screws and machine screws for electrical purposes.

THE EDISON MANUFACTURING COMPANY, 110 East Twenty-third street, New York, furnish special X-ray plates for radiographs.

M. T. HORN, 42 Dey street, New York, furnishes metal tubing seamless or brazed for electrical and scientific purposes. Any size to order.

J. H. BUNNELL & CO., 76 Cortlandt street, New York, are furnishing the "Mascot" dry battery at 50 cents per cell.

A. W. FRANCE, Tacony, Pa., is selling a fuse box which, he says, cannot arc from terminal to terminal or from porcelain to case.

J. G. BIDDLE, 906 Drexel Building, Philadelphia, Pa., is introducing the "W-S" X-ray machine.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., have brought out another line of flush switches. They are "indicating," wired from the front, are encased in porcelain and have self-adjusting handle.

THE BELKNAP MOTOR CO., Portland, Me., are advertising the Chapman voltage regulator for controlling the voltage of varying speed dynamos. It is an automatic device, magnetically controlled, by which a variation of 25 to 50 per cent.

in speed of water wheel or engine is brought within 2 per cent. of the normal.

NEW YORK NOTES.

THE STANDARD AIR-BRAKE COMPANY, New York, reports good business for March, and in addition to deliveries at home, secured several good orders from abroad, including one by cable for air brakes for the British Colonies.

E. J. WARING, 136 Liberty street, reports doing a good trade. His "Daylight" electric desk lamps are giving satisfaction wherever placed, resulting in many duplicate orders. Mr. Waring will be pleased to mail price list, etc., to any address on application.

EDWARDS & CO., 144th street and Fourth avenue, New York, have recently installed a 24-inch motor gong of their make on the end of the pier, foot of East Twenty-third street, New York, for the Greenpoint Ferry Company. It is to be used as a fog bell. It is giving first-class satisfaction. Messrs. Edwards & Co., report orders for their bells from several other companies.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has declared a regular quarterly dividend of 1¾ per cent. upon its preferred stock.

PETERKIN & PETERSEN, electricians, Niagara Falls, N. Y., are bringing out a new cell which they call the Electric City battery. They are exhibiting in their show window the Brunell third-rail street car system.

THE GOODYEAR VULCANITE CO., 353 Broadway, New York, manufacture and carry a full line of hard rubber goods of almost every description suitable for electrical purposes. Their immense factory in New Jersey is kept busy full time and is equipped to fill any special order at shortest notice. The Goodyear Vulcanite Company solicit correspondence regarding their lines.

WESTERN NOTES

THE ELECTRIC APPLIANCE COMPANY advise their customers, and the electric railway trade generally, that they have made arrangements with the Ohio Brass Company to carry a complete line of their railway specialties in Chicago stock. The electric railway trade will undoubtedly appreciate the advantage of being able to send large or small orders for the celebrated Ohio Brass Company's specialties, and have the goods shipped from Chicago on the day the order is received. Both the Ohio Brass Company and the Electric Appliance Company hope this arrangement will be appreciated by the users of electric railway material.

MR. J. N. BROWNLEE, of Brownlee & Co., the large producers of poles for electrical purposes, has been in New York on an Eastern business trip. He reports business as good not only in poles but in cross arms, for which there has been a very large demand.

MR. S. C. Dyke, of the Brunt and Thompson Manufacturing Company, of East Liverpool, O., was in the city last week, and stated he was making a little trip among the chief Eastern cities. Mr. Dyke reports that there has been an unprecedented demand for their new regulating socket, and that they have hard work to keep up with their orders.

THE FOREST CITY ELECTRIC COMPANY, Cleveland, O., have issued a very pretty circular, with cover, relative to their roll drop and drop forged commutator bars. It mentions nearly 50 concerns whose style of bars it makes and quotes warm testimonials from a great many others, such as operating street railway and lighting companies and repair concerns. The indorsements could not well be stronger in regard to this very useful specialty.

CONOVER-GOE COMPANY, Monadnock Building, Chicago, have issued a pocket kinetoscopic reproduction of the great prize fight. It is full of go, and one can con over the whole affair quietly and at leisure by running his eye across its nimble pages. The number of copies given out is necessarily limited.

THE ROYAL ELECTRIC COMPANY, of Peoria, have just issued another edition of their pamphlet entitled "Facts Worth Considering." This pamphlet contains useful information for central station owners, and will be mailed to all who desire a copy.

THE NOWOTNY ELECTRIC COMPANY, of Cincinnati, have on exhibition at 36 Dey street, New York, some of their new long-burning improved arc lamps, which can be used on either constant current or constant potential circuits. Mr. L. R. Keck, president of the company, was in New York for a few days last week introducing these lamps to the trade.

NEW ENGLAND NOTES

THE AMERICAN CIRCULAR LOOM COMPANY, of Boston, have opened a branch office for the sale of their well-known flexible conduit at 27 Thames street, New York, and have installed Mr. H. B. Kirkland as manager. Mr. Kirkland has been for years associated with Mr. C. D. Doubleday, is thoroughly familiar with the conduit business, and is so well and favorably known to the trade that he requires no introduction here.

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The Electrical Engineer.

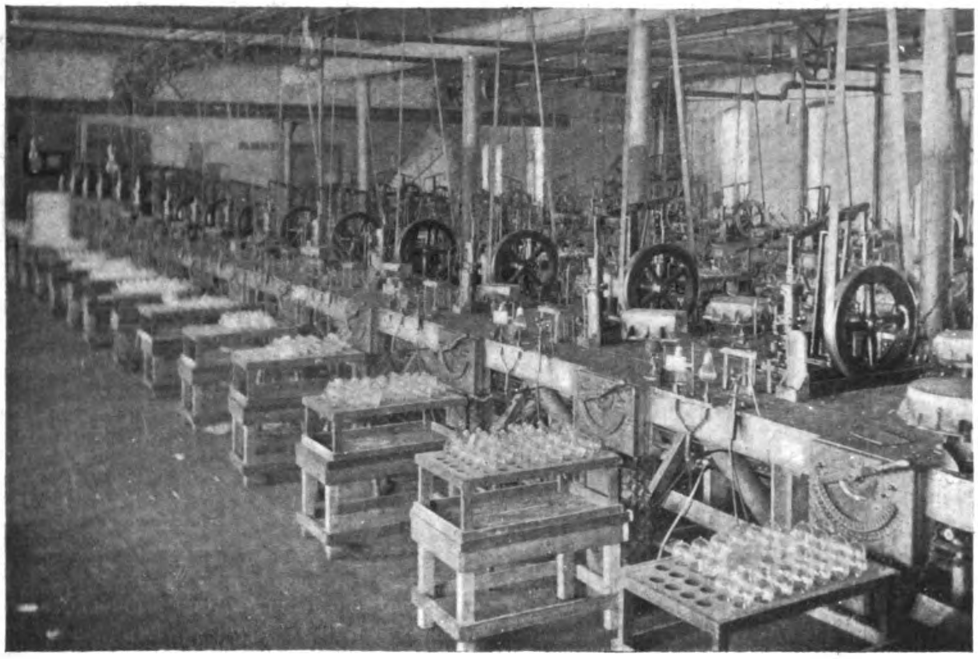
Vol. XXIII. MARCH 31, 1897. No. 465.

ELECTRIC LIGHTING

EXHAUSTING LAMPS BY THE "CHEMICAL" METHOD AT THE EDISON LAMP WORKS.

THE exhaustion of incandescent electric lamps has up to the present been almost universally done upon mercury pumps. Two classes of pumps have been generally used, the Geissler, and the Sprengel pump. The Geissler pumps have always been made of quite large capacity, and the lamps have been placed upon the pumps in groups, usually of about a dozen, all of which were exhausted together, and to all of which a current was applied at the same time, and under the same conditions.

The engineers of the General Electric Company's Edison lamp works have always advocated the use of the Sprengel pumps, rather than the Geissler pumps, because they can be made of such small size, that each lamp can be advantageously placed upon a separate pump and exhausted independently of any other. The advantages of this system are, that a leak in any lamp affects no other lamp and is readily detected by the failure of one pump to get a high vacuum, and the breakage of any lamp, in any way, during the process of exhaustion, does not interfere with any other lamp.



New Chemical Process of Exhausting Incandescent Lamps. View in Exhausting Department, Edison Lamp Works, Harrison, N. J.

From time to time during recent years, mechanical vacuum pumps operated without mercury, have been brought before the public, and while the engineers of the General Electric Company have fully appreciated the advantages of such pumps, they have been prevented from adopting any of them, owing to the large size in which these pumps have invariably been made, the object of their inventors being to exhaust a very large number of lamps at the same time, which the General Electric Company's engineers have always considered bad practice.

Recently this company succeeded in obtaining a small mechanical vacuum pump, whose rate of exhaustion is such that it can practically be employed to exhaust only one lamp at a time. Experiments were begun with these pumps about a year and a half ago. These early experiments showed that lamps could be exhausted to a degree much nearer perfection than by any previous method employed, as the various phenomena of exhaustion are clearly marked so as to enable a very definite rule of operation to be worked out. Lamps exhausted by the new process when compared with those exhausted on mercury pumps, have proved to be superior to them in every respect, including length of life and ability to maintain their initial candle power during their life.

The success of these early experiments led to the rapid introduction of these small pumps, so that now nearly the entire product of the Edison Lamp Works is exhausted by them. A large number of these pumps have been in operation several months and are very satisfactory. One aisle of the new pump room of the lamp works is shown in the accompanying illustration. The pumps are arranged in rows, as shown. Each pump has two cylinders, each employé using one cylinder only.

The final perfection of the vacuum, however, is not obtained by the pump unaided. The natural residual gases in an incandescent lamp may be called conducting gases, as they allow currents to pass through them from one leg of the filament to the other.[1] By any other method than the one we are now describing, the last traces of these gases are very hard to remove from the lamp, and are very injurious if not entirely removed. Their removal requires a long time on the mercury pumps generally used. By the new method, usually called the chemical exhaustion, when a pump has taken out all but the residual gases, a gas capable of combining with these residual gases, is introduced into the bulb. Previous to this introduction, the bulb, while the carbon is at a high degree of incandescence, is filled with a sort of blue glow; shortly after the introduction of the gases, and while the carbon is still at a high degree of incandescence, the blue glow suddenly disappears, indicating that a combination has taken place between the natural residual gases, and the introduced gas. When this combination takes place the lamp is ready to be sealed off, and the vacuous space is found to be in a thoroughly insulating condition. The advantages of this method of exhaustion are:

First: The phenomenon of the introduced gas combining with the residual gases, and thus perfecting the exhaustion, is so marked as to make the perfection in each lamp more certain than by the old method.

Second: Lamps are exhausted one at a time, and the whole attention of the operator is given to each lamp, insuring the proper manipulation and application of the electric current, and the final perfection of the vacuum in each lamp, which is so difficult to get in lamps which are exhausted in groups.

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[1] See the paper read by Mr. John W. Howell before the A. I. E. E., Elec. Engr., March 17 and 24.

Third: The operator does the work sitting in a comfortable position, does not get tired, and can do as careful and accurate work late in the afternoon as early in the day, which is not the case in systems in which the operators are obliged to stand while doing their work.

Fourth: The lamps are conveniently arranged by the side of the operator, and get the least possible amount of handling. This fact alone saves considerable breakage.

Fifth: The injurious effects of mercury upon the health of the operators are entirely avoided.

It is gratifying to find that a new method has been discovered which results in a much greater degree of certainty of duplicating results in the pump room, thus removing one of the most serious obstacles in the past to greatly advancing the average quality of lamps and the consequent general improvement in incandescent lighting.

THE ISOLATED PLANT AT THE HILLSIDE HOME, SCRANTON, PA.

BY H. B. COHO.

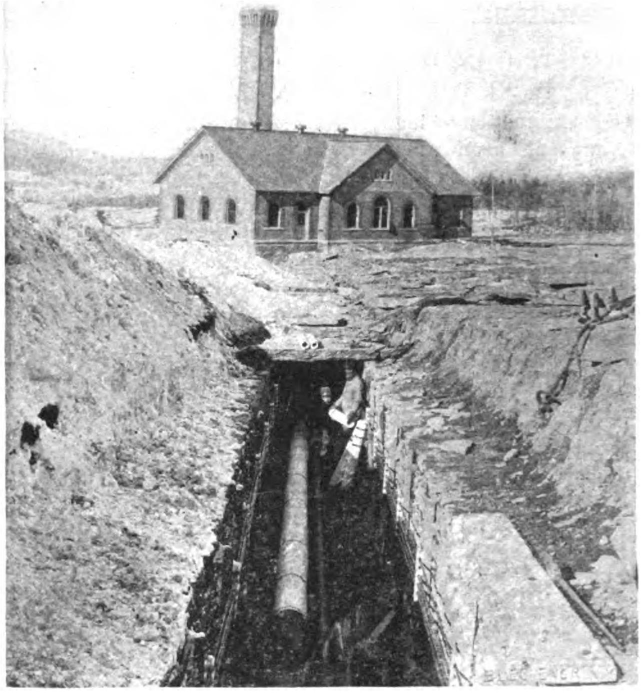
Mrs. Frances B. Swan.

In view of the deep interest of The Electrical Engineer in the success of isolated electric lighting plants, and of the fact that a plant which my firm has recently had the honor of installing embodies many noteworthy features, I venture to give a few details, such as the readers of an electrical journal would like to know. The success of such a plant as the one I propose to describe briefly, is, of course, an argument for the installation of other like plants; and when one sees the direct good and benefit resulting to those who are subjected to the new conditions thus introduced by electricity, one learns the importance of many features quite outside of commercial considerations. It has been said that a new thing to be successful must be a luxury and be taken up by the rich. My own observation goes to show that the rapid introduction and success of the electric light is largely due to its merits being proved in the numerous isolated plants installed in asylums and public institutions of all kinds, where intelligent charity has gathered together the old, the poor, the insane, and the generally lower elements of society. In such places, electricity has shown itself to be a boon of the first magnitude.

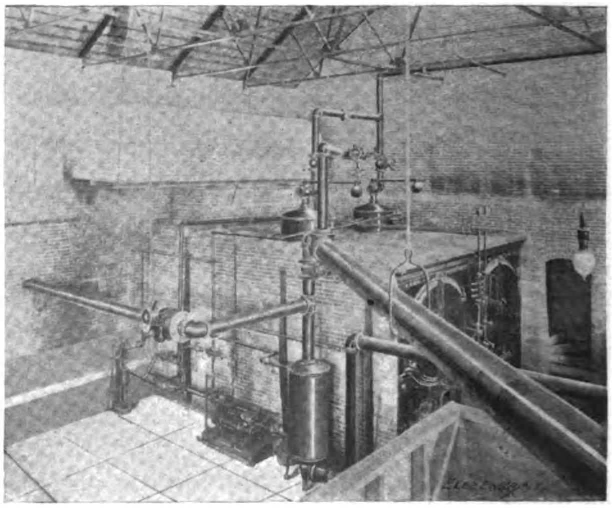
When the question of equipping the Hillside Home at Scranton, Pa., with electric light first came up, the board of directors, consisting of Mrs. Frances B. Swan, Messrs. Fuller, Dr. Payne, Murphy, Langstaff, Shotten and Terpie, discussed the question from a permanent investment standpoint, and appointed Messrs. Fuller, Payne, Langstaff and Mrs. Swan, a committee to investigate the various forms of electrical equipment and to purchase that which in their judgment proved the most desirable. Mrs. Swan, whose picture is here shown, was chosen chairman of the committee, and, although it is not a part of our report, it may be of interest to Engineer readers to know that at this time Mrs. Swan was the only lady Poor Director in the State of Pennsylvania and had served five years. Hence her selection as chairman was not made in polite deference to her as a woman, but because she was a director of long experience and exceptional judgment. Mrs. Swan, with Messrs. Payne and Langstaff, visited New York on one of our hottest days last summer, and she was the most energetic of the party in going from one torrid engine room to another. The contract was finally awarded to Messrs. H. B. Coho & Co., who designed and laid out the electric plant, as described further on.

THE INSTITUTION.

Before going into the details of the electric plant proper, it may be well to describe the situation of the institution and give a short history of its existence. Hillside Home of the Scranton Poor District is situated two miles from Clark's Summit, Pa., and was established by legislation April 9, 1862. At that time the town of Scranton was a mere village compared to its generous extent and growth to-day. On July 23, 1862, the first pauper was received, and on Jan. 19, 1863, the first insane patient. The first building was a small two-story frame building still extant. From this modest beginning the present magnificent structure has grown, and the superintendent, Mr. George W. Beemer, is responsible to-day for the welfare of five hundred people, while the property is valued at $500,000. This increase in the number of paupers and insane is in proportion to the population, but to my mind it would seem to indicate that in these advanced days our less fortunate fellows are cared for with so much greater care, that the skeletons of many families are no longer concealed in closets, but in our well-run and humane institutions. I desire to say here that although I spent many days on the premises while supervising all parts of the installation, I never saw a patient treated with anything but the utmost consideration, that being the main principle of Mr. Beemer's method, and one in which he is ably assisted by Mrs. Beemer, the matron, and Dr. Strang, the resident physician.

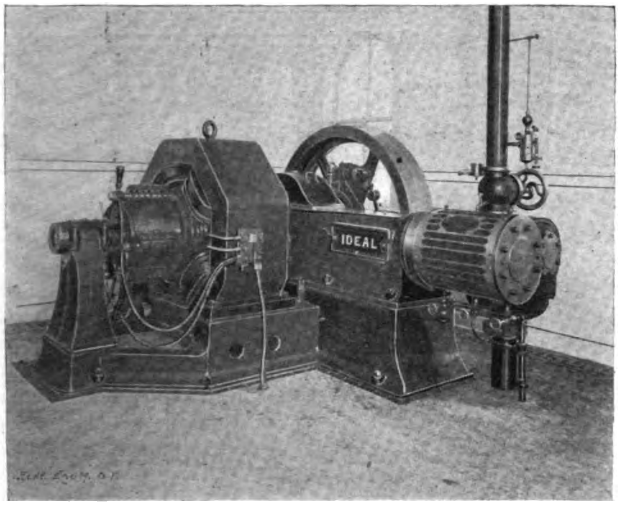


Electric Light and Power Station, with Subway, Hillside Home, Scranton, Pa.



Boiler Room, Hillside Home, Scranton.

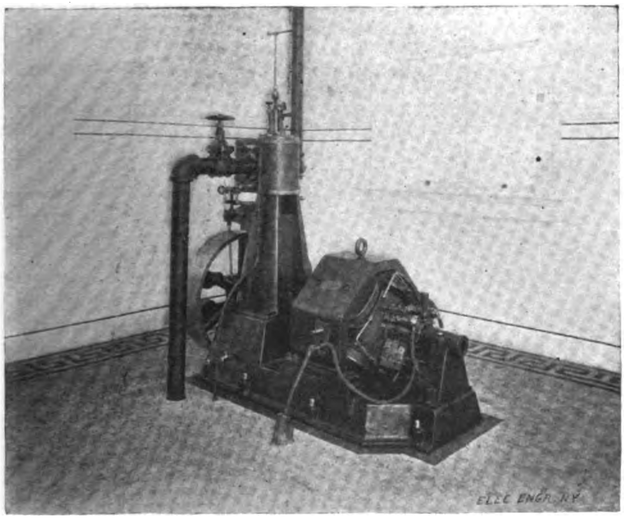
The benefit of the electric light to the patients is well stated in Dr. Strang's report to the directors, and from which I quote as follows: "The effect on the patients, when the change from oil lamps and gasoline was affected, was magical, and now in the evenings these poor unfortunates resort to games and music instead of sitting around moodily until ordered to bed. The improved ventilation, by means of electric fans, is also of tremendous advantage, and I venture to say that not only has your board of directors made a wise investment in your electric plant, but you have also improved the condition of the patients a hundred per cent." As will be seen from the above, the doctor believes in electricity; and I now go on to give a detailed description of the plant.



Large Lighting Unit, Hillside Home.

STEAM AND ELECTRICAL EQUIPMENT.

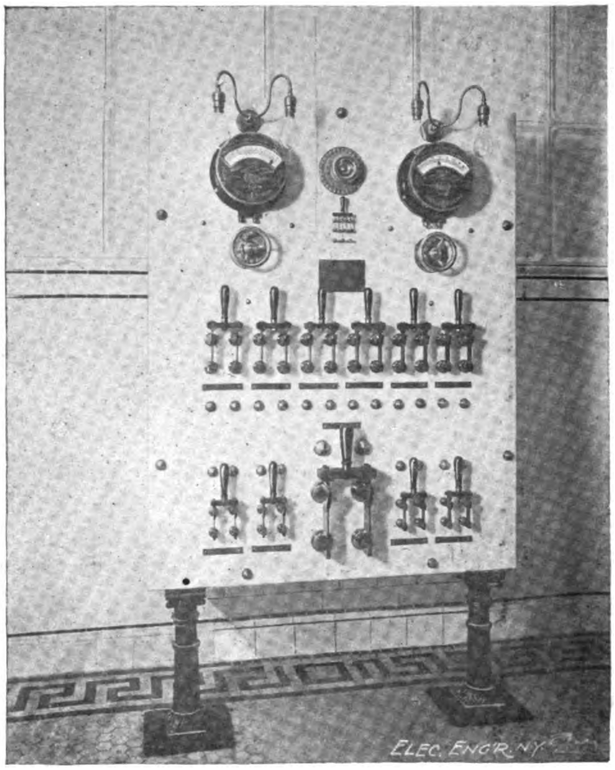
In describing the electrical equipment of the Hillside Home, I will first take up the generating plant. It consists of two Oswego boilers of 100 horse power each, one 14 x 14 Ideal engine, and 75-kilowatt Eddy dynamo directly connected, and one 6 x 8 Shepherd engine and 15-kilowatt Eddy dynamo directly connected. The large unit is used from the time the light is required in the evening until the heavy load is over for the night, when the little machine is started and run for the balance of the night, and during the day. The method of wiring will be described later. A special word may be given to the flue of the boilers, as is shown in the engraving. The flue is made entirely of brick, supported by iron girders, and so constructed that a return draft is effected, and this in connection with the fine stack, makes the finest natural draft I have ever seen. The damper is of the ordinary butterfly type controlled by a damper regulator and so perfect is the regulation that all the operator has to do is to keep his fire going and see that the pump keeps the proper amount of water in the boilers. Another fine feature of the boiler plant consists of its McClave grate bars. These grates enable the fireman to clean one-quarter of his fire at a time and an ordinary fireman can clean his fires without losing a pound of steam.



Small Lighting Unit, Hillside Home.

Besides the damper regulator, the plant is supplied with a Snow steam pump, a Metropolitan injector and a National feed water heater. The boilers are supplied with water from a cistern placed under the machine shop floor. This cistern is supplied from a spring, which the foresight of Mr. Beemer, the superintendent, led him to buy some years before. By this act of foresight, Mr. Beemer is independent of his driven well, and has a double supply of water always on hand.

The finish of the engine and boiler rooms is of the best, the engine room being tiled with white tiles. The mains from dynamo to switchboard are laid under the floor and the main steam pipe is the only overhead work in the engine room. The switchboard shown in the picture is of white marble and is extremely complete. Each switch controls a building, and in addition, there is an independent night circuit, which by the means of two switches is thrown on or off either machine. This arrangement gives the engineer control at all times, and at a certain hour of the night enables him to turn out all but those lights which it is necessary should burn all night. While on the subject of night lights, let me point out what an advantage this is in itself. Under the old methods the attendants were obliged to use lanterns and were constantly at the mercy of some unbalanced patient, with consequent risk of fire.



Switchboard, Hillside Home Electric Light Plant.

ELECTRICAL WIRING.

The object in view in designing all the wiring has been to conceal everything, and in so far as possible, keep all the lights out of the reach of patients. To accomplish this, a form of picture molding was used in the wards. The molding resembles an ordinary picture mold, and at the same time is used as such. The effect of this is shown in the cut and is decidedly pleasing. Where it was not practical to run molding, the walls were chiselled and the wires placed in iron conduit and run to the middle of the rooms, the rooms being lighted by clusters placed close to the ceilings and protected by heavy opaque glass globes.

The wires are all run to junction boxes, and each circuit is fused and controlled by a baby knife switch. Two sets of risers are run on each side of the building, one for main load and one for night circuits.

The increased protection against fire in this installation is very marked, each branch circuit being fused, each ward being fused, and each riser, besides the main switchboard fuse, thus making four sets of fuses from lamps to dynamos.

MAINS.

The mains from the power house to the various buildings are run in a trench, as shown in the picture. The tunnel is 800 feet long, 5 feet wide and 6 feet deep. It was dug and walled in by the inmates, under the directions of the superintendent. The mains are run with positive wires on one side and negative on the other. The wires were placed on insulating knobs and are readily accessible at any time.

STEAM HEATING.

The old steam plant has been done away with and a 10-inch main run up the tunnel intd which all the exhausts are run. By this method, in all except extreme cold weather, they are enabled to heat the buildings with only the exhaust. All the returns are run into a tank and are pumped back into the boiler.

MOTORS.

Motors are used to run the laundry and the pumps and have also been used for threshing. They are also used for ventilating purposes. The idea in mind all the time, has been to make one central power house, and the result of this is shown by the fact that the coal saving alone is at the rate of over $3,000 per year.

CORRIDOR IN HOME, WITH LIGHTS FROM MOULDING, OUT OF REACH.

From the above facts, the electrical installation at Hillside Home will be seen to do two things. It saves the county 10 per cent. on the old style of lighting and at the same time they are getting 200 per cent. more light. In addition, the comfort, health and security of the unfortunate charges has been increased beyond all measure, so that I may claim that in this case electricity has proved both a financial success and a physical and mental healer.

HARVESTING ICE UNDER THE ELECTRIC LIGHT.

KINGAN & CO., Ltd., the pork and beef packers of Indianapolis Ind., write us: "As you well know, the harvesting of ice is something that must be done in a very limited space of time, and it becomes necessary for us to work night and day. For this reason, we have resorted during the past winter to the use of electric lights. We had intended sending out a dynamo from our packing house and running it directly from our power engines operating our elevator. But, finding that the neighboring park at Broad Ripple had a plant which was not in use at this time of year, we started it up for them. We ran wires to the ice houses along our runs and elevators and also out on to the ice, using arc lights. This has been done by so many people that we cannot claim any novelty for it, but we can cordially recommend the use of electricity for this work, as it enabled us to cut and store ice almost as well by night as we did during the day. The lights or wires in the ice houses are permanent; we simply disconnect the lamps and carry them from one house to another as each fills up. With regard to work out on the ice fields, we string our wires on a movable frame, which is pushed around as our cutting advances from point to point."

ROENTGEN RAYS

AN APPLIANCE FOR SECURING PROPER RADIOGRAPHS OF FRACTURES ABOUT THE ELBOW JOINT.

BY FRANCIS S. KOLLE, M. D.

TO secure perfect and satisfactory radiograms of the elbow joint is a difficult task, especially when the joint is swollen and painful and the patient unable to extend the forearm. In children especially have I found it difficult to obtain a good negative, where the mere suggestion of straightening the arm caused so much fear of pain, that the attempt to optain any picture had to be abandoned. Not until lately have I secured the desired results.

My work in this direction has been stimulated by the failures of other radiographers, to produce the necessary and important results, confirming either dislocation or fracture about the joint in reference. The usual radiograms are made in the semi-extended or practically the lateral angular splint position, where the palm of the hand faces the film of the dry plate.

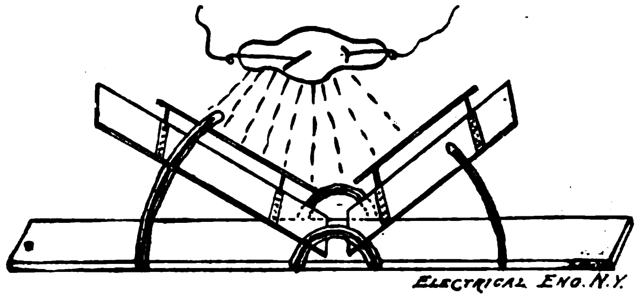


FIG. 1.—KOLLE'S FRAME FOR TAKING RADIOGRAPHS OF JOINTS.

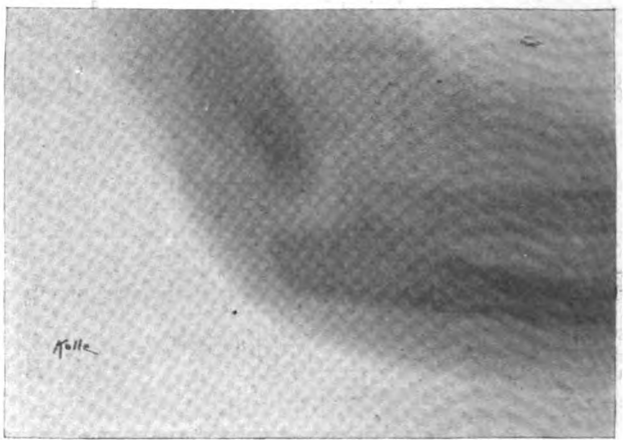


FIG. 2.—RADIOGRAPH TAKEN FROM THE SIDE, SHOWING NO FRACTURE.

That a picture taken in such a way will not show the proper relation of the articulation of the bones with each other is self-evident, and a fracture of either condyles is only brought out by an over-exposure, wherein the larger bones have been rendered transparent or penetrated sufficiently to leave shadows corresponding to the piece of displaced bone or fragment. That this is not only true of the elbow joint can be readily imagined, as fractures about the ankle and wrist joints would give the same results. No one would think of taking a radiogram of the wrist joint from a lateral point of view, if a fracture of one of the bones making up that joint was presented, and yet a number of failures to locate fractures or to diagnose dislocations have been recorded, only because the operator failed to consider the anatomy of the subject in hand. What is necessary is to make a picture of the joint in such a way that the entire joint is exposed, and that is in the antero-posterior position. Not only is the relation of the bones making up the joint shown, but a fracture or displacement of the fragments in such is readily demonstrated.

That there are certain conditions in which a lateral view is necessary, I do not dispute—a knowledge of the anatomy, making up the bony skeleton of such parts will, of course, assist the radiographer in these cases.

Now, it will be asked, How can one secure an antero-posterior view of an angulated or fixed joint, assuming that the patient cannot extend the arm? The answer is this: "Use two plates, bandaged to the posterior surface of the arm in such a way that they will form an angle, corresponding to the angle of the semi-extended arm and overlapping one another."

To accomplish this and partially to avoid movement, I have devised the cradle illustrated in Fig. 1. It is composed of a base, containing two movable shelves of wood, moved in an upward direction, and so forming an angle with one another, and retained in position by the aid of thumb-screws. A sliding device is added to allow of the use of wider plates than the actual width of the shelves; these are also fixed like the former. The arm is laid within the cradle, the two movable pieces of wood are approximated and fixed into position, allowing the arm to rest easily within the angle so formed, and, if need be, the arm may be bandaged to the shelves, which is particularly advantageous with children. The plates are laid between the posterior surface of the arm and upon the shelves, overlapping one another slightly. The tube is placed as shown in the illustration. An exposure of 30 seconds in children is sufficient and one to two minutes in adults will give a good negative, using a 6 to 10-inch spark coil.

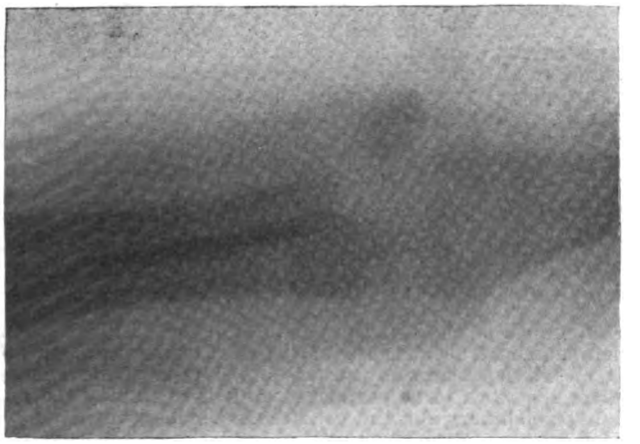


FIG. 3.—RADIOGRAPH TAKEN FROM FRONT, SHOWING DISTINCT FRACTURE.

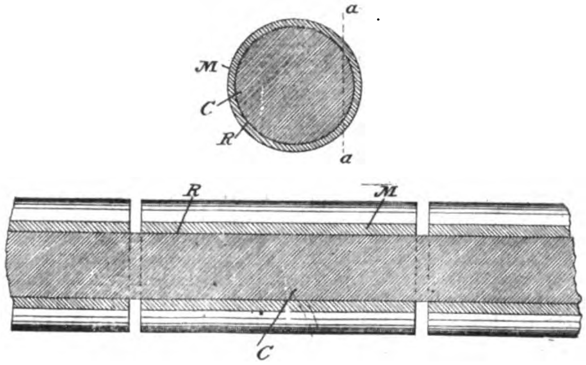
The prints made from the plates so obtained, are cut where the plates overlapped and are mounted upon the usual mount as one print. If the latter is neatly done, the finished picture will be both exact and reliable. The accompanying illustration, Fig. 3, is a radiograph made in the manner described, with a half-minute exposure and where previous pictures failed to show the fracture so plainly shown in this picture.

"THE TELEPHONE" is the name of a new electrical monthly, which is frankly anti-Bell and "independent" in its leanings. It is a clean, bright, well-printed paper, with Mr. W. R. Mackrille as editor. We confess we do not see any need for any more electrical papers, but each, whether old or new, must stand on its merits, and this the latest comer makes an excellent bid for patronage in a special department, being done in a thoroughly journalistic way. One of its items of news is that there is new material available for defeating the Berliner patent should it live after the Supreme Court gets through with it. The publication office is in Chicago.

TELEPHONY AND TELEGRAPHY

STONE'S COMPOUND TELEPHONE CONDUCTOR.

IT has long been observed in telegraphy that in many instances, owing to the relatively great electrostatic capacity and resistance of the conductors along which the variable telegraphic currents are transmitted, but a small portion of the current developed at the sending end of the line proceeds all the way to the distant or receiving station, and that, moreover, in such cases the current-waves which do reach the distant station are not of the same form as that in which they were when they set out on their journey from the transmitting end of the line. The first of these effects is termed "attenuation" and the second is termed "distortion." Attenuation and distortion, as might be expected, were found to be more pronounced in the case of submarine cables, and especially in the case of Atlantic cables, on account of their great length and relatively great electrostatic capacity. At a later date, when it was attempted to transmit telephonic currents over circuits of relatively great electrostatic capacity and resistance, attenuation and distortion were again observed and were found to be even more pronounced in the case of the rapidly varying telephonic currents than in the case of the more slowly variable telegraphic currents.



FIGS. 1 AND 2.—STONE'S COMPOUND TELEPHONE CONDUCTOR.

It has been determined, mathematically, that the evil effects of excessive distributed electrostatic capacity along circuits can be greatly reduced by the addition to the circuit of suitable distributed inductance or self-induction, and in order to apply this method Mr. John S. Stone has designed a novel type of compound wire, which he describes in a recent patent.

The manner of suppressing the evil effects of capacity involves giving the circuit suitable inductance. For the purpose of increasing the inductance of a conductor, Mr. Stone surrounds the wire with a cylinder of paramagnetic material, such as iron, M, Figs. 1 and 2, but in order to prevent the current from flowing along the surface of this iron cylinder, the inventor separates the iron cylinder from the copper core, C, by an insulating coating or film D. The resistance of this coating or film, owing to the longitudinal discontinuities of the sheath, need not be great. In fact, if the longitudinal discontinuities be sufficiently frequent a mere coating of the oxides of the metals will suffice. Further, in order to prevent the iron sheath from unduly increasing the effective electrostatic capacity of the circuit and for other reasons, Mr. Stone makes the iron cylinder discontinuous longitudinally.

The presence of one conductor in the neighborhood of another necessarily increases the electrostatic capacity of the latter, and to that extent the iron sheath surrounding the copper core increases the electrostatic capacity of the latter, but if the longitudinal sections be sufficiently small this increase in capacity will be the only resulting increase in capacity experienced. As far as this feature is concerned it is sufficient to make the longitudinal sections small compared to one-half of the wave-length of the electric current transmitted over the circuit. This latter condition is imposed by the fact that if the longitudinal sections of the sheath be as great or greater than one-half of the wave-length of the electric current to be transmitted over the core the individual sections of the sheath will have different portions simultaneously subjected to the extreme differences of potential of the positive and negative maxima of the waves, the effect of which on the current would be that of a spurious increase of electrostatic capacity.

The other conditions which demand the division of the sheath into relatively short longitudinal sections are relative to the prevention of the current from passing to the surface of the sheath, as already described, and these conditions are therefore closely allied with the insulation between the sheath and the core.

In order to prevent the current from passing to the sheath at one end of a section and returning to the core at the other end of the section, it is only necessary to make the impedance of the path via the sheath greater than that via the core. Of course this could be done with scarcely any film of high-resistance material between the core and the sheath if the sections were made sufficiently short, and it is advisable to make the longitudinal sections sufficiently short to materially assist in the operation of preventing the current from passing to the sheath.

TELEPHONE WAR AT KEOKUK, IA,

A dispatch from Keokuk says: Competition fierce and uncompromising in the telephone business is just at present playing havoc with the people of Keokuk and with the warring companies. The competitors for public patronage are the Iowa Telephone Company and the Mississippi Valley Telephone Company. The latter is a new concern, and its owner is J. C. Hubinger, a wealthy citizen of this town. Some time ago Mr. Hubinger opened a telephone exchange and cut the price in two. It was believed that he could drive the old company out of town, but thus far he has failed. The people hailed his advent with joy, but they discovered that when theory was put into practice theory was not always carried out. They found that to get complete service they were compelled to have both telephones in their houses, and thus paid the old price. But this was not all. The rival's wires are always crossing one another, and subscribers are always talking to people they don't desire to converse with. Then the two bells sound so much alike that one never knows what telephone is used. The old telephone company has evinced no disposition to buy the newcomer's plant, and the war rages with unspeakable dissatisfaction to all parties concerned. Mr. Hubinger is the proprietor of the electric light and power plant and of the street car lines of Keokuk. He intends to carry his telephone war into Burlington, Davenport, Quincy and Kansas City.

BELL TELEPHONE vs. WESTERN UNION IN NEW ENGLAND.

No better example of the competition the Western Union Telegraph Company is meeting from the American Bell Telephone Company can be found than the situation in and around Boston. It is not generally known that the New England Telephone Company is catering for local messages, which business has been exclusively within the control of the telegraph companies, but such is the fact. One can now call a pay station office in any of the Boston suburbs, and dictate a message over the telephone to the operator in charge, and the message will be delivered for fifteen to twenty-five cents, according to distance. The New England Telephone Company has had blanks prepared, similar to those used for telegrams, with a printed contract on same, for delivering such messages. It costs twenty-five cents to send a telegram limited to ten words, but there is no such limitation clause in the New England Telephone contract, and there are no such delays as in the case of telegrams, while the sender of such a dispatch by telephone can usually get a very prompt response.—Boston News Bureau.

PENALIZING DELAY OF A TELEPHONE MESSAGE.

A dispatch from Hopkinsville, Tenn., of March 15 says: Rev. J. C. Graves, a minister of this city, who recently brought suit against the Cumberland Telephone and Telegraph Company for damages for failure to promptly deliver a message, had his case decided in his favor in the Christian Circuit Court today, when a verdict for $50 damages was given him. It is the first case against the telephone company ever brought in court here, and the verdict was awaited with unusual interest.

THE AMERICAN BELL TELEPHONE net gain in instruments was 800 in the month ending February 20, and 1,199 since December 21.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—III.

BY JOSEPH APPLETON.

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APPLICATION AND USES IN GENERAL.

BROADLY speaking, the use of a storage battery is to accumulate electrical energy, when it can be generated cheaply, and to give it out at a time or place when the conditions are such that to produce it would be expensive or impossible. We will consider generally, in this chapter, the applications of the storage battery to various engineering problems, and later examine each in detail.

To obtain the best results with storage batteries in any service, one point must be rigidly observed, that is, to employ the proper type of cell for the work to be performed. In the early days of storage battery work this was ignored and many of the failures which have been recorded are traceable to this account.

In other branches of engineering infinite time and skill are expended in considering and selecting the type of apparatus most suited to the conditions. For example, high speed engines will not work efficiently at slow speed, and slow speed engines cannot be run at high speed, neither is each type equally suited to all conditions of service where efficiency and economy are properly considered. It is needless to mention more instances of this, yet in spite of the universal recognition of this principle in general engineering work, in the case of storage batteries, the general practice was to ignore it, and to consider a storage battery simply as a piece of apparatus to store up electrical energy, for any purpose, irrespective of the character of the work, the classification being nothing more than good, bad and indifferent, with very little of the first.

Modern practice has, however, changed this and it is at last understood that there are many types of cell, and that a cell which can run a phonograph, need not of necessity be the one which should be used for regulation on a trolley road; in fact, it is just as necessary to use the proper type of storage battery for the work to be performed as it is to employ the most suitable machinery for the conditions which govern the generating portion of the plant.

In isolated plants a storage battery performs the following functions:

1. To store up surplus energy, thereby keeping the plant operating at the most economical load.
2. To supply current when the generating plant is shut down.
3. To act as a regulator and a reservoir.

Take, for example, a plant in an office building or large dry goods store. A sufficient capacity in generating machinery must be kept in readiness to supply the maximum demand; this demand varies according to the conditions of the weather, state of business and other causes which are entirely outside the control of the engineer, who, in fact, receives no warning before his load is increased and sometimes doubled. Where a storage battery is installed the conditions are very different; less machinery is required and that which is used can be operated practically at full load and consequent maximum efficiency, the surplus energy over actual requirement being used for charging the battery. In the event of any increase in load, the current used for charging the battery is available, and in addition to this the battery will discharge and take care of a portion of the extra load. The amount of surplus energy thus stored up during the operation of the generating plant can be used to carry the load after the machinery is shut down.

It is found from actual experience, that where a storage battery is used in this way the fuel consumption is no more than when sufficient generating machinery is kept in readiness to meet any emergency, and therefore the energy stored during the day and used for carrying the load after the plant is shut down costs practically nothing.

Again where electric elevators are used, and they are coming into use more and more every day, a storage battery is an indispensable part of the equipment. The elevator takes from three to four times the energy to start that it takes to hoist, and this has to be provided for in the generating machinery, unless a battery is used. It is also impossible to operate elevators and furnish current to incandescent lamps from the same generator without a storage battery, as the fluctuations due to the starting of the elevator cause the lamps to burn unsteadily. In a plant of this description a storage battery of suitable capacity will reduce the generating machinery required about one-third, and, moreover, effect a great saving in operating expenses.

A different class of isolated plant is found in residence lighting, especially in country and suburban districts. Here the motive power may be either steam, water, gas or oil, the storage battery being used chiefly as a reservoir. The generating plant is run two or three times a week, or oftener, to charge the battery, the current for lighting being drawn entirely from the battery, except on special occasions, when all the lights are required and the total capacity of both generating plant and battery is needed. This is one of the cheapest possible methods of producing electricity, especially where water, gas, or oil is used as the motive power.

It is not generally known that by using a gas engine to run a dynamo three times the amount of light can be obtained from electric incandescent lamps than would be given by burning the gas direct. This is due to the fact that the gas contains more energy in the form of heat than illuminating power. An oil engine compares very favorably in cost with a gas engine, the cost per horse-power hour being a little less. Numerous instances where this class of installation is in successful operation will be given later.

While dealing with the question of isolated plants, it may be well to refer to a method of utilizing storage batteries which has repeatedly been put before the public in flattering terms; that is, to the delivery of electricity stored in batteries to consumers, in the same way that groceries and milk are delivered. This sounds very enticing and easy, but from the commercial point of view it is absurd, as the cost of hauling around the full and empty batteries, together with the contingent expenses of handling, greatly exceeds the cost of distributing electricity from a central station by means of conductors, while the cost of generating the current is practically the same in both cases, if anything favoring the direct distribution method.

In direct current central lighting stations, there are six ways in which storage batteries can be used to advantage, the relative value of each method depending on the conditions which obtain.

1. To carry the peak of the load.
2. To carry the entire load during periods of light demands.
3. To regulate pressure on the system.
4. To absorb surplus energy.
5. To act as a reservoir.
6. In sub-stations which form centers of distribution for sections which are too far away from the main station to be reached economically by the ordinary system.

In all central stations which generate current for lighting purposes, the maximum demand occurs only for about two hours out of the twenty-four. This means that sufficient generating machinery must be installed to take care of the maximum load or peak; yet probably 50 per cent. of the same is used only for from two to three hours a day, and the remainder of the time lying idle and unprofitable. By the use of a storage battery, which can be discharged at high rates for two or three hours and can take care of the maximum demand or peak, sufficient generating machinery need be installed to provide only for the balance of the load, together with the current required for charging the battery.

The battery can be charged when the load is light, thus utilizing the generators when they would otherwise be idle. In this way the load curve on the generators, during the twenty-four hours approaches more nearly the straight line, which is the aim of all central station managers, and ensures the most efficient operation of the plant. Central stations which were designed and constructed without a storage battery equipment can increase their capacity by installing a storage battery, the cost per kilowatt being less than that for a generating plant.

This feature of carrying the peak is only one of the uses to which a storage battery can be put in central stations and, although, perhaps, the most prominent, yet in addition a properly designed storage battery equipment makes the whole system very flexible and enables economies to be effected which would be impossible without the use of a battery.

This question will be dealt with fully in a later article, and examples given, showing how a storage battery can be used to advantage in direct current central stations.

The problem of reducing the cost of electrical energy to the lowest possible figure is one which confronts all electric light and power companies. Selling prices have to be reduced to meet competition and secure new business, yet dividends must be earned and paid to the stockholders who are generally ignorant of the business and look upon it purely from a money-making point of view.

The efficiency of generating machinery has been gradually increased till there is not a great deal of room for improvement in this direction, consequently the question of cheaper power and of fuel economy is the one which attracts most attention. Modern practice is tending toward the location of large generating plants where cost of production is the lowest the electricity being transmitted to centers of distribution. The generating plant is usually located in the spot most advantageous for generating and not necessarily for distribution. This location is generally on a water front, where real estate is cheap, water plentiful and coal easily obtainable. In order, therefore, to obtain the fullest economy, the cost of transmitting the electrical energy to the centers of distribution must be so reduced as not to offset the saving effected by cheap generating facilities.

Transmission over long distances by means of direct currents, at low tension, is too costly on account of the large investment in copper required, and direct current transmission at high tension is impractical on account of the difficulties in constructing and operating direct current generators and transformers at a sufficient voltage to reduce the copper investment to a point which is commercially practical.

The solution of this problem lies in the use of alternating current generators for producing the energy which can be safely and economically transmitted over long distances and converted into direct current for distribution by means of rotary transformers and storage batteries. This system appears to be the most perfect method at present of utilizing cheap power obtained from water, where available, or from steam, where the cost of production can be reduced on account of special facilities. Examples of this system will be illustrated and described later on.

In electric railway work there are two methods of utilizing storage batteries. First, where the battery is stationary and acts as an auxiliary to the generating plant. Second, where the battery is carried on the car or locomotive and supplies the current for its propulsion.

In the application of storage batteries to the first or stationary method, there are two distinct ways of utilizing them.

First: In the power house to equalize the load on the generators and to maintain a constant pressure on the system.

Second: At the end of the long feeders to maintain a good pressure on the section under all conditions with an economical investment in copper.

In both of the above cases the battery will also assist the generating plant during the peak or time of maximum load. The application of storage batteries in the power house is better suited to smaller roads where comparatively few cars are operated and the load on the generating plant is much more fluctuating than on a large system where many cars are operated and the fluctuations, due to the starting and stopping of the cars, are felt in a much less degree on account of the number of cars in operation, being averaged or distributed over the whole number.

A storage battery in this case will discharge during times of heavy load, and store up energy during periods of light load, thus reducing the capacity of the generating plant required and enabling that which is in operation to work at a constant and economical point; in addition, the battery is of great service in protecting the machinery from sudden and severe strains due to the large portion of the load being thrown on or off.

Where batteries are placed at the end of a long feeder they act as a reservoir and equalizer, giving out current when the load on that section is greater than the capacity of the feeder and storing up energy when the demand is less than the capacity of the feeder. In other words, a storage battery enables the section to be operated with a feeder capable of carrying the average current, instead of the maximum, besides maintaining the pressure as steady as in the power house. Examples of these methods will be given later on with figures showing results obtained and saving effected.

There is probably no greater field for the use of storage batteries than in connection with railway work on these lines. Managers and engineers have been sceptical and have not realized the fact that storage batteries properly applied are a much more profitable investment than additional copper, which, like generating machinery, pays for itself only when fully loaded, whereas storage batteries enable both generating machinery and feeders to be operated at maximum efficiency, thereby giving the greatest return on the investment.

The second method, where the batteries are carried on the cars or locomotives, is still more or less in the experimental stage. Numerous trials have been made with satisfactory results, yet at the present time this system has not proved its commercial value sufficiently to become a serious competitor to the other systems of electricity as applied to railway work.

At the present time a road in Chicago is being equipped entirely with storage battery cars, every detail from the track upwards being designed and constructed especially for the purpose of getting the best results from this system. This work is attracting great attention among electrical railway men, and the results will be eagerly watched.

Recently the attention of the public has been drawn to the question of horseless or motor vehicles, and those operated by electricity seem to be the most practical and likely to attain commercial success. There is an entire absence of smell, noise and danger which, to a certain extent, must of necessity accompany all vehicles operated by explosive or heat motors. In addition to this there is no doubt that electrically propelled vehicles can be operated and controlled with greater ease and accuracy than other types and their operation is dependent entirely on the storage battery which provides the motive power. It is not probable that these motor vehicles will replace the horse for some time to come, yet there is undoubtedly a large field for them if arrangements are made to recharge the batteries without trouble to the user; this of course is purely a matter of organization.

An article will be devoted to the consideration of this subject, in which the details of construction and results obtained will be fully described.

Launches propelled by electricity are very popular for pleasure purposes, the current being obtained from storage batteries carried under the seats and in the bottom of the boat. The chief advantage of electric propulsion for this purpose is the entire absence of smell and noise, together with the small amount of attention required to operate the launch.

In telegraph and telephone work storage batteries have replaced gravity cells to a large extent, the cost of maintenance being reduced to less than one half. In this and similar service, such as fire alarm and signal work, the use of storage batteries is very successful, their voltage and internal resistance being better adapted for the work than that of primary cells.

Train lighting by electricity is undoubtedly the most satisfactory method yet devised and naturally storage batteries must play an important part in this work.

There are numerous other uses for storage batteries in profitable form where small quantities of electrical energy are required at intermittent periods. Among these, the following may be specially mentioned: Cauteries and lamps for medical purposes; dental engines and mallets; phonographs, kinetoscopes and similar apparatus; lamps for carriages, bicycles, etc.; electric fans, sewing machines; X-ray outfits, and a multitude of similar purposes.

LEGISLATION IN CONNECTICUT AGAINST THEFT OF ELECTRIC CURRENT.

WE give below the full text of a bill which is going through the Connecticut Legislature to prevent theft of electric current and has already passed the House of Representatives, after being reported favorably by the Committee on the Judiciary:

AN ACT CONCERNING THE PUNISHMENT OF PERSONS STEALING ELECTRICITY.

General Assembly, January Session, A. D. 1897.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Any person who has no contract, agreement, license, or permission, oral or written, with or from any person or corporation authorized to manufacture, sell, or use electricity for the purpose of light, heat, or power, or with or from any authorized agent of such person or corporation, for the use of the electric current belonging to any of said persons or corporations, who shall knowingly withdraw or cause to be withdrawn in any manner, and appropriate to himself, such current from the wires of any of said persons or corporations for his own use, or for the use of any other person or corporation, shall be punished by a fine not exceeding fifty dollars, or by imprisonment in the county jail not more than ninety days, or both; and any person who shall knowingly assist such other person in such withdrawing and appropriating such current from such wires, to the use of such other person, or to the use of any other person or corporation, shall be punished by a fine not exceeding fifty dollars, or by imprisonment in the county jail not more than ninety days, or both.

Sec. 2. Any person who has a contract, agreement, license, or permission, oral or written, with or from any person or corporation authorized to manufacture, sell, or use electricity for the purpose of light, heat, or power, or with or from any authorized agent of the same, for the use of the electric current belonging to any of said persons or corporations, for certain specified purposes, who shall knowingly, willfully, and intentionally withdraw, or cause to be withdrawn in any manner, and appropriate to his own use, or to the use of any other person or corporation, such electric current, from the wires of any of said persons or corporations, for purposes other than those specified, shall be punished by a fine not exceeding fifty dollars, or by imprisonment in the county jail not more than ninety days, or both; and any such person to whom such electric current is furnished, from or by means of a meter, who shall willfully and with intent to cheat and defraud any of said persons or corporations, alter or interfere with such meter, or by any contrivance whatsoever, withdraw or take off the electric current in any manner, except through such meter, shall be punished by a fine not exceeding fifty dollars, or by imprisonment in the county jail not more than ninety days, or both.

BURGLARIZING SAFES BY ELECTRIC HEAT.—IS IT FEASIBLE?

DURING the past month or two the columns of The Electrical Engineer have contained frequent references to the alleged new danger threatening the inviolability of safes, in the shape of the electric arc, by means of which, it is claimed, holes are bored in the stoutest safes in a few minutes, and all wonted precautions are frustrated. If this were true, it would, of course, have its serious meaning for safe makers, burglar alarm companies, and bankers, but it is obvious that the electrician is also closely concerned. The great argument that has been put forward is that the now almost universal use of electricity places within reach of the burglar the immediate supply of current that he needs, so that all he has to do is to hitch on his wires and his boring stick of carbon and melt his way through the thick ribs of steel as easily as though he were sampling cheese with an ordinary groceryman's gouge. Describing the operation in our issue of Feb. 24, Lieut. S. Rodman, Jr., said with regard to certain sensational experiments in Chicago:

"As a matter of fact the experiment under discussion was not made in a laboratory but under exactly the same conditions which in practice would exist and might be made use of by an unscrupulous person for a surreptitious purpose. That is, flexible wires were connected to electric light mains and under the sidewalk—the same as could be done in any city—and led to the safe which was pierced. One wire was connected to the safe and the other having a suitable resistance in circuit was connected to a carbon electrode. The remainder of the operation—that is, the burning of a hole through the safe—is so simple that I have seen persons who have had little or no knowledge of electricity do it with perfect ease almost the very first time. * * * * The operation of burning holes through safes by the use of the electric current such as can be drawn from an electric light main or a trolley wire, is a perfectly practical and feasible operation, and it is one which many bankers to my knowledge have investigated. The result is that any safe or vault, no matter how thick, can be readily and quickly pierced, consequently there is no security whatever in safes and vaults by themselves. They must be protected and the most practical and economical method which suggests itself is that of electrical protection."

Now, bankers say that if these reports were trustworthy, then they have no further use for electricity in their bank buildings, but would exclude it; and they add that they would make it their business to drive away exterior circuits on the streets just as far as the law compels saloons to be separated from the school houses. The restriction of electrical growth and utilization thus implied is not to be idly dismissed. These Chicago tests have been put forward in connection with the exploitation of a new safe protective system, and might therefore be guardedly received, however legitimate the enterprise; but it is evident that data on this subject is not difficult to secure and that the new plan of burglarizing suggested may be found, when studied practically, to take its place among the possible impossibilities of which the electrical arts are already so full.

The tests reported show that with currents of from 50 to 80 volts and from 250 to 350 amperes, small holes have been bored through 3½-inch steel safe walls with the electric carbon boring tool in about three to five minutes. The business end of the carbon point pressed against the safe is concealed by a small hollow box lined with fire clay or asbestos, and a wooden handle is fastened to the other end by which it is pushed forward as the metal yields like wax. This sounds simple enough, but the actual doing in a practical way out in the hard, cold world, where the burglar has to work with a minimum of leisure and of facilities, is attended with enormous difficulties. We have already called attention in our pages to the opinion of Prof. Elihu Thomson, who is certainly the leading authority in the world on electric welding and metal melting. Prof. Thomson believes that there is no doubt whatever of the possibility of melting through masses of iron or steel of even considerable thickness, provided there is time enough to do it and sufficient current is available; but he thinks it very doubtful, whether any burglar could tap a lighting circuit and obtain the current required, which might range in the neighborhood of 200 to 300 amperes. He would not only need to tap the mains, but he would have to arrange a resistance in circuit so as to produce a stability in the arc formed; that is, he would have to cause a drop of a certain number of volts between the constant potential mains and the arc produced and get rid thereby of a considerable amount of energy. Prof. Thomson does not think that he could, with much less than the current stated, melt into the iron or steel at a rate sufficient to be of much effect in a reasonable time. Furthermore, the use of such an affair produces an intense light and radiant heat, which demands ventilation, particularly as vicious fumes are given out besides. This would seem to make it impossible for work to be done in a restricted space and it certainly could not be accomplished without attracting notice on account of the glare and fitful light, unless very effective screening were used to prevent the light from getting out through windows and attracting attention. To put it in another way, Prof. Thomson thinks the paraphernalia which the burglar would have to carry along and have at his disposal for the attempted work would be a sufficient discouragement in itself, while the time required and the risk of discovery would be so great as to remove the operation from among the possibilities, except under very exceptional circumstances.

Another distinguished authority is Mr. J. J. Wood, the electrician and general superintendent of the Fort Wayne Electric Corporation, who says: "Immediately after the appearance of the article in the newspapers, we made some experiments at this factory to determine the feasibility of the plan, and found that it would require much more current than could be conveniently drawn from the circuits. In addition to which, special regulating devices had to be employed in order to keep the current at a suitable voltage for the work. During the experiment, the light was so intense that the parties performing it, including myself, burned their eyes very badly; while the fumes given off required the best possible ventilation for their removal."

Mr. C. O. Mailloux, the consulting electrical engineer of this city, whose work for the Astor and Vanderbilt estates is well known, and who has probably supervised more bank installations than any other man, has kindly gone into the question very thoroughly for us, and his analysis of the matter is here given:

"Replying to your query as to the possible rôle that electricity might be made to play in facilitating the work of the modern 'scientific' bank burglar, I would state at the outset that I cannot pretend to do anything more than to give an idea of the limitations of the electrical current supply that is likely to be available for burglary purposes. These limitations appear to me to be such as to make the possibilities of any new departure in burglar methods involving the use of electricity of much more limited application and practicability than might at first be supposed.

"It takes a certain amount of energy in the form of heat to fuse, volatilize, burn up, or otherwise dispose of a given quantity of material. I have no data on which to base any exact calculations as to the quantity of electrical current required to burn a hole of given size through metal plates of various thicknesses, but there is probably a definite relation between the quantity of material melted and the quantity of current used. This quantity might be expressed in calories, or heat-units, or it might be expressed in the more convenient electrical unit of coulombs or ampere hours or minutes, per cubic centimeter or per cubic inch, or some other convenient unit or ratio. It would be more practical in this case to take the current (ampere-hours), than the watts (watt-hours), because the watts will depend upon the proportion of energy expended in resistance extraneous to that portion of the circuit where the work is to be done. In the electric arc, for instance, a considerable proportion of the energy is expended in overcoming the resistance between the two carbons, and a much smaller proportion is expended in burning the carbons themselves.

"In the case of the street lighting arc lamp, the consumption of positive carbon goes on at a rate varying between two and four ampere hours per cubic centimeter. Iron or steel may be from four to six times less refractory than carbon, and may therefore require a proportionately reduced current consumption. Allowing, for instance, about ½ ampere hour, or thirty ampere minutes, per cubic centimeter of plate, then we can form a rough idea of the quantity of energy that would likely be required to perforate a safe plate having a thickness of from six to fifteen inches. It requires a certain nicety of judgment on the part of the burglar to determine what size hole he shall 'bore.' With an ordinary arc light carbon, he could scarcely hope to increase the current density above 20 or 25 amperes, unless he is prepared to work with red-hot carbons. With larger carbons, on the other hand, the hole would have to be bigger and the quantity of energy required would increase.

"If, instead of boring the hole through by means of the arc, Mr. Burglar were to attempt to do so by melting a portion of the plate between two contact points, on the principle of an electric welding heat, there would still be the same relation between the coulombs of current (not the watts) and the volume of metal to be disposed of, and the time required would depend entirely on the current density that could be maintained through such electrodes as might be used for passing the current through the portion that is to be burned out. The size of opening of bore desired in this case would also influence the amount of energy and the time required for the operation.

"As the burglar is necessarily compelled to do his work in the shortest possible space of time, it is necessary for him that he shall use the largest possible current densities. To produce a hole having an average area of one square inch through six or seven inches of plate, the current would have to remove from 100 to 125 cubic centimeters of metal. This would likely require at least 2,500 to 3,000 ampere minutes of current. If the work is to be done in, say, ten minutes, the current must be used at the rate of 250 to 300 amperes. If the plates are thicker, of if the 'hole' must be larger, the quantity of current required will correspondingly increase. With the present systems of interior wiring, it would be difficult for the burglar, except by the purest accident, to find any circuit, to draw his current supply from, that would be able to furnish even half that output of current, without causing the safety fuses or automatic cut-outs, or other safety circuit-breaking appliances to operate so as to open the circuit and cut off the current supply altogether. It must be remembered that the circuits which supply current to the electric light outlets are usually limited to something like ten amperes; and even allowing for the eccentric and erratic fusing point of the fuse, it is doubtful if a current supply of more than thirty amperes could be depended upon for a period even as long as ten minutes; while in all cases where the fuses are made of tested wires, the circuit would probably be opened by the safety fuse in much less time, and by a much lower current. If, perchance, the burglar could obtain access to a cut-out box, and could thus be enabled to make direct connection with some feeder or main conveying the current to this point direct from the source, whether said source be an isolated plant or the (Edison or other) street mains, it would still even then be doubtful if he could depend upon a sufficient supply of current for effecting his purpose.

"The most approved practice of the last four or five years has been in the direction of relatively minute sub-division and individualization of the lighting circuits. In the early days of electric lighting,, it was not uncommon to run a vertical riser from the cellar to the top story, and to connect with this vertical riser at all the floors. In such a case as that it might be possible that the safety fuse protecting the main at the particular floor on which the burglar is operating might allow a current load of two or three times the amount of current actually required for that particular floor. The safety fuse supplying the vertical riser would not be expected, of course, to operate until the total load on the vertical riser had reached the limiting point. With the present system of wiring, however, the sub-division of load on individual feeders or mains, is such that it is seldom that the load on an individual feeder exceeds 125 to 150 amperes, while in the majority of cases, the load is scarcely over 100 amperes. It can readily be seen, therefore, that under those conditions, even assuming the safety cut-out to be adjusted for a considerable increase above the normal load of said feeder or main, the burglar could scarcely count on even as much as 200 amperes before causing the safety cut-out to operate so as to cut off the entire current supply. The possibility of the burglar so drawing his current supply direct from a feeder or main is remote for the reason that in most, if not all, cases, the cut-out cabinets are located in corridors, or in other public portions of the building, where they would be more or less distant from the bank vaults; which circumstance not only increases the difficulty of bringing the current supply to the point where it is to be utilized by the burglar, but also increases the chances of his being detected while he is doing his work. If, then, he has nothing to depend upon but an ordinary fixture connection, or lighting circuit, he cannot hope to get a current much greater than 20 to 30 amperes before his current supply becomes cut off, while if the circuit work is properly designed, and the fuses are as they should be, his current supply will more than likely be cut off by the time he has drawn 15 amperes for a minute or less.

"If the system of current supply is one utilizing the alternating current, it is possible that a converter might be used which would transform the electrical energy from the line potential (say 110 to 115 volts), to a lower potential (10 to 20 volts), such as used in electric welding. The same thing could also be done with a direct current by using motor dynamo or rotary transformers; but we must bear in mind the fact that these appliances are more or less bulky and heavy, and that they cannot, consequently, be carried in the burglar's satchel with the rest of his tools, while, at the same time, they require more or less skill and experience for their proper handling.

"In conclusion, my opinion is that while the 'trick' or 'scheme' is theoretically possible, there are so many elements of uncertainty and so many contingencies likely to frustrate it, that it does not seem to me at all likely that we shall hear of many bank safe burglaries which have been rendered possible, or which have been effected, by the aid of electricity in any such manner as outlined in your query."

These three weighty comments bring up points enough to throw entire discredit on the whole idea, but we may venture to supplement them with a few other comments. It will be noted that the smallest current spoken of as necessary is, say, 350 amperes at 50 volts, or not far short of 25 horse power. Mr. Mailloux has shown the conditions against which the burglar would have to contend everywhere in getting that current in a building. But Lieut. Rodman has suggested that the burglar can use a storage battery. So he can, but he would need a room to place the cells in and facilities for running wires to them and from them, and it may be doubted whether he could get along with less than a ton or two, or even more, as enormous capacity for quick and heavy discharge of the current would be needed. The suggestion has also been made that the live current from the line in the building or outside could be immediately converted to its necessary conditions by means of a rotary transformer; but such a transformer unit of from 15 to 25 horse power would weigh complete, between three and five tons, and the burglar would be even less likely to carry that around in his kit than the storage batteries.

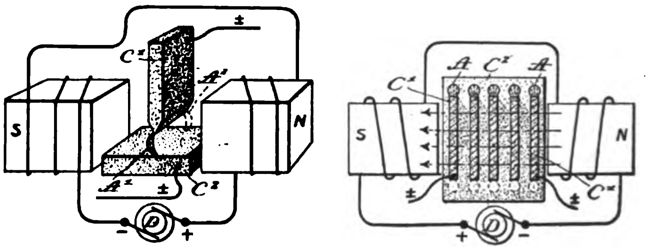
The proposition to go outside the bank building for the current is one that could hardly be seriously meant, if the plan involved is that of attachment to aerial circuits; but Lieut. Rodman says that "the electrician can readily see that with proper manipulation the trolley system may also be made use of." Our readers are tolerably familiar with such work, and we would like to ask them what freedom from detection they would expect while making a 25-horse-power connection to an exposed, overhead electric light or trolley circuit, and while running it afterwards into an adjacent bank building? How would they do the work in such a way that nobody would see them or interfere with them and nobody would after it was done find out its existence? There are some things more preposterous than others, and this seems to be among them.

Nothing has been said so far with direct emphasis on the necessity the burglar would be under of knowing what current he was working with. Prof. Thomson has referred to the necessary use of a resistance, supposing the burglar had no batteries or no direct current transformer. Most buildings are wired on the low potential direct current 220 volt system, and it is doubtful whether a large amount of current could be taken from one side of a 3-wire system without its being noticed, especially if the unbalancing occurred in the night time and was of a sort of fitful character. The arc which does the melting requires only about 50 volts, and if 200 amperes were used on the 220-volt circuit, it will readily be seen that something like 160 to 170 volts might be required to be lost, or taken up, in resistance, or about 45 horse power! Can any one imagine the burglar dealing successfully with such conditions and without further encumbrances in the shape of heavy resistances, regulators, measuring instruments, etc.? Moreover, in this review of the subject, which could be gone into further, if space permitted, it has been assumed that all the burglar has to do is to take his supper and sit down quietly to his job on the safe. We have assumed that the bank employs no burglar alarms, no watchman, no bull dogs, that there are no police or janitors, and that the safe stands out on the floor as readily accessible as the ice water filter. It is to be assumed that banks are fairly careful in these respects; but even if they were not we should feel inclined to back a good modern safe against the electrical burglar unless he came far better prepared than any investigation yet made, or any proof yet produced, shows him to be.

In view of the able expert testimony we have gathered on this subject, we have no hesitation in advancing the opinion that bankers and other guardians of funds and securities need lose no sleep worrying over a possible burglary by electrical means. We would further suggest that if such sensational methods are resorted to in order to exploit a new system of electrical protection, it would be well for bankers to examine carefully into the merits of this system before placing extra confidence in it. In our mind a watchman and a couple of bulldogs would be a more conservative investment, at least until this system has been demonstrated to possess the merits claimed for it.

PATTEN'S CARBIDE OF CALCIUM ELECTRIC BLOW-PIPE FURNACE.

It is well known that an electric arc will blow or move out of a magnetic field if free to do so and in a definite direction determined by the direction of the lines of force. Thus in Fig. 1, where C' represents an upright slab of carbon placed at arcing distance from the horizontal carbon slab C^2, and N S are the poles of an electromagnet, so placed that the arc between the electrodes is normally in the field of the magnet of which the lines of force flow from N to S, then the arc between carbons will assume a position dependent upon the direction of current flow and the lines of force. Thus if the lines of force have the direction N to S and the current flows from the upper to the lower carbon then the arc will assume the position A' at the left-hand corner of the upright carbon slab. Now if either the current should change direction or the magnetic field should reverse then in either case the arc would pass over to the right-hand edge or corner of the upper carbon slab, assuming the position A^2. In these physical conditions there-



FIGS. 1 AND 2.

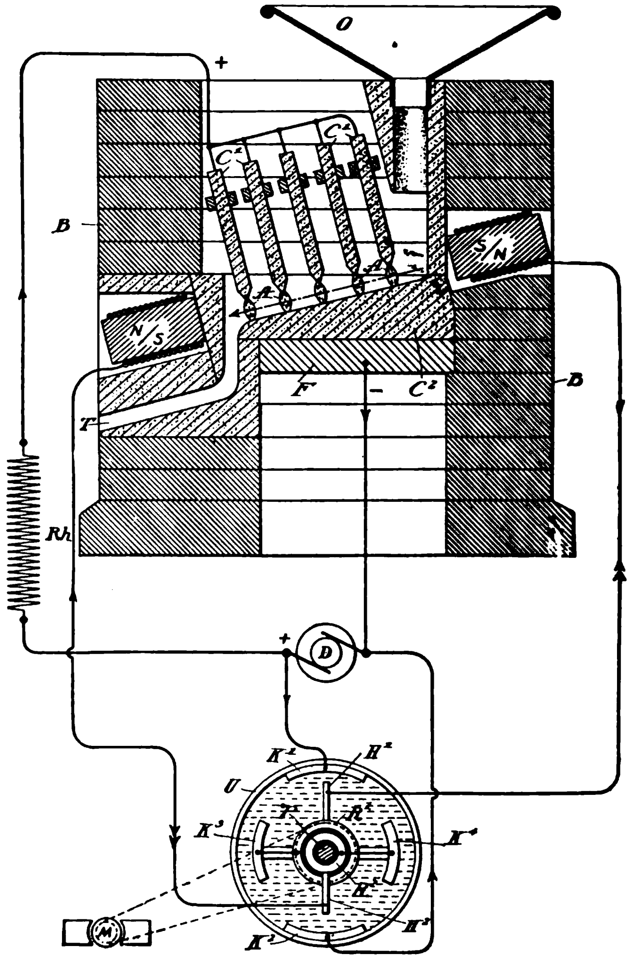


FIG. 3.—PATTEN'S ELECTRIC BLOW PIPE CARBIDE FURNACE.

fore, lies the possibility of moving the arc to and fro across the edge of the upper carbon slab.

Fig. 2 shows an arrangement of a number of upright parallel electrodes placed in juxtaposition to a carbon slab forming the other electrode. The several arcs in such case between upper and lower electrodes traverse back and forth from side to side of the upper carbon with each alternation of current, and material passed between the upper and lower carbons on the lower carbon slab is attacked by the electric arcs A A in rapid succession as they vibrate to and fro over the passing material.

Based upon this principle of the electric blow-pipe, Mr. F. J. Patten, of New York, has designed and recently patented a most ingenious furnace for the production of carbide of calcium and similar products.

Our engraving, Fig. 3, shows in cross-sectional elevation a furnace constructed on the plan of using a continuous current between the electrodes and an alternating field. The lower electrode C^2 is given a slanting position, so that the material between electrodes will slide, or flow down, its surface from right to left while the arcs between the several upper electrodes and the lower one are traversing back and forth from one side of the magnetic field N S to the other, thus maintaining practically a sheet of electric flame, through which the material must pass.

F is an iron slab on which the lower carbon electrode C^2 rests, and to which one terminal of the working circuit is attached, C' C' are the upper carbon electrodes, all attached to the other working-circuit terminal, and N S are the poles of an electromagnet. O indicates a hopper through which the material to be fused is admitted, and T a draw-off tube from which the material when in the liquid or molten form is taken from the furnace.

Of course, it will be understood that the current must not reverse too rapidly in the system shown, but should have a comparatively slow period or rate of movement, preferably much slower than the period or rate of ordinary alternating currents as used for lighting. It is also a ready inference that if the current between electrodes be direct and the magnetic field be reversed in order to move the arc, then this magnetic reversal should also be comparatively slow; otherwise excessive heating and loss of energy would be the consequence.

This is accomplished as follows: A direct-current dynamo D supplies the continuous direct current sent through the electrodesC' C' and C^2 of the furnace. A shunt-circuit taken from the brushes of the dynamo D is led to the two plates of conducting material K' K^2 of the liquid current-reverser shown at the bottom of the figure. This is a current-reverser of special form adapted to reverse currents of considerable strength without sparking or rupture of the circuit.

The circular part U represents in horizontal projection a vessel. At its center is a spindle P, that carries an arm at the extremities of which are two other conducting plates K^3 K^4, which, revolving with the spindle P, driven by the motor M, thus pass the fixed plates K' K^2 each half revolution.

The revolving plates are connected each to an insulated sliding-ring contact R' R^2, on which brushes H' H^2 bear, and as a result of the rotation of the plates K^3 K^4 a slowly-reversing alternating current is delivered to the circuit that includes the windings of the electromagnet N S S N, the magnetism of which is thus slowly reversed, causing the arc between the electrodes C' C' and C^2 to be traversed back and forth with the changing magnetism. Thus there is a direct-current system throughout, with slowly-reversing magnetism in this last form.

AN ELECTRIC SEWING MACHINE.

A Chicagoan, Mr. John S. Biggar, has patented an electrically operated sewing machine. It is very simple in its construction and is adapted to be driven by a battery current. The needle is mounted upon the lower end of a core which is reciprocated by a pair of solenoids. A motor is contained within the frame of the machine and rotates the shuttle shaft. The solenoids and motor are placed in a common circuit controlled by a switch mounted on the frame of the machine. By this construction all the working parts are inclosed, thus eliminating all danger from handling by the uninitiated.

MR. NIKOLA TESLA will deliver a brief address, it is stated, at the annual exhibition of the New York Academy of Sciences, at the American Museum of Natural History, on Tuesday evening, April 6. His subject will be: "The Streams of Lenard and Röentgen, with Novel Apparatus for their Production."

DEAD WIRE IN ARMATURES.

BY R. PFUND.

REFERRING to Prof. Anthony's article on "Dead Wire on Armatures" in The Engineer, issue of Feb. 24, I find that I have made an error in giving the direction of the induced e. m. f. in the wire A in Fig. 2, in my article in the issue of Feb. 10. I should have said that when the lines of force are shot over the wire, the induced e. m. f. or current would be toward the observer, and in the opposite direction if they pass under the wire. I cannot, however, agree with Prof. Anthony that, under the conditions named, no e. m. f. will be developed in the wire in the position, shown in Figs. 2 and 4, but that one will be developed in the position shown in Fig. 3. On the contrary, an e. m. f. will be developed in any position of the wire except that shown in Fig. 3. The accompanying diagrams, representing the face and section of an electromagnet will, perhaps, make this clear. Let us assume also that instead of the lines of force around a wire being, not as usually represented, simply a series of concentric circles having a right or left-handed direction, according to the direction of the current, but that the flow of a current in a wire tends to rotate or strain the medium or atmosphere surrounding the wire; the rotation, or strain, being in a clockwise direction if the current flows away, and counter-clockwise if the current flows toward the observer, the amount of rotation or strain depending upon the strength of the current.

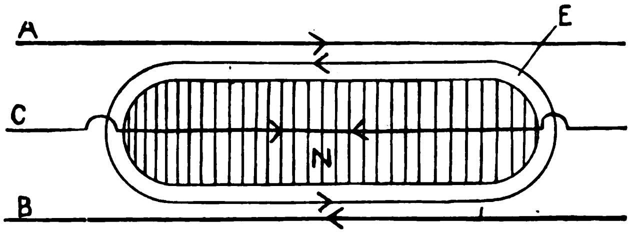


FIG. 1A.

Now, referring to Fig. 1A, E is the energizing coil. A and B are two wires stretched on each side, and C a wire stretched across the center of the face of the magnet. Suddenly charging the magnet so as to make the face a north pole will, according to the usual way of stating it, cause lines of force to come toward the observer, and will induce an e. m. f. in both A and B in the direction of the arrows; but none in C, because the strain is equal and in the same direction on both sides of C, as shown in Fig. 2A. For simplicity's sake, but a single stationary straight wire has been considered in the above diagrams, and in Figs. 2 and 3 of my former article; but, no matter where the return circuit comes in, no e. m. f. will be developed in that portion of the complete circuit, which has, like the wire in Fig. 3, an equal number of lines of force traveling in the same direction on each side, or, as shown above, is subjected to an equal and unidirectional strain on each side. Now, again, referring to Fig. 3, and assuming that the return circuit is directly opposite, facing my original straight wire, just as soon as this loop is turned around its axis out of its horizontal position, an opposite e. m. f. will be developed in each wire in accordance with the direction of the strain, and furthermore, the maximum e. m. f. will be developed with a given speed, while the position of this loop is changing from the horizontal to the perpendicular, because, assuming that the total strain is ten—five on each side of the plane of the loop, turning the loop through a certain number of degrees so as to make the strain six on one side, will leave but four on the other, and so on.

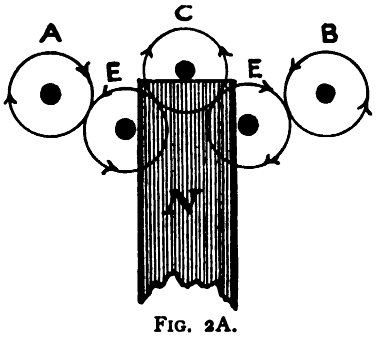


FIG. 2A.

Now, if the loop is in the perpendicular position, the entire strain will be on one side of each leg. Moving it through the same number of degrees as before will develop a very much weaker e. m. f., because it will not move far enough to materially reduce the strain on one side and increase it on the other. Even if it is moved a sufficient distance to transfer one entire assumed unit of strain to the other side of each leg of the loop, the effect will still be due to but one to nine.

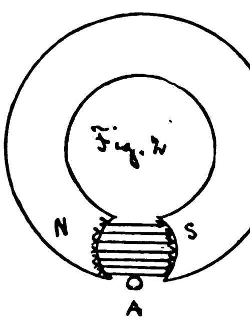


FIG. 2.

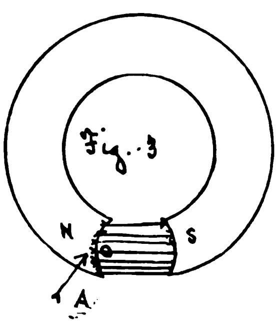


FIG. 3.

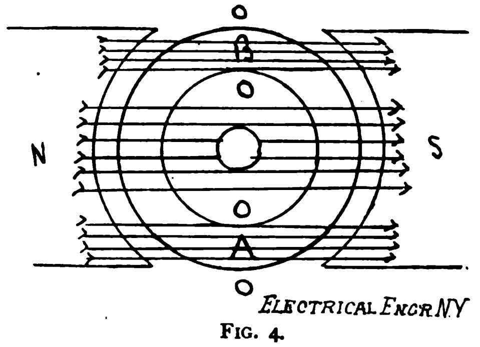


FIG. 4.

LETTERS TO THE EDITOR

THE CELLULOSE PRODUCT OF THE CORN-STALK.

I NOTICE in the last issue of The Electrical Engineer, page 317, a very uncomplimentary reference to the Marsden Company recently organized under the statutes of New Jersey with a capital of $50,000,000. The statement has never been made by any one competent to make it, or any one in connection with the company, that this was to be a sugar company, or that sugar was to be made electrically, or any other statement that would justify the article that you republish.

I desire to say for your information, and to enable you to intelligently correct the impression given by your publication, that this is an entirely legitimate business; that its object is to convert what has heretofore been largely or wholly a waste product and the largest waste product in the world, into commercial products of great value.

Mr. Marsden recently discovered that in the Indian corn-stalk was to be found the greatest body of practically pure cellulose in the world—cellulose of a higher grade in its natural state than that manufactured from cotton or wood pulp, costing anywhere from $500 to $1,000 per ton. Scientists have long recognized the value of a pure cellulose in the arts but its excessive cost has heretofore made its use limited only to cases where nothing but cellulose could be employed. But when we realize that this product of the corn-stalk has a world-wide market and can be utilized to the fullest extent that it can be produced, at many times the value of the corn, it will be readily seen that this feature of the discovery is of great importance.

One of the first uses made of this material was as a packing for the coffer-dams of warships, it having proven its superiority over any other material yet found. After a thorough trial made by the United States Naval Board, this material has been adopted by the Navy Department, and in the five warships now under process of construction, American corn-pith cellulose is specified, and we have no doubt of its universal adoption by all the leading navies of the world.

It has also proved to be the most perfect non-conductor known. In actual competitive tests, as a covering for steam pipes and boilers, it shows 27 per cent. better results than the best magnesia covering, and the same advantage when used in refrigeration. More than 150 different applications have been made of this material, with equally advantageous results.

From the foregoing, it will be seen that the cellulose of the Indian corn plant is destined to play an important part in the arts and manufactures of the world. This material is about one-half the bulk and one-eighth in weight of the corn-stalk.

When Mr. Marsden was requested by the Navy Department to furnish a quantity of this material for test, it was necessary for him to use several tons of corn-stalks in order to obtain a sufficient quantity. For this purpose he arranged a mill that cut the stalks into small pieces, and then by means of an attrition mill he ground the pieces into a fine meal. This product was taken from the mill by means of an air-blast, the difference in the specific gravity of the outside fibrous portion of the stalk and the inner portion, or pith, enabling the separation to be very successfully accomplished.

Upon an examination by Mr. Marsden of the fibrous portion of the stalk, he discovered that it was a valuable food for live stock. It was tested practically, and the cattle ate it with a relish. The matter was referred to Prof. H. J. Patterson, chemist of the Maryland Agricultural Experiment Station, College Park, Maryland, who made a thorough and exhaustive test of its value as a live-stock food, and I herewith enclose you a copy of an official bulletin issued by that station in December on the value of this new corn product.

When we realize that this heretofore waste product aggregated 160,000,000 tons per annum, which was practically a total waste, and that every particle of these stalks can be utilized to very great advantage—much more in value per ton than the corn crop—you can readily appreciate the importance of this discovery. The United States Government, after a very thorough investigation, have granted Mr. Marsden patents not only upon the product produced, but upon the method of manufacture as well. Patents have also been obtained in all corn growing countries throughout the world.

In addition to the advantages set forth, the statement has been made, based upon limited experiments, that the concentrated nutritious fibrous portion of the stalk, after the elimination of the pith and other impurities, contains saccharine, or cane sugar, in considerable quantities. Certain tests have been made, which indicate that the percentage is as great as in Louisiana sugar cane. Methods have not yet been devised for the extraction of this sugar. It is probably from this feature of the discovery that the erroneous impression has been stated that the company organized was a sugar company.

After the extraction of the saccharine matter, the fiber left is found to be a paper stock of greater value than wood pulp. When we consider that it is possible, therefore, from this same source, to produce all the paper that the country will require, its importance is still further enhanced.

The foregoing will give you some idea of the scope and possibilities of the Marsden Company, and why it is capitalized at $50,000,000, all of which we believe will be profitably employed both to the people who manage the enterprise, and to the country at large. We know of no development which can add so much to the commercial prosperity of the country at large, and the great farming districts of the West particularly, as this important discovery of Mr. Marsden, and we do not feel that any erroneous impressions or adverse criticisms are justified.

I have taken the trouble to write you quite fully on this subject, feeling personally that you do not intend to do us any injustice knowingly.

W. W. GIBBS,
President the Marsden Co.

Philadelphia, Pa.

THE DECISION ON HEATER SWITCHES.

WE note in your issue of Feb. 17, a communication from the Consolidated Company in regard to the recent decision on car heater switches and that you state that a copy of the decision was furnished you. By reference to that decision, you will note that the judge states that the element of the invention is contained in the necessary combination of an indicator with the switch for varying the heat supplied in the car. He says: "The novelty is in the combination and not in the separate elements." He also states that the defendant does not employ the same kind of an indicator or arrange his heaters in the same manner in which they were shown in the Dewey patent and also that the indicator is of a different type from that shown in the patent. He says further: "All such differences are immaterial. Matter relating merely to form and location are not the essence of the invention. The specification expressly states that the principle upon which regulating devices operate is well known and that almost any form can be used. It is thought that the defendant's combination operates in substantially the same manner and accomplishes the same result as the combination of the claim."

It is clear that the communication from the Consolidated Company does not fairly state the case when they say that it affects nothing but a particular kind of indicator on a switch and that it has nothing to do with the electric heating system. Anyone at all familiar with electric heaters knows that where one switch is used to vary combinations of heat, it is absolutely necessary to have an indicator to show what the combination is. All who have attempted to make car heaters have gone to considerable expense to get up some kind of an indicator switch for the reason that for a variety of combinations, without this kind of a switch, a number of independent switches were necessary and the street railway companies seriously object to putting up a switchboard in each car. While the Consolidated Company have not yet appealed their cases, they have stated that they intend to. In the meantime favorable action has been taken by the court on an application for an injunction against the Consolidated Company in addition to the judgment against the Albany Railroad.

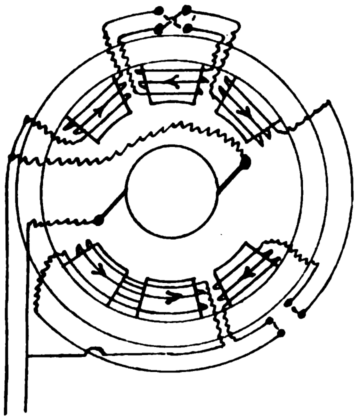
All who use an indicator switch in connection with heaters infringe the Dewey patent No. 464247, which is the subject of this discussion.

AMERICAN ELECTRIC HEATING CORPORATION,
JAS. I. AYER, General Manager.
Boston, Mass.

ANTHONY'S METHOD OF SPEED CONTROL FOR ELECTRIC MOTORS.

I HAVE just received The Electrical Engineer of Feb. 10, containing Prof. Anthony's remarks on my criticism of his method of speed control for electric motors. These remarks show that the description given in the original article was somewhat misleading. In that article (in The Electrical Engineer, of Dec. 16, 1896) reference is made to the machine as a multipolar machine. This is absolutely a misnomer, since Prof. Anthony's scheme, as he now explains it, requires a bipolar machine. Had his first description been sufficiently clear to bring out this point, I should have referred him to a German patent by R. Bauch, No. 83635, issued May 9, 1894. This patent is even older than the one I cited in my previous communication.

This whole subject of motor regulation has been gone over extensively in years past. The multipolar scheme, as I have shown, is the one most frequently used, on account of the fact that a multipolar machine is, in general, cheaper to build than a bipolar machine for the same output. Mr. Bauch's patent is very broad, and diagram b, under Fig. 2, here reproduced, illustrates the idea plainly.



Prof. Anthony states that he has been unable to find the German and French patents which I quoted. I thought that I had made a mistake; but I find that I was right, the German patent being, as before mentioned, No. 84182, issued June 10, 1894, to J. A. Essberger.

With reference to the sparking, I wish to say a word against the antiquated method of accounting for sparking by "disappearance of the lines," and other similar phrases, as employed in Prof. Anthony's original article. This is a very common error, and I hope that I may have the pleasure of dealing with the point further at the next meeting of the American Institute of Electrical Engineers in the topical discussion.

JOHN BALCH BLOOD.
Berlin, Germany, March 8, 1897.

DANGER IN POLE LINES.

A CORRESPONDENT sends us the following notice appearing in the South African Mining Journal, Johannesburg, Transvaal Republic:

THE RAND CENTRAL ELECTRIC WORKS, LIMITED.

"The public are hereby cautioned that the electrical conductor of the Rand Central Electric Works, Limited, running from the company's central station at Brakpan to the Farm Langlaagte is about to carry current, and are therefore warned against touching the electric wires directly or indirectly (such as by means of a stick or whip or otherwise), or in any way damaging the iron poles, or interfering with the line in general. The conductor is easily recognizable, the iron posts being painted red, and showing a Death's head, with the words 'Wire, Dangerous.'

"RAND CENTRAL ELECTRIC WORKS, LTD."

Our correspondent adds that on the high potential lines in Colorado, in damp weather, the linemen run and jump at the poles, being careful not to have contact with the pole and earth at the same time.

MASTERPIECES OF LITERATURE.

THE two volumes just issued of Charles Dudley Warner's Library of the World's Best Literature repeat the excellence of those gone before. The two volumes now before us range from Bion, the Greek poet, to James M. Barrie. Along with a remarkably intelligent and sympathetic study of Mr. Barrie's genius is given the best of his stories, and even a fine episode from "Sentimental Tommy," which in a work of the magnitude and enduring quality of the library, is keeping up to date with an emphasis.

One of the most interesting sections in this volume is that devoted to Balzac. Mr. Warner's library makes it possible to get out of the great bulk of Balzac literature just what the general reader ought to have.

"Masterpieces every one," may truly be said of the varied and interesting contents of the library, also of the the special articles prepared by over three hundred literary celebrities of this country and Europe. In these exhaustive reviews, not only individual authors but entire fields of literature of Assyria, for instance, Egypt, even South America—are covered, giving the reader a connected, comprehensive and impressive idea of the history of the rise and progress of the literatures of the world from the earliest time until to-day.

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THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription
United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - .10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, MARCH 31, 1897. No. 465.

THE INFLUENCE OF HEAT ON MAGNETIZED STEEL.

THE influence of heat on the magnetic properties of iron and steel has been the subject of several classic treatises which have thrown much light on the subject and led to valuable practical results in the treatment of iron and steel, especially in relation to dynamo-electric machinery and transformers. That this field of study is not exhausted, however, is evident from the excellent paper read before the American Institute of Electrical Engineers at its last meeting, by Dr. K. E. Guthe. About twelve years ago, Barus and Strouhal in an exhaustive article embodied in the United States Geological Survey Reports, showed the influence of tempering on the retentivity of steel magnets, and originated the well-known method of seasoning magnets by subjecting them for several hours to a temperature of 100 degs. It was this and some additional results that Dr. Guthe took as a stepping stone to further work in the investigation of the effects of annealing. Without going into the details of the eleborate tests made by Dr. Guthe, we deem it of importance to draw attention to some of the principal results obtained. Thus he found that: 1. The point at which steel becomes magnetically hardened by quenching, lies at different temperatures, according to the amount of carbon contained. It is considerably lower in high carbon steel than in low carbon steel, and corresponds closely to the different temperatures at which occur recalescence of steel. 2. The higher above the point of recalescence steel is heated before being quenched, the harder it is magnetically. 3. The magnetic hardening produced by quenching is the larger, the higher the percentage of carbon. 4. Reheating has in general a softening effect upon the magnetic properties of hardened steel, i. e., the permeability increases, and is accompanied by an increase of maximum induction and a decrease of the coercive force. But a hardening is noticeable in the low carbon steel after it has been reheated for a short time to 100 degs. The greatest change in the maximum induction takes place for high carbon steel between 200 degs. and 300 degs., for low carbon steel between 300 degs. and 450 degs., beyond which temperature there is hardly any change in the practical limit of saturation. All change taking place in reheating beyond 450 degs. consists in an increase of permeability for small magnetizing forces, i. e., a decrease in the coercive force or hysteresis loss. 5. To produce strong magnets, the hardened steel should first be heated to 450 degs. 6. Heating to a high temperature below the point of recalescence and sudden quenching produces a steel with a very weak retentivity; in consequence of which the hysteresis loss in a cycle is greatly decreased. This result may also be obtained, though in a lesser degree, by annealing at a very high temperature.

The results above indicated are directly applicable to a variety if important electrical apparatus, not the least important being its bearing on the manipulation of magnets for electric measuring instruments. For, in spite of the old objection to the employment of permanent steel magnets, the fact remains that instruments embodying them in their construction are to-day the most accurate and reliable for commercial measurements, while even in the laboratory they are coming into more general use on account of their great convenience. Their permanency of indication must always rest on the efficacy of the hardening and ageing processes employed for the magnets, and anything that can add to our present knowledge on the subject, such as the work of Dr. Guthe, is of direct benefit to the whole profession.

CHEAP RAPID TRANSIT.

THE recent struggle of the Metropolitan Traction Company in this city to secure further privileges has been sucessful so far, and may be expected to give the city an early increase in its facilities for rapid transit. The new electric lines will run practically the entire length of the Island of Manhattan, from one tip to the other, and thus by paralleling the surface and elevated lines in existence will not only add new conveniences but stimulate the old. Although in a sense parallels, the new lines open up new territory and will create a large travel of their own, while the welcome awaiting them was oddly proved by the attitude of the dwellers on Eighth avenue, who fought tooth and nail against the proposition of the company to turn aside at Fifty-ninth street, an uptown artery, into Sixth avenue, and leave lower Eighth without the modern service. But a few short years ago, the fight would have been altogether the other way, and the newspapers would have been filled with denunciations and lurid pictures of the dangers of electricity. Travel is pretty cheap in New York to-day, but it will now be better and cheaper than ever. What has been also accomplished in Chicago, is shown by a diagram appearing on another page, which shows that the average distance which can be traveled there for 5 cents has rapidly increased from 4 to 15 miles. This is the more remarkable when we consider the density of population, upon which the earning capacity of a street railway system must so largely depend. Mr. P. F. Sullivan, the manager of the Lowell and Suburban Railway, has issued recently for private circulation, the notes made by him during a tour of observation in Europe, and he brings out some significant facts. He shows, for example, that Chicago has only 2,857 population per mile of track, and New York 4,042, St. Louis having but 1,922 and Cleveland 1,371; while Liverpool has 10,000 per mile, Manchester, 10,400; Glasgow, 11,507; Berlin, 10,000, and Paris 13,587. If anybody said that our roads in cities have too many miles of track, on this basis of comparison, it would be defensible. But the public would not agree with that proposition, and hence it would follow that the European cities are very much under-equipped.

Mr. Sullivan, we are glad to say, administers the final coup de grace to the fantastic legend that out of the operation of its municipal street railway system Glasgow is in process of paying all its running expenses and liquidating its entire indebtedness. The story is still going the rounds, but its usefulness as a choice piece of misrepresentation is now obviously limited. It appears that the city of Glasgow has an average of 10,000 employés and disburses $10,000,000 a year in such expenses, or six times the total gross receipts from the street railways! The net returns to the municipal treasury from the roads, moreover, is only $45,000 a year, nominal. The city debt just now is $39,852,175. We leave our readers to figure out how soon the $45,000 will overtake the $39,000,000 besides providing salaries meantime every year for the army of 10,000 city officials.

As to the service given, Mr. Sullivan states that in November he paid six cents for a ride in Glasgow and in December 10 cents for a ride in Berlin, and that in any city in Massachusetts he could get a longer ride, in better cars, for the regular fare of 5 cents. Of course one could ride a shorter distance for a smaller fare in the European cities, especially on the roof, exposed to all weathers, but Mr. Sullivan calls attention to the fact that the higher fare for the longer distance is the very reason why there is such terrific overcrowding in cities like Glasgow, Paris and Berlin, and why in the United States, the cheap rates for the long distances are building up large suburbs full of beautiful little homes, enjoyed by people who would otherwise be cooped up in garrets or cellars. Mr. Sullivan says, in addition to this, that not only are fares actually higher in Europe than here, requiring more equivalent in hours of labor at current rates of wage; but that under the further conditions of density of population, low mileage and careful protection afforded to capital in such enterprises, railway investments are more desirable and are better in Europe than in the United States. This may be the reason why some of our most enterprising street railway men have been securing the ownership of some of the larger properties in Europe, to develop them on the best lines of American practice.

THE TELEPHONE IN NEW ENGLAND.

A PROPOSITION having recently been made in Massachusetts to establish a telephone commission, Mr. S. L. Powers appeared before the committee on mercantile affairs of the Massachusetts legislature to oppose it in behalf of the New England Telephone and Telegraph Company. We must confess our own belief in the general efficacy of such commissions, on the Massachusetts plan; but in view of the fact that only eight subscribers in eight years have asked for one, and that 16 subscribers have objected, it would seem that there is no great need or yearning for it just now in that State. What is of more interest is the remarkable data brought forward by Mr. Powers as to the use of the telephone in this country.

The population of Europe in 1890 was 354,957,776, and there are 336,037 telephone stations, or 1 to every 970 of the inhabitants. The population of the United States was 62,622,250 in 1890, and there are 325,810 telephone stations, or 1 to every 192 of the population. Moreover, while in Europe the telephone conversations reach 767,109,824 per year, here they reach 757,000,000. Hence it follows that measured by population the number of telephones in this country is five times as great as in Europe and the use per capita is six times as great.

If we descend from the general to the particular, we find that while Sweden, the most liberal user of the telephone in Europe, has but 1 to every 136 of her inhabitants, the Commonwealth of Massachusetts has 1 to every 95. The little Bay State has very nearly as many telephones as the great republic of France, which has fifteen times her population. If we come to cities, London has 1 instrument to each 700 of her population, while Boston has 1 to every 55; so that London, with 8,000 exchange instruments, plays second fiddle to Boston, with over 9,000. These, surely, are striking proofs of the general use of the telephone in this country, and when we come to rates and service, the advantage is still found to remain on our side. Mr. Powers quotes a great many statistics on this point, going into the relative quantity of service obtainable, the average prices of labor, and the general use made of the system; but while this is convincing the best proof one can have is to go to Europe and try it for one's self, in any country that may be selected. To-day in New England each use costs the subscriber only 2½ cents, a price hard to beat.

We might dwell on these figures but there seems to us even more interest in the analysis that is furnished of the earnings of the New England Company. A great many of the "independent" local telephone companies have made their remarkable headway by asking low rates, and we are afraid that the public is being educated in many places to a much lower tariff than the business at any time can stand. Competition is an excellent thing, on the right lines, but we cannot see what the business or the art of telephony is going to gain if it is to be done at a loss. The real question narrows down to an inquiry into what it does cost to carry on a good exchange system, and in this connection some figures we collate from Mr. Powers' argument may be valuable. He gives the following as authentic: The company receives on an average from its exchange and pay station instruments $74.56 per year. Out of this comes, labor, $36.26; taxes, $6; American Bell rental, on the average, $5; rent, insurance, material, office expenses, etc., $9.75. This makes a total of $57.01 for operation and maintenance. We do not note any allowance for depreciation, which would obviously make a further considerable deduction from the amount available for dividend. The New England Company appears to be paying at present $5.00 annual dividends per share of $100, but the average over 15 years is only $2.70. The issued capital of the company is $10,390,000, and as in Massachusetts the company pays on a taxable valuation of over $8,000,000, it is reasonable to assume that the property in Maine, Vermont and New Hampshire is worth at least the remaining $2,390,000; so that there is no "water" discoverable. It is curious that the company pays less as a Bell royalty than it does as taxes, on each instrument; and there may be something in the contention of Mr. Powers that for an equal amount of $5, the New England Company could not afford to maintain a shop to make and repair its own apparatus, as it would do if not dealing with its parent company.

There are several interesting points here suggested, many of which it is difficult to pronounce even an opinion upon, but a full understanding of which would go far to reveal the future of telephone exchange work in this country, as a profitable enterprise.

THE GRIEVOUS TALE OF GRAVESEND.

We doubt whether the annals of unsuccessful municipal lighting plants present a more pitiable and pathetic record than that of Gravesend, Long Island. This plant cost the town $119,000, to raise which a lot of common lands were sold. The real value of the plant at the time of its installation was less than $60,000, and where the rest of the money went does not appear. The plant has just been sold to the Brooklyn Edison Company for $31,000, which will be eaten away by other charges and is all the town has to show for lands which, it is generally understood, were disposed of in another little deal, far below their intrinsic or prospective market value. The plan was put through by Mr. John Y. McKane, then the political boss of Gravesend, who was sent to Sing Sing for several years for wholesale fraud in elections. There is no doubt that had his career of usefulness not been cut short, Mr. McKane would have operated the plant, and the neat little problem now presenting itself to the citizens is to figure out whether they would have been actually better off, if the plant had been used. A nominal saving of so much per lamp, as compared with rates from a private company, might, they think, have meant a big addition to the municipal indebtedness, and they have at least escaped that. As it is, the plant was never in regular working order, and it is said that never a single lamp was lighted from the city dynamos. Next!

INTENTIONAL DISABLING OF MACHINERY.

Down on Long Island, at the pleasant summer resort of Southampton, a man has been held for trial on the charge of sanding the dynamos and machinery of the local electric light company. The facts in such a case would seem easy to establish, as one does not apply sand to dynamos with a box, as a lubricant; and if the deleterious substance is there, the presumption is that some one put it there, either the person accused or another. We are glad to believe that the malicious disabling of machinery is much less in vogue than it once was. The reports of such accusations even as this are rare, and in cases of embittered industrial strife, the great majority of the men show themselves anxious to abstain from destructive acts that wipe out so much of the wealth of the community. Their intelligence teaches them the deep truth of Prof. Hadley's recent remarks that "Investments of capital in machinery, on however large a scale, have tended to create an increased demand for the services of the laborer as a producer, and a yet more conspicuously increased competition for his purchases as a consumer." In other words, the disabling of machinery by accident is a recognized misfortune for all; and, by intent, is a crime against labor more even than against society as a whole.

THE STOCK TICKER SITUATION.

The position that we took last week as to the duty of the Western Union Company in regard to the "bucket shops," is now sustained, as will be seen from our Legal Notes, by a Western decision, namely, that it is broadly the function and province of the company to treat all comers alike; and, correlatively, that of the legal authorities to suppress institutions making a bad use of the service or of the information. When we see the whole legal machinery of the government exerted, in another direction, on the telegraph company and the steam railroads, to establish equality for all customers, it is too much to expect the exactly contrary proposition also to be supported. In this matter, the Western Union Company represents the widest interests of the public. If the courts and officers of justice cannot take care of evil-doers, it is as well to know it, and to mend the law. But it is pushing things beyond the limits of propriety, into the region of absurdity, to expect a telegraph company to investigate the moral character of people anxious to get its service and tendering good money for it.

Stealing current is now to be a definite offense in Connecticut. There have been a good many instances of the "sneaking away" of little quantities of current, but when detected, which has not proven difficult or long in occurring, the trouble has been to get a verdict, either because the thief said he had permission or it was hard to show exactly how much he had stolen, or the court would not regard electricity as a tangible, material thing. The little wires for these paltry thefts have usually been taps inside a room or a hall, lighting one or two lamps, and contrast very forcibly with the other cool plan of putting in circuits and installations that will allow a burglar undetected to steal and work with currents that would easily run anywhere from 250 to 500 lights! To get the best safe he can, must ever be the first duty of a banker, but we confess we don't share any anxiety as to the use of the current en bloc for burglarizing such safes by the electric arc. The idea is not one for commercial consumption, but ought certainly to be brought to Jules Verne's attention as affording a good plot for his next novel.

They must be pretty good arc lights at Utica, N. Y. One of the aldermen stated in the common council last week that he had moved a lamp to which reference had been made, because two people had complained that it was so intense they could not sleep; and the complainants had even gone so far as to ask for smoked glasses to be put around the lamp if it was not moved. We should say that those lamps are undoubtedly full 2,000 candle-power.

ELECTRIC TRANSPORTATION

THE DIAGONAL SYSTEM OF RAILWAY LINE CONSTRUCTION.

BY JOHN C. HENRY.

RECENTLY I have been making an estimate on the cost of constructing a long electric railroad in the mountains. In scheming to cut down the expense, it occurred to me that a very considerable saving could be made by using a slight modification of the writer's previously described diagonal methods of support. The plan shown in the above sketch requires but one-quarter of the number of poles that the ordinary span construction does, or but one-half the number required by the bracket construction. In addition, the span wires may serve as feeders and also act as stays for such pull-offs as may be required on long curves. The span has other advantages; among them, the liability of the poles being broken down by land slides, falling rocks, runaway teams, etc., is reduced in proportion to their number.

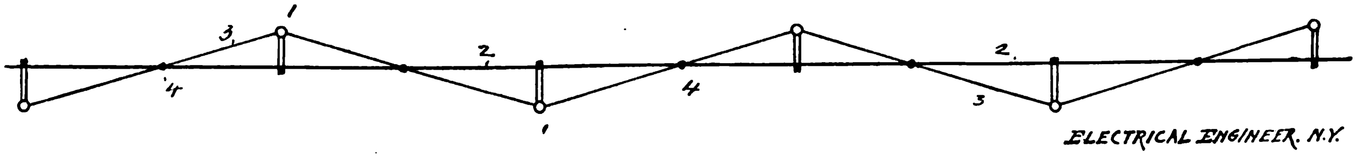


FIG. 1.—HENRY'S METHOD OF DIAGONAL SUSPENSION OF TROLLEY WIRES.

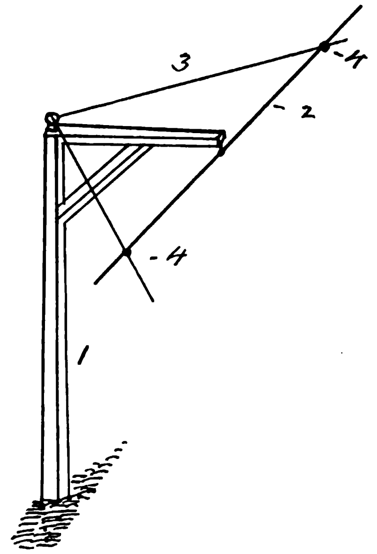


FIG. 2.

In the sketch, Fig. 1, 1 represents the ordinary bracket poles, and Fig. 2 a plan view of the line construction. Trolley wire is shown at 2; the diagonal span wire and feeder at 3, and the insulating hanger at 4.

MR. T. DOLAN ON THE SUB TROLLEY AND AIR MOTORS.

MR. THOMAS DOLAN, of Philadelphia, who is one of the men most largely interested in the Metropolitan Traction Company, of New York City, was interviewed last week as to the preference shown for the sub-trolley and the decision not to adopt the compressed air motor. As to the failure of the air motors, he said: "We have reason to know, for we have spent a year's time and much money endeavoring and hoping—at one time almost believing—that we had found in it just what we wanted. We are working on it to-day in our experiment shops, and we are far enough along with it to know and to understand the obstacles that are yet in the way of its successful operation. Compressed air may be made practical as a motive power in a month, or six months, or six years—perhaps never. Nobody can tell. Its perfected form is still in the inventor's brain. One car does not constitute a system any more than one swallow makes a summer. There is a difference between operating one car and operating several hundred cars. You can have skilled experts handling the one car, doctoring it between trips, and all that sort of thing. It is a much different matter when you attempt to operate an entire system. You cannot have experts on every car, skilled in the technicalities, nor can you lay the cars up for repairs. They must be moving all the time. Why, there is every reason why we should be acting in this matter only after the most painstaking investigations. It is to our interest to have the best possible motive power. We cannot invest millions to-day to be dug up and thrown away to-morrow. It is our business to get the best."

With regard to the conduit system, he said: "Two years ago we heard of the underground conduit in Budapesth. We sent our engineers over there to study it, and they reported it imperfect. Finally, the General Electric Company offered to build an underground conduit on Lenox avenue, in New York City, and to remove it if it proved a failure. We accepted the offer, and the line has been in successful operation nearly two years. A year ago, at this time, we had determined to change our motive power to the underground, and were about to do it when the compressed air system was brought to our attention. Instantly we abandoned our purpose to lay conduits and began costly experiments with compressed air. It looked at one time last summer as though the air motor would answer, but fuller tests proved that not to be the fact. Meanwhile the conduit system has been perfected. The question before us is: 'Shall we give the people of New York City rapid transit now or, in order to save money, wait an indefinite period until some system now undeveloped can be perfected?' We answer that inquiry by offering to go right ahead with the underground."

ELECTRICITY ON THE CHICAGO ALLEY ELEVATED.

Steam power is to be superseded by electricity as motive power of the Chicago Alley "L." The road will also be connected with the Union loop and will carry passengers into the downtown districts instead of leaving them at Congress street. It is designed to make the trains run almost as fast as those of the Illinois Central. Management of the Alley "L" will extend its lines into the present territory of the railroad company and make a fight for a larger share of the South Side patronage. Engineers are at work on specifications for bids on equipping the road with electricity. The plant will be ready in six months, if present plans are carried out. Work will be commenced on the connecting track with the Union loop as soon as Mayor Swift signs the ordinance passed recently. Fifty motors will be built for the road by Sargent & Lundy at a cost of between $400,000 and $500,000. The coaches now in use are to be reconstructed. Other changes and the electric plant will cost $1,000,000. A third rail will be used. To make it a more formidable rival of the Illinois Central, President Leslie Carter and other officers and directors of the Alley "L" will make the passenger cars comfortable to a point of luxuriousness, and will cause trains to be run almost as frequently as street cars.

ELECTRICITY ON THE "L".

Mr. George J. Gould has denied that the officials of the elevated railroad had abandoned the idea of equipping the road with electrical motive power.

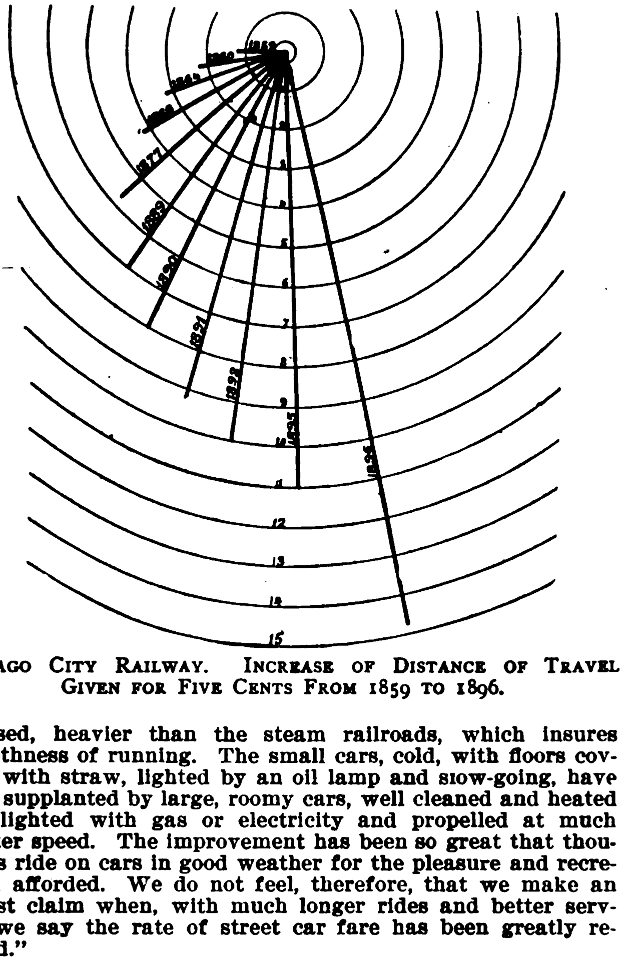
"I am studying the subject all the time," said he, "and am as much an enthusiast about electric motive power as ever."

TROLLEY vs. STEAM AT PITTSBURG.

Recent experiments on the Monongahela have once again shown, says the Pittsburg Post, that the steam roads cannot compete with the electric lines for the suburban traffic. The best they can do is to hold their own legitimate share of the business. Since the building of the electric roads much traffic has been developed at points far removed from the railway stations, and this cannot be attracted by frequent train service on the steam roads or lower rates.

HOW FAR ONE MAY TRAVEL FOR FIVE CENTS IN CHICAGO.

ONE of the best appeals for fair treatment, addressed to the public of a great city, is that put forth by Mr. G. H. Wheeler, president of the Chicago City Railway Company, through the pages of the local newspapers. The pith of the argument is found in one of the diagrams, which we reproduce here. It shows the growth in the distance that a passenger can travel in 1896 for one 5-cent fare, as compared with the distance in 1859. The exhibit is certainly a very striking one, although it could probably be duplicated in other cities. But as Mr. Wheeler says, it does not tell the whole story. "Notwithstanding the cheapening of the cost of a ride the improvement in the physical condition of the railways has been marvelous. Instead of a light, rough-running track, a girder rail is used, heavier than the steam railroads, which insures smoothness of running. The small cars, cold, with floors covered with straw, lighted by an oil lamp and slow-going, have been supplanted by large, roomy cars, well cleaned and heated and lighted with gas or electricity and propelled at much greater speed. The improvement has been so great that thousands ride on cars in good weather for the pleasure and recreation afforded. We do not feel, therefore, that we make an unjust claim when, with much longer rides and better service, we say the rate of street car fare has been greatly reduced."



Chicago City Railway. Increase of Distance of Travel Given for Five Cents From 1859 to 1896.

The Chicago City Railway Company has to-day 184 miles of track, 25 miles of which is in territory that is far from being able to support the service afforded. The company employs from 3,500 to 5,000 men.

THE NORTHERN OF NEW JERSEY MAY ADOPT ELECTRIC MOTORS.

The Northern Railroad of New Jersey, it is reported, is contemplating changing its motive power and adopting electrical propulsion. It is also said that if the road decides to adopt this method of operation it will have its terminus at the Hoboken Ferry and will build branches in different directions so as to compete with the Erie, the New Jersey and New York and the Susquehanna for local and through traffic at points not now touched by the Northern.

BIG NEW RAILWAY PLANT FOR PITTSBURG.

The Consolidated Traction Company of Pittsburg intends, apparently very soon, to begin the erection of an immense power plant, the building and machinery to cost about $400,000. The plant is to be located, so it is stated, at Twenty-sixth street, near the Allegheny River, which would be not far from Penn avenue. The contracts for supplying the machinery will be awarded at once. The machinery will cost between $250,000 and $300,000, and will consist of engines, boilers, dynamos, etc.

The building will cost in all probability about $125,000 and will be a large structure. It looks as if the work of building would be commenced the coming summer.

ELECTRIC TRACTION FOR LIMA, PERU.

J. Mitchell de las Carreras of Lima, who has been in this city some time for the purpose of transferrring the Lima Tramway Company to an American company, entitled the South America Light, Power and Traction Company, has effected his plans and will soon return to Peru. The above company is now controlled by Messrs. Hearst & Stump, of New York City; ex-Senator Paddock, of Nebraska, and Mr. A. Murphy, of Omaha. The new company proposes to change all the horse car lines in the city of Lima to electric roads. Negotiations are already being effected with different electric companies for estimates, etc. Mr. Carreras says that some very advantageous concessions which the government of Lima made with the old Tramway Company have been transferred to the new company, among them the privilege of importing all the materials for the roads free of duty. The government, this gentleman also says, is inclined to give the new company the concession for the electric light plant to be built in the city of Lima.

ELECTRIC MINING FREIGHT ROAD FOR CALIFORNIA.

An electric railway to operate in Summit and Park counties, California, is about to be incorporated for the purpose of furnishing transportation facilities to mining camps which have been shut out of the market owing to the high price attendant on existing means of hauling. The line will start at Alma and Breckinridge, where connection may be had with the South Park railway leading to the Denver smelters. It is estimated that the electric line can handle 200 tons a day at a cost of not to exceed one dollar a ton, owing to the power being generated on the right of way by mountain torrents whose waters have been going to waste. M. M. Howe, an experienced mine manager, is at the head of the project and with him are associated J. P. Pierce, of Buffalo, N. Y.; Judge Hibbard, Paul Marker and W. F. Fox, of Chicago; J. W. Boone, of Syracuse, N. Y.; Henry Clews and Melville E. Stone. The road will cost about $100,000, and will be in operation by the middle of September.

ELECTRIC RAILWAY WORK AROUND NIAGARA.

The Tonawanda Electric Railroad Company, of Tonawanda, N. Y., and the Tonawanda Street Railroad Company, of North Tonawanda, N. Y., have been granted the privilege of crossing the bridge across Tonawanda Creek. Workmen are now engaged in strengthening the bridge for the extra load brought on by the street railroad traffic, and will have it completed in about one week, giving through service from Gratwick and North Tonawanda to the Buffalo city line. It is contemplated that the line of these two roads will be consolidated and extended to Niagara Falls, forming a through line from Buffalo to Niagara Falls and will be operated under the name of the Buffalo, Tonawanda & Niagara Falls Electric Railroad Company. Much of the right of way has already been secured and the preliminary work is being pushed forward as rapidly as possible. The lack of permission to cross the bridge above referred to has been a great detriment to the roads in the past. This bridge will be the means of giving better service to the public and a better revenue to the company.

MOVING HOUSEHOLD GOODS BY TROLLEY.

A novel electric train went north on High street about 10 A. M. over the lines of the Columbus Street Railway. It consisted of the sand car and one of the construction cars, both loaded with household goods, stoves, beds, carpets and all manner of requisites for housekeeping. Inquiry developed that the goods belonged to Mr. Wolfe, one of the faithful employés of the company, who has been living on Oak street, near the Rose avenue sheds, but has been given the occupancy of the house at Olentangy park, owned by the company. The train of two cars furnished an admirable means of making the transfer.—Columbus (O.) Dispatch.

POWER TRANSMISSION

ELECTRIC HOISTS IN MINING WORKS.

THE application of the electric motor to hoisting work and the appreciation of the combination by mine operators is shown by the numerous installations of electrical hoists which have been made in mines during the past few years. In the operation of these hoists, it has been found that they markedly emphasize the advantages of electrical operation. They may be located in relation to the incline of shaft exactly where they can be operated with the greatest advantage consistent with convenience of position, without any of the pipes inseparable from the air or the steam hoist. In responsiveness to the movement of the starting lever, the electric motor is instantaneous. There is no short interval of hesitation as in the steam hoist. The speed is constant and only the requisite power required to handle the load is consumed, while the general cost of operation is less than with compressed air or steam hoists.

These points in favor of the operation of hoists by electricity have been demonstrated in many instances, and the following may be looked upon as affording additional evidence. At the Free Silver Mine at Aspen, Colo., is an electrical hoist, Fig. 1, rated at 125 horse power, but capable of applying to the hoisting machinery power to the extent of 200 horse power. This is the largest electrical hoist in the world. It is a double reel, flat rope, overbalanced hoist built after the designs of Mr. D. W. Brunton, manager of the Free Silver Mining Company, and also of the Cowenhoven tunnel, Della S., Alta Argent and Johnson Mines. The electrical equipment consists of one General Electric Company's 100-kilowatt multipolar motor, with a speed of 550 revolutions per minute, and a smaller motor of similar type of 60-kilowatt capacity, and a speed of 475 revolutions. This smaller motor is ordinarily used to run an air compressor and winch for pulling pumps, but in case the main hoist motor is called upon for heavier work than usual, the smaller one can be thrown in gear with it.

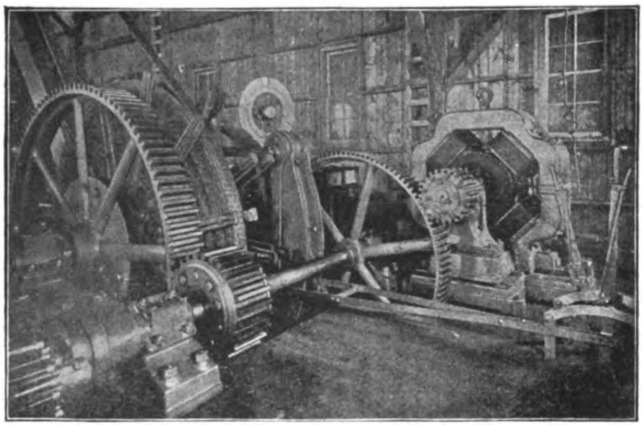


FIG. 1.—OVERBALANCED HOIST, FREE SILVER MINE, ASPEN, COLO.

The hoist being counterbalanced, the load on the motors is reduced to about one-third of that which would be thrown on a plain hoist of the same capacity. The radius of the arms of the reels is 5 feet, each reel carrying 1,500 feet of rope 4 inches wide and ⅝ inch thick. The hoist is provided with a car and cage, and the loaded car and cage weigh about 5,000 pounds. As in sinking the mine it cannot be timbered entirely to the bottom, and the cage cannot go below the timbering, a bucket is hung below the cage. This is 35 inches high and about 28 inches in diameter. It weighs 400 pounds, and holds 12¾ cubic feet of water, weighing 800 pounds, or rock weighing 2,000 pounds. To relieve the shaft from a sudden inflow of water, this hoist is provided with a bailer, which is used as an adjunct to the pumps. This is 4 feet 2 inches by 3 feet 2 inches by 8 feet 4 inches and weighs empty 1,950 pounds, and filled 8,880 pounds. The counterweight used with the cage and bucket is 2,450 pounds with the cage and car 2,675 pounds. With the bailer these two weights are used, making a total counterweight of 5,125 pounds. The maximum hoisting speed with the cage and ore, and using the small pinion on the motor, is about 600 feet per minute; with the bailer and using the larger pinion about 1,000 feet per minute. The voltage used is 525 volts, and the current is taken from the central station at Aspen.

Last summer an interesting test was made with this hoist when using it for bailing. At that time the mine shaft was 835 feet deep, a depth to be ultimately increased to from 1,200 to 1,500 feet. The condensed figures showing the operation of this hoist during the test are as follows: Hoisting: Weight of bailer 1,950 pounds, water 6,930 pounds, total, 8,880 pounds; counterweight, 5,125 pounds; (ropes balance, considering entire trip); net weight raised, 3,755 pounds; depth of shaft, 835 feet; work, 3,755 x 835, 3,135,425 feet pounds; time hoisting, 2:25 min.; foot-pounds per minute 1,393,521; mechanical horse power, 1,393,521 ÷ 33,000 = 42.2.

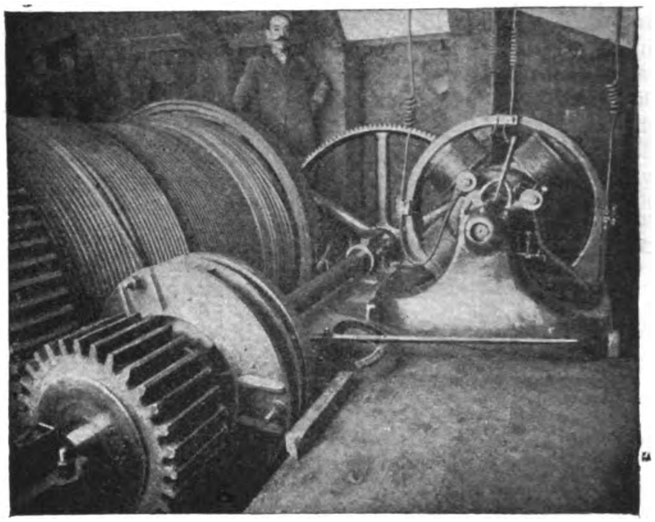


FIG. 2.—ELECTRIC HOIST, ALTA ARGENT MINE, ASPEN, COLO.

Lowering: Counterweight, 3,175 pounds; weight of bailer empty, 1,950 pounds; (ropes balance, considering entire trip); net weight, 3,175 pounds; depth of shaft, 835 feet; work, 3,175 x 835, 2,651,125 feet pounds; time of lowering, 2:25 min.; foot-pounds per minute, 1,178,277; mechanical horse power, 1,178,277 ÷ 33,000 = 35.7 horse power.

At the Alta Argent Mine, also at Aspen is another hoist, Fig. 2. This is placed at the head of the incline. The current is taken from the power plant of the Roaring Fork Electric Light and Power Company, three and one-half miles distant, two miles being above the ground and one and one-half miles through the Cowenhoven tunnel and mine workings. This hoist is also overbalanced and is equipped with a General Electric Company's multipolar slow-speed 500 volt motor, having a capacity of 20 horse power.

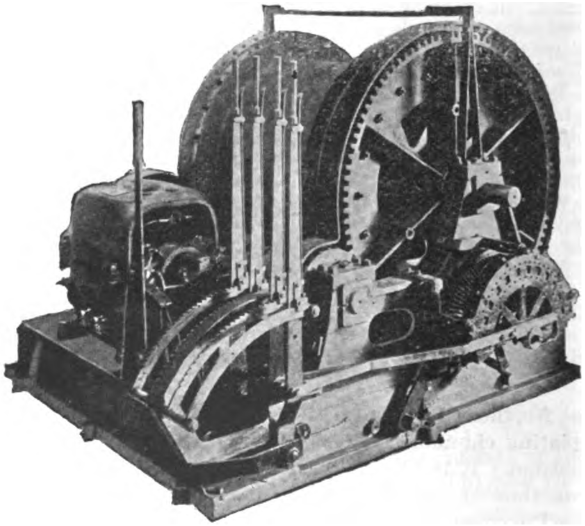


FIG. 3.—ELECTRIC HOIST, PLEASANT VALLEY COAL MINE, CASTLE GATE, UTAH.

The location of this hoist has been arranged with an eye almost exclusively directed to the convenience of handling the cars. The hoist is placed on a platform about 10 feet above the level at the head of the incline, where the ore cars are stopped and run off after being hoisted. Here the hoist operator stands and handles his controlling levers and reversing switch. This arrangement gets the hoist out of the way, while it allows the operator to attend to the cars. In the case of other hoists at Aspen, the hoist is placed directly at the head of the incline. This relegates the operator to the back of the hoist, where he can see both shaft and rope when hoisting and lowering. To attend to the cars he would be compelled to pass around the hoist, and as this entails loss of time, a second man to handle the cars is usually necessary. At the Alta Argent, one man suffices to operate the hoist and handle the cars.

In the mines of the Pleasant Valley Coal Company of Castle Gate, Utah, is another direct current mine hoist used for hauling the coal cars up the incline, Fig. 3. This hoist is a Lidgerwood double-reduction single-drum hoist, equipped with a standard L. W. P. 20-horse-power railway motor and double 51 rheostat. It is designed to lift 4,000 pounds 500 feet per minute. The drum is 47 inches in diameter and 36 inches face with two brake hands in V-shaped grooves on the drums. It is provided with both friction and positive clutches, and is operated by five levers—one for the rheostat, one for the friction clutches, one for the positive clutch and two for the brake. The dimensions of the base on which are mounted the drum, motor and controller, are only 78 inches by 95 inches. Another hoist of similar pattern but using a friction clutch only and a G. E. 2,000 motor with a double 83 rheostat has recently been added to the very complete mining equipment of the Pleasant Valley Coal Company. The motor in this case is fully enclosed.

All of these hoists are and have been in constant service for months without serious hitch or stoppage beyond those necessitated in ordinary mine service. They have been found superior to steam hoisting engines, both in efficiency, in simplicity, in convenience, and in speed of operation, and no better proof can be adduced than that in the three first mentioned cases, the first hoists have induced orders for additional ones.

SCOTT AND JANNEY ALTERNATING MOTOR FOR DESK AND CEILING FAN OUTFITS.

FOR some time past the Scott & Janney Electric and Manufacturing Company, of Philadelphia, have been at work upon a new alternating current motor and are now prepared to place their machines on the market. This type of motor is claimed to be entirely new. No pains or expense have been spared to make this machine of the highest type, both electrically and mechanically. It has been experimented with in all conceivable shapes and sizes in order to make it economical and durable.

The moving part of the motor, namely, the armature and shaft, is simplicity itself. The windings are of cast copper into which the stampings of sheet iron are inserted. The copper casting has no soldered joints and as a consequence the armature can be raised to a red heat without danger to it in any way. There is no insulation in or upon the armature, and hence nothing to burn, shrink or expand except the metal; even expansion and contraction cannot do any damage to this part of the machine owing to its peculiar construction. Strange as it may seem, expansion and contraction will only bind the armature parts tighter together, as there are no screws or bolts used in its construction, it being held together by pressure.

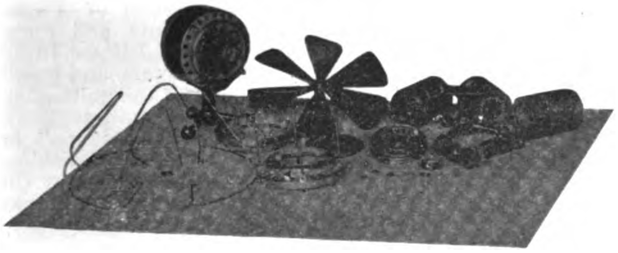


FIG. 1.—SCOTT & JANNEY ALTERNATING DESK FAN.

The armature is of the induced type and, as said before, it is the part which revolves. No commutators, slip rings, or sliding contacts of any kind are used. It is purely an induction motor.

The Scott & Janney motor is claimed to be in a class by itself, even its principle of operation, although caused by magnetism, being different from that of motors heretofore designed.

The main feature of the motor lies in the construction of the magnetic circuits and the windings upon them. These windings are so placed as to cause two field magnetisms or two fluxes to circulate; this is also true of other induction motors, but the difference is that, in other induction motors, the two fluxes occur in the same plane and parallel, but at different times. In the Scott & Janney motor they occur in different planes and at right angles to each other and at different times.

There is another important feature about this motor and that is the proximity of the induced circuits and the currents flowing therein to the primary windings and the magnetic poles. This is an essential feature in motors built for high frequency circuits, but does not prove of so much value in low frequency apparatus, as the projection of the lines of force across an air gap is favored more in low than in high frequency machines.

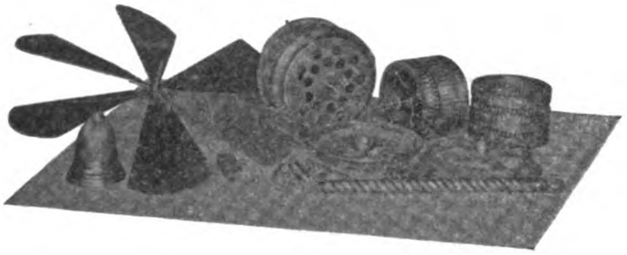


FIG. 2.—SCOTT & JANNEY ALTERNATING CEILING FAN.

The accompanying engraving, Fig. 1, shows the details of construction of the large size desk fan, and Fig. 2 those of the ceiling fan motor. The advertisement of the Scott & Janney Electric Manufacturing Company, elsewhere in this issue, contains illustrations of the completed fan outfits just mentioned.

AN ELECTRIC POWER FACTORY SCHEME FOR HAVERHILL, MASS.

A. J. Tilton, of Haverhill, Mass., is perfecting a big building and manufacturing project which will necessitate the use of $300,000. The proposed plan is to build on the ground owned by Mr. Tilton, and lying between Essex street, Locke street, Little River and the B. & M. tracks, three mammoth factories, each 300 feet long and of mill construction.

In the center there would be built a complete electric power and lighting plant, water to be furnished from Little River, which will probably be arched.

OBITUARY

JOHN M. ORFORD.

We note with deep regret the death of Mr. John M. Orford, assistant manager of the Boston Electric Light Company, who died at his home in Jamaica Plain, on March 23. He gained his electrical experience in the service of the British government, and many years ago was engaged in electrical work in India. Later he left England and had a prosperous career as an electrical engineer, coming to this country. He was for some time general manager of the Bridgeport (Conn.) Electric Light Company. He leaves a widow and four children. He was widely known and greatly liked in electrical circles. The cause of death was typhoid pneumonia.

ADOLPH VOGEL.

Mr. Adolph Vogel, treasurer of the Cambridge Gas and Electric Company, died at his home, 16 Martin street, Cambridge, Mass., on March 24. He was a native of Bohemia and seventy years of age. For a quarter of a century he was cashier of the University Press, and for the past fifteen years he had been treasurer of the Electric Light Company.

SOCIETY & CLUB NOTES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the meeting of the Institute held at 12 West Thirty-first street, March 24, a paper was presented by Dr. Karl E. Guthe on "The Influence of Heat Treatment Upon the Magnetic Properties of Hardened Steel." In the absence of the author the paper was read by Prof. H. S. Carhart of the University of Michigan, who took part in the discussion, together with Dr. Pupin and Mr. Winand.

At the council meeting in the afternoon the following associate members were elected: Ernest J. Bechtel, superintendent power plant, Toledo Traction Co., Toledo, O.; Arthur Hillyer Ford, fellow in electrical engineering, University of Wisconsin, Madison, Wis.; Herman L. Holbrow, with New York Telephone Co., New York City, residence Rutherford, N. J.; William F. Kelly, student in expert course, Fort Wayne Electric Corporation, Fort Wayne, Ind.

It was also decided on the invitation of Miss Mary Farmer, to hold the general meeting of the Institute at Greenacre-on-the-Piscataqua, Eliot, Me., beginning Monday, July 26. This date is the 50th anniversary of the entrance of the late Prof. Moses Gerrish Farmer, into the field of electricity, which became his life work. Prof. Farmer was one of the charter members of the Institute and in consideration of his high standing as an original investigator and inventor he was elected an honorary member of the Institute Oct. 21, 1890. His home during the latter part of his distinguished career was at Eliot, Me., and he died at Chicago, May 25, 1893, where he had been engaged in the preparation of his personal exhibit at the World's Fair. Greenacre is already noted for its various conferences and meetings held annually.

The council nominees for the Institute election on May 18 are as follows: For president, Dr. Francis B. Crocker, New York City; for vice-presidents, Dr. A. E. Kennelly, Philadelphia, Pa.; Chas. S. Bradley, New York City; Prof. Dugald C. Jackson, Madison, Wis.; for managers, Dr. Alexander Macfarlane, South Bethlehem, Pa.; Gano S. Dunn, New York City; W. F. C. Hasson, San Francisco, Cal.; Herbert Laws Webb, New York City; for treasurer, George A. Hamilton, New York City; for secretary, Ralph W. Pope, New York City. The officers whose terms have not expired are Vice-Presidents Chas. P. Steinmetz, of Schenectady, N. Y.; Prof. Harris J. Ryan, of Ithaca, N. Y.; Prof. Wilbur M. Stine, Chicago, Ill. Managers, Chas. F. Scott, Pittsburg, Bion J. Arnold, Chicago; Carl Hering, Philadelphia; Dr. Cary T. Hutchinson, John W. Lieb, Jr., and F. A. Pickernell, New York City; Prof. Wm. L. Puffer, Boston, and L. B. Stillwell, Niagara Falls.

THE MISSOURI WATER, GAS AND ELECTRIC LIGHT ASSOCIATION.

A special dispatch from Sedalia, Mo., of March 16, says: The Missouri Water, Gas and Electric Light Association held its third annual convention here to-day, J. A. Montgomery, of Sedalia, presiding, with C. F. Strohm, of Nevada, as secretary. A resolution was adopted favoring uniform rules all over the State for wiring and plumbing, under the supervision of inspectors to be appointed by the cities.

J. B. Quigly, James A. Montmogery, of Sedalia; S. J. H. White, of Carrollton; Wort, of Independence, and C. F. Strohm, of Nevada, were appointed a committee on rules and regulations for the government of wire fitters, plumbers and architects, the rules to conform to the rules and regulations of the United States Board of Underwriters.

Delegates favored the passage of a bill by the Legislature establishing a commission similar to and having the same powers of the State Railroad Commission, with power to regulate the price of water, gas and electric light in the different cities and to look after and maintain the purity of water sheds and water, and to establish a standard of purity for gas and power of electric light. The Massachusetts Commission law was accepted as a model and its adoption in this State will be urged.

The committee was given power to urge the passage of the law. It was decided for the old officers to hold over to the next meeting, the second Tuesday in September, which will be held in Sedalia.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION.

THE meeting for the organization of the Street Railway Accountants' Association of America was held at the Hollenden, Cleveland, O., March 23 and 24, 1897. The meeting was called to order by Mr. H. H. Windsor, of Chicago. Mr. Morris W. Hall, of Camden, N. J., was elected temporary chairman, and Mr. W. B. Brockway, of Toledo, O., temporary secretary. Committees on organization and nomination of officers were appointed.

The following gentlemen were present: Frank R. Greene, secretary, Chicago City Railway Company; Morris W. Hall, secretary, Camden and Suburban Railway Company, Camden, N. J.; W. W. Herrick, adjuster, Cleveland Electric Railway Company, Cleveland, O.; A. F. Walker, accountant, Allentown and Lehigh Valley Traction Company, Allentown, Pa.; William F. Ham, secretary, Nassau Electric Railroad, Brooklyn, N. Y.; D. A. Keister, auditor, Marion City Railway Company, Marion, Ind.; W. B. Brockway, auditor, Toledo, Bowling Green and Fremont Railway Company, Toledo, O.; F. S. Borton, secretary, Cleveland, Painesville and Eastern Railroad Company, Cleveland; Charles L. Wight, auditor, Toledo Traction Company, Toledo, O.; J. F. Calderwood, auditor, Twin City Rapid Transit Company, Minneapolis and St. Paul, Minn.; F. T. Pomeroy, general manager and treasurer, Cleveland, Berea and Elyria Railway Company, Cleveland; F. E. Smith, auditor, Lynn and Boston Railroad Company, Lynn, Mass.; H. J. Davies, assistant secretary and treasurer, Cleveland Electric Railway Company, Cleveland; E. S. Doud, secretary, Lehigh Traction Company, Hazleton, Pa.; H. C. McJilton, secretary, Baltimore Traction Company, Baltimore, Md.; H. L. Wilson, auditor, West End Street Railway Company, Boston, Mass.; W. G. McDole, auditor, Cleveland Electric Railway Company, Cleveland; William R. Avery, auditor, Cincinnati Street Railway Company, Cincinnati, O.; W. S. Dimmock, general superintendent, Omaha and Council Bluffs Railway Company, Council Bluffs, Ia.; P. V. Burlington, auditor, Columbus Street Railway Company, Columbus, O.; John Erhardt, assistant secretary, Cleveland City Railway Company, Cleveland; E. R. L. Tighe, accountant, Brooklyn Rapid Transit Company, Brooklyn, N. Y.; W. G. Ross, comptroller, Montreal Street Railway Company, Montreal, Canada; A. L. Linn, Jr., bookkeeper, Cleveland Electric Railway, Cleveland; J. M. Smith, comptroller, Toronto Railway Company, Toronto, Ont.; Dana Stevens, accountant, Eckington and Soldiers' Home Railway Company, Washington, D. C.; C. E. Reavis, secretary, Augusta Railway and Electric Company, Augusta, Ga.; E. D. Hibbs, auditor, Consolidated Traction Company, Jersey City, N. J.; Walter M. Barnaby, chief accountant, Brooklyn Heights Railroad Company, Brooklyn, N. Y.; C. N. Duffy, secretary and treasurer, Citizens' Railway Company, St. Louis, Mo.; Robert V. McCullough, cashier, Southern Electric Railway Company, St. Louis, Mo.; Henry H. Windsor, Street Railway Review, Chicago; Eward E. Higgins, Street Railway Journal, New York; T. E. Crossman, stenographer, New York.

The following programme was carried out, the papers being carefully prepared and eliciting considerable discussion:

Tuesday, March 23, 10 a. m.—Call to order and election of temporary chairman and secretary. "From Horse to Electric Accounts," H. L. Wilson, auditor West End Street Railroad, Boston. "Suggestions for a Standard System of Accounts: Classification of Operating Expense Accounts, and Form of Report that Will Admit of Comparison and Diffuse Information between Companies," C. N. Duffy, secretary and treasurer Citizens Railway, St. Louis. Appointment of Committee on Organization. Appointment of Nominating Committee.

Tuesday, 2 p. m., "Monthly Closing of Accounts," Dana Stevens, accountant for receiver, Belt Railway, Washington, D. C. "Transfer Tickets," Frank R. Greene, secretary Chicago City Railway. "The Relation of Accountants to Managers and Employés," P. V. Burlington, secreteary and auditor Columbus Street Railway, Columbus, O.

Wednesday, March 24, 9.30 a. m.—Report of Committee on Organization. Adoption of Constitution and By-Laws. Report of Nominating Committee. Election and Installation of Officers. "A Simple System of Interurban Accounts," W. B. Brockway, auditor Toledo, Bowling Green and Fremont Railway, Toledo, O.

Wednesday, 4 p. m.—"Naming and Standardizing Apparatus," J. P. E. Clark, general manager Binghamton Railroad Company, Binghamton, N. Y. "Depreciation," H. C. McJilton, auditor Baltimore Traction Company.

For General Discussion.—"Statistical Reports in a Nutshell." "Some Ways We Can Simplify Accounts." "Standardizing Accounts."

The following officers were elected: President, Henry L. Wilson, Boston, Mass.; first vice-president, C. N. Duffy, St. Louis, Mo.; second vice-president, J. F. Calderwood, Minneapolis, Minn.; third vice-president, C. E. Reavis, Augusta, Ga.; secretary and treasurer, W. B. Brockway, Toledo, O. Executive Committee, in addition to all of the foregoing, Dana Stevens, Washington, D. C.; W. S. Dimmock, Council Bluffs, Ia.; W. G. Ross, Montreal, Canada; E. R. L. Tighe, Brooklyn, N. Y

The afternoon of Wednesday was devoted to an extensive ride over the line of the Cleveland railways, and an examination of several power houses. An interesting feature of the meeting was the large number of accounting blanks which were exhibited by the delegates.

The meeting adjourned to convene at the time of the meeting of the American Street Railway Association, Oct. 19-22, 1897, Niagara Falls, N. Y.

HENRY ELECTRICAL SOCIETY.

The Henry Electrical Society will give its members and friends an especially interesting treat on Friday, April 2, in a lecture to be delivered at its rooms, 111 West 38th street, by Mr. W. B. Potter, on "Electric Railway Vagaries." Mr. Potter is the chief railway engineer of the General Electric Company, and is consequently so situated as to be able to present the latest developments in electric railway engineering. The lecture will be illustrated by slides.

The lecture following will be delivered by Mr. Alexander Stratton on Friday, April 23, entitled "The Use of Different Kinds of Iron and Steel in Dynamo Electric Machines."

MEETING OF TEXAS STREET RAILWAY MEN.

The street railway association of Texas met at Austin last week, and had a pleasant time. Resolutions of regret were adopted concerning the death of Mr. W. H. Sinclair, of Galveston, and against a bill giving one road free use of 2,500 feet of any other road it might connect with. Other business, chiefly of a routine character, was disposed of. The delegates present were: John H. Chiles, of the Austin Dam and Suburban Railroad; S. E. Scovill, of the Austin Rapid Transit; C. L. Wakefield, of the Elm street line, Dallas; Geo. T. Harston, of the Dallas Rapid Transit; Geo. D. Hanson, of the Fort Worth City Railroad, H. C. Chase, of the Houston City Electric Street Railroad, and D. D. Willis, of the San Antonio Street Railroad.

Maj. Ira H. Evans and other gentlemen connected with the street railroads were also present.

MARRIED

MR. H. H. KABAT, manager of the S. & B. Electric Company, of New York City, was married on Feb. 23 to Miss Hattie C. Ludwig. The marriage was a home ceremony, and several electricians were present to witness it.

LEGAL NOTES

TICKER QUOTATIONS MUST BE GIVEN OUT.

At Chicago, on March 25, Judge Horton, of the Circuit Court, overruled the motions of the Board of Trade, the Western Union Telegraph Company, the Gold and Stock Telegraph Company and the Postal Telegraph Company to dissolve the temporary injunctions restraining these parties from "detaching telegraph wires from the place of business of Harry E. Wiley, the W. A. Michael Commission Company et al., from removing 'tickers' and from cutting off or in any wise interfering with the 'supply of market information as has been heretofore supplied.'" The court said: "The Board of Trade is a private corporation. It has the same rights as other private corporations. It has the right to control and manage its private property and affairs, the same as any other private corporation has. If, however, the Board of Trade has so used or permitted such use of its property, or any part of it, that the same has become charged with a public interest, then said board has no legal right to deprive the public of the interest thus acquired, when it is sought and used only for legitimate purposes."

THE STOCK MARKET

SECURITIES STEADY DESPITE EVERYTHING.

THE United States Supreme Court having given a decision which is interpreted as a substantial condemnation of all agreements to maintain transportation rates, it might be expected that the stock market would go to pieces. But the conditions have all given evidence of a remarkable firmness, and it is beginning to be felt that for their own sake the roads will seek to maintain living rates, even without a mutual understanding. They must, unless desiring to find a lower depth of poverty than that of the last five years.

Outside of such general conditions of disturbance including the international troubles in Europe, the outlook is generally bright. There is a continued falling off in the number of business failures, trade shows improvement in dry goods, hardware, leather, shoes and agricultural implements; and even the numerous industrial strikes reflect the general expectancy of better wages.

During the past week, 10,126 shares of Western Union were sold, closing at 83; and of General Electric, 14,460, closing at 32. The decline in both is attributed to the state of the market. American Bell, however, rose two points from 223 and 687 shares were sold.

Local traction stocks and bonds are unchanged in price; Brooklyn, Buffalo and Worcester street railway securities are reported in better demand and rising. Edison Illuminating Companies remain firm and in fair demand.

PERSONAL

MR. CHAS. E. HART, who has been superintendent of the Toledo (O.) Electric Company for some time, has resigned his position to accept one as city electrician of Joplin, Mo. The employés of the company, to the number of thirty-five, called on Mr. Hart and presented him with an address expressing their regret at his departure, tendering him their best wishes for his success in his new home, and gave him several valuable presents as tokens of the esteem in which they held him.

PROF. R. A. FESSENDEN, of the Western University, at Allegheny, Pa., has been making successful tests of armor plate, for blow holes, by means of the Röntgen ray. He states that a heavy armor plate, ten inches thick, can be radiographed in two hours, and that the picture would then show any holes not smaller than an egg.

GARRET HOBART, JR., is, like his distinguished father, very much interested in practical electricity. The Vice-President of the United States inclines to electric roads and lighting plants, but his son, a bright chapple of twelve, is an expert in bell-hanging and has just applied seriously for the contract to keep the White House bells in order during the McKinley Administration. His request was made direct to the President.

MR. WALTER PHILLIPS has resigned as electrical engineer for the Illinois Steel Company, at South Chicago, to accept a similar position with the Russian-American Manufacturing Company, at Mariopol, Russia. Mr. Phillips sailed for his new post last week.

MR. J. A. RUTHERFORD, for some years past with the Westinghouse Electric & Manufacturing Company, has joined the Johnson Company, of Johnstown, Pa., as salesman in the street railway department.

MR. W. T. SCHELMERDINE, of Philadelphia, becomes president of the Queens County and New York Traction Company, and Mr. J. R. Beetem is to be general manager. The Queens County system comprises sixty miles of track.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

BY MAX OSTERBERG.

Central Stations:

STATEMENT OF CAPITAL EXPENDITURE IN ELECTRIC SUPPLY UNDERTAKINGS.—Details of 55 supply undertakings in charge of companies and of 69 in charge of local authorities, making a total expenditure of £9,673,335.—Lond. "Elec." Feb. 26, '97.

Dynamos and Motors.

CALCULATION OF IRON LOSSES IN TOOTHED ARMATURES.—By Dr. Max Breslauer. Objecting to the use of Steinmetz's formula, when applied to the mean of the magnetization of the teeth, author calculates an applicable formula, in which the results obtained, which for several values are tabulated, are determined by calculus, thus allowing of a calculation taking care of the gradual variation from small magnetization at the surface to the dense lines of force in the middle and at the end.—"Elek. Zeitschr.," Feb. 11, '97.

Electro Physics.

MECHANICAL CONCEPTIONS OF ELECTRICAL PHENOMENA AND INVESTIGATIONS ON ALTERNATING CURRENT RESONANCE EFFECTS.—By Dr. C. Heinke. An exhaustive study on the line of the Maxwellian celebrated mechanical analogies extended so as to include resonance effects. "Elek. Zeitschr.," Feb. 4, '97.

SOME PRACTICAL ASPECTS OF ELECTRICAL RESONANCE.—By Kempster B. Miller. Paper read before the Chicago Elec. Assoc. After briefly reviewing the fundamental principles of electrical resonance, author explains how prime movers may be regulated in speed by selective resonant effects. After explaining roughly the multiplex system of telephony of Hutin and Le Blanc of Paris, he closes with the hope that the condenser may be sufficiently improved upon to make it commercially a more valuable instrument.—"West. Elec.," March 13, '97.

Lighting:

FAULTS IN ARC LAMPS.—The lamps are separated into three classes, series or constant current system, constant potential system and 500 volt, or multiple series system. Methods of inspection and finding faults in these various systems are discussed.—"Sc. Mach.," March 15, '97, from "Am. Elec."

ELECTRIC SUPPLY AT 230 VOLTS. A. H. Gibbings, in a paper read before the Nor. Soc. of Elec. Eng's, Glasgow, maintained that the town of Bradford has run this system of high voltage lamps successfully for some time.—"Mech. World and Progr. Age," March 15, '97.

Mechanical:

RAWORTH "UNIVERSAL" TRIPLE EXPANSION ENGINE AND MORDEY INDUCTOR ALTERNATOR.—Detailed description with illustrations.—Lond. "Elec. Rev.," Feb. 12, '97.

Mining:

ELECTRIC ROCK-DRILLING BY THE SOCIETE DE CHARBONNAGES DES BOUCHES DU RHONE.—By Albion T. Snell. Illustrations of several types of drills, as well as data on the length of time required for drilling.—Lond. "Elec.," Feb. 26, 1897.

Power Transmission:

INSTALLATION AT STEINAMANGER WITH 12,000 VOLTS DIRECT CURRENT.—Steinamanger, Hungary, has a 12,000 volt direct current transmission plant of 1,200 horse power. The central station is at Ikervar. A waterfall is utilized and each turbine runs two six-pole generators. The dynamos are run in series, carefully insulated from ground. They are regulated indirectly by changing the inlet of the water in the turbine. The transmission line consists of 65 kilometers of copper wire, 9 mm. in diamter, and has a drop of 10 per cent. The wires, which are bare, are fastened to double petticoat insulators on painted poles.—"Elek. Anz.," Feb. 21, '97.

Roentgen Rays.

ON AN IMPROVED METHOD FOR PRESERVING THE PROPER VACUUM IN TUBES.—By Dr. Arnold Berliner. By attaching a poor conductor, such as damp wood to the cathode and putting a layer around the tube, the vacuum can be properly preserved.—"Elek. Zeitschr.," Feb. 11, '97.

Railways:

CLARET VUILLEUMIER TRAMWAY OF PARIS.—Description of a new contact system with illustration of distribution.—"West. Elec.," March 13, '97.

COST OF ELECTRIC CAR HEATING.—A car having about six heaters consumes approximately 6 horse power to 8 horse power. Considering the 700 to 800 cars constantly kept on the road in Boston, it is found that the amount of coal required for successful heating is about 12,000 tons per year.—"Bost. Journ. of Comm. and Sc. Mach.," March 15, '97.

GERMAN ELECTRIC TRAMWAYS.—Data taken from "Elek. Zeitschr.," giving details of tramways now running, such as date of opening, system, length of line, gauge, power station, etc. Eight out of 42 stations are run by the municipalities.—Lond. "Elec.," Feb. 26, '97.

Telegraphy, Telephony, Etc.

THE PRESENT DEVELOPMENT OF THE LONG-DISTANCE TELEPHONE.—By Jul. H. West. After a general introduction on the value of the service in general, the author mentions the necessity of (1) regular service, (2) quick service and (3) a cheap one. He then discusses the distances, which may now be successfully handled and divides the country into single sections, proposing to connect the various centers, 25 in all, by single, metallic circuit, trunk lines, involving an approximate cost for Germany of about $50,000,000. The question of disturbing influences receives attention, but the author is very liberal towards the electric railroads, claiming that the telephone company should first of all have metallic circuits and only then hold the railroads responsible for disturbing influences.—"Elek. Zeitschr.," Feb. 4, '97.

IS THE REDUCTION OF TELEPHONE RATES IN GERMANY FEASIBLE?—An editorial treats this problem and it is shown that a reduction of 33 per cent. in the rates would, within a very short time, increase the demand for telephone service to such an extent that the necessary outlay for enlarging would reach such dimensions that the government could not undertake it without serious difficulties.—"Elek. Zeitschr.," Feb. 11, '97.

REPORTS OF COMPANIES

SWAN INCANDESCENT ELECTRIC LIGHT CO.

The Swan Incandescent Electric Light Company, of No. 14 White street, New York City, has applied to the Supreme Court for the voluntary dissolution of the company, and Louis B. Van Gaasbeek has been appointed referee by Judge Smyth. The following directors united in the application: Mayor William L. Strong, Edwin Einstein, Emanuel Einstein, David L. Einstein, Charles W. Spear, Morris Fatman and Felix Samson. The company was incorporated in 1882, with a capital stock of $800,000, to manufacture and sell electric lamps under the patents of Joseph W. Swan. From 1885 until two years ago the manufacture was carried on by a licensee, the Swan Lamp Manufacturing Company, of Cleveland, Ohio, and during that period the only source of revenue was the royalty. Two years ago the licensee discontinued business, and since then the company has had no income. It was unable to begin the manufacture on its own account now, and as the patents expire during the current year the directors deemed it advisable to wind up the company. It has no liabilities, and its assets are $6,903 in cash, patents and a safe.

THOMSON ELECTRIC WELDING CO.

The annual meeting of the stockholders of the Thomson Electric Welding Company will be held at Portland, Me., on April 6. This company was reorganized last April, and under the plan of reorganization the assets were divided into two parts. One part, consisting of the assets not needed in the conduct of the new business, was placed in trust to be sold, and proceeds distributed according to the holdings of trust certificates. The other part, consisting of patents, patterns and drawings, leases and royalty contracts, manufactured stock and the balance of assets necessary to the development of the business, was retained by the reorganized company. There has been paid to date from the proceeds of the sale of the assets in the trust $2 per share, and it is expected that $2 per share more will be paid upon the final liquidation of the trust. The present stock is receiving semi-annual dividends at the rate of 6 per cent. per annum. A contract has been recently negotiated with the French government for some of the apparatus manufactured by the company. The company has cash assets amounting to over $75,000, and the total amount of its cash liabilities is nominal, being but $300.

TRADE NOTES & NOVELTIES

SOME INTERESTING FACTS ABOUT PLATINUM.

A RECENT importation of crude platinum consigned to Baker & Co., the platinum refiners of Newark, N. J., contained a nugget which is believed to be the largest ever exhibited in this country. This nugget illustrated herewith, is as usual of irregular form; it measures approximately three by two by three-quarter inches and weighs nearly two pounds. It is now on exhibition at the New York office of the above named firm, No. 121 Liberty street, where it is attracting the attention of metallurgists and the admiration of all who are interested in mineralogical curiosities.

It may be of interest to the general reader to learn that platinum ore is a most complex mixture of mineralogical species and includes not only a number of heavy reguline ingredients, such as platinum, iridium, osmiridium, palladium, rhodium, and gold, but also certain non-metallic species, notably chrome iron ore, magnetic oxide of iron, zircon corundum, and frequently diamonds. Because of its complex composition the ore has received the surname of "polyxine."

The heavy reguline ingredients are rarely found except in the form of small detached granules; the most notable exception to this rule being a nugget of Russian ore now in the Demidoff Cabinet in St. Petersburg, weighing between seven and eight kilograms. The average yield of metallic platinum from the ore varies between 50 and 80 per cent.

Platinum was first discovered in a Spanish mine of South America, early in the sixteenth century from which source it received its name "platina del Pinto" (little silver from the river Pinto). The ore is now found in various parts of the world, but the richest deposits are those of the Ural mountains which have been worked under the supervision of the Russian government since 1828.

The platinum of commerce is obtained entirely from alluvial deposits at depths varying from six to forty feet. The sand and gravel of former river beds are subjected to a series of screenings and washings to effect the separation of the ore; most of this labor in Russia being done by women. The yield of the ore per ton of sand seldom exceeds six grams. Sand yielding less than three grams per ton is rarely worked with profit. All Russian ore pays a government tax of three per cent., in the form of the ore mined, and any person possessed of the ore without a license is subject to imprisonment and confiscation of the metal.

Platinum occupies a unique position among metals. When pure and in compact form, it is tin white in color. It is the heaviest and has the highest fusing point of any metal in commercial use unalloyed. Its specific gravity is 21.5; it is therefore twice as heavy as silver and nearly three times heavier than cast iron. A temperature of nearly 1,800 degs. Cent., or 3,300 degs. Fahr., is necessary to fuse the metal, hence it is unaffected by temperatures attained in the hottest of blast furnaces. This valued property has led to the extensive use of the metal in such furnaces as an important part of an instrument for measuring temperatures.

Platinum ranks fourth as a conductor of heat and sixth as a conductor of electricity among metals. It expands and contracts, under variations of temperature, less than any other metal, and because of this fact, its high fusing point and nonoxidability, platinum is the only metal that can be successfully sealed into glass vacuum apparatus.

It is almost as soft as copper and ductile as gold. It can easily be rolled into sheets so thin that a thousand of them piled on top of each other would not exceed an inch in height. It is daily drawn into the form of wire not exceeding one-thousandth part of an inch in diameter.

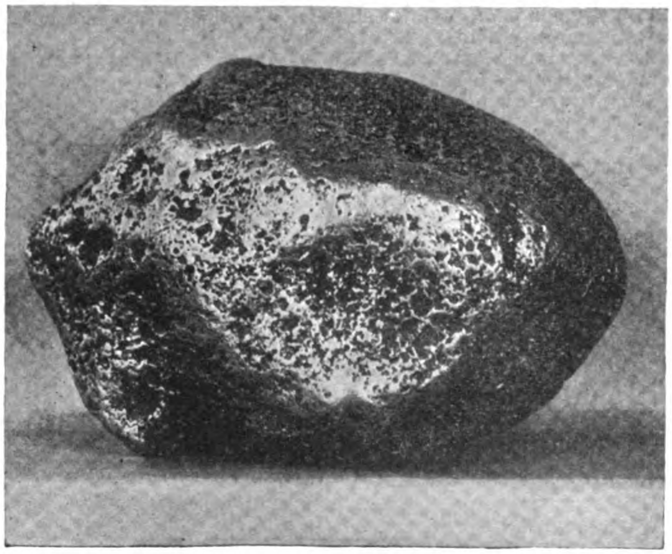
For use as "spider lines" in optical instruments platinum is drawn by a special process to diameters as small as sixty millionths of an inch. Such wires are nearly invisible to the unaided eye—a strand of it of sufficient length to encircle the earth at the equator would only weigh forty-six ounces.

Platinum is not attacked by any single ordinary acid and is not changed by air, water or steam at any temperature. Because of its many peculiar qualities it is one of the most valued metals made available to man's wants and notwithstanding its excessive cost, the present market price being $14 per ounce, its yearly consumption is rapidly increasing.

The chemist would be practically helpless in much of his work without the aid of platinum. In the words of Liebig, the eminent German chemist, "Without platinum it would be impossible, in many cases, to make the analysis of a mineral. The mineral must be dissolved, and it must be first rendered soluble, or prepared for solution. Now vessels of glass, of porcelain and of all non-metallic substances are destroyed by the means we employ for that purpose.

Crucibles of gold and silver would melt at high temperatures, but platinum is cheaper than gold, harder and more durable than silver, infusible at all temperatures of our furnaces, and is left intact by acids and alkaline carbonates. Platinum unites all the valuable properties of gold and of porcelain, resisting the action of heat and of almost all chemical agents. Without platinum the composition of most minerals would have yet remained unknown." Platinum is pre-eminently the metal of the chemist, both in analytical and industrial operations. No chemical laboratory is complete without a varied assortment of platinum apparatus and fortunes are annually invested in platinum retorts for the commercial concentration of oil of vitriol; chemical operations alone consumed until within a few years the bulk of the metal produced.

The dental and electrical industries which have progressed so rapidly within recent years are said at the present time to consume, in the United States alone, more than half of the world's supply of platinum. In the manufacture of artificial teeth, platinum pins are used to fasten the porcelain teeth to the supporting plate during the process of baking the porcelain. Platinum is the only metal available for this purpose because of the high temperatures required. It is also used in the form of thin foil for taking the impression of cavities in natural teeth which are to be subsequently filled with baked porcelain and still more extensively in the form of muffles to protect the baking porcelain from direct contact with the fire or the products of combustion which would discolor the porcelain. The consumption of platinum in the dental industry of this country for 1897 will probably be a larger quantity than ever consumed before in a single year in that industry.



A TWO-POUND PLATINUM NUGGET.

Platinum has, as is well known, played a most important part in the development of the incandescent lamp. It was early used as the light-giving body of the lamp, but subsequently yielded this position to carbon because of the latter's higher electrical resistance, higher fusion point and lessened cost. Although now occupying a less prominent position in the modern lamp it is nevertheless one considered as essential in the construction of a successful lamp. Many devices have been tried to avoid its use but without commercial success.

Radical changes in the construction of incandescent lamps have reduced the consumption of platinum per lamp enormously, but on the other hand the production of lamps has increased in greater proportion and the aggregate consumption is greater than ever before in that industry. The telephone, telegraph, and, in fact, almost all of the electrical industries, are yearly making heavier demands upon the limited supply of the metal. Physicians require it in cauteries and surgical instruments where extreme cleanliness is important. Platinum is extensively used in the finer grades of jewelry and a number of its salts continue in favor as superior to anything else for producing dead black surface effects upon silverware.

In photography the present fad for "platinotypes" illustrates a comparatively recent demand for certain salts of platinum. Platinum salts are also used by many photographers in preference to gold salts in toning silver prints. The platinotype is a special favorite because of the simplicity of the process of production, the artistic effects produced and the permanency of the picture.

To enumerate the many and varied uses of platinum and its salts would extend this article beyond reasonable limits. Suffice it to add that the latest application of its peculiar properties is due to Röntgen's discovery that certain invisible rays of energy when allowed to fall upon one of the double salts of platinum (barium-platino-cyanide) renders the same luminous so that a screen of paper covered with this salt and exposed to the action of Röntgen rays serves for the production thereon of a shadow picture of many objects of variable density which may be interposed between the screen and the source of the Röntgen rays. Metallic platinum is also a most important factor in the construction of Röntgen ray apparatus, both as a means of conveying electric energy into the vacuum chamber and as a source of excitation of Röntgen rays. Thus in this most recent development of the agencies for anatomical and physical research platinum plays a most important part; one which largely enhances its utility and value to mankind.

G. E. 1897 FAN MOTORS.

THE General Electric Company will this year, as last, place on the market fan motors for both alternating and direct currents designating them as G. E. fan motors, '97 model. They retain the compactness and simplicity of the '96 models, with certain improvements.

The alternating current fan motor, shown in Fig. 1, is made for operation on currents of either 60 cycles or 125 cycles. The speed is regulated by an inductive resistance operated by a three-point switch giving full speed and half speed and cutting off the current at the third point. The presence of this switch allows of direct connection of the motor to the circuit without the use of a socket and plug connection—an appreciable convenience.

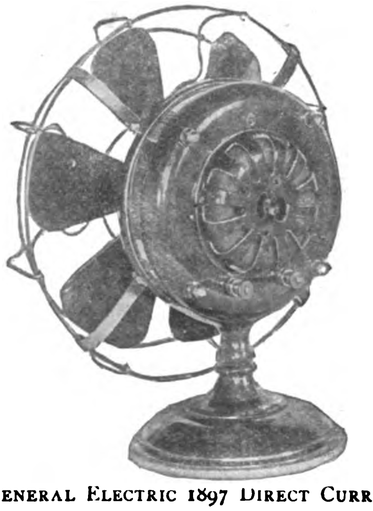


Fig. 1.—General Electric 1897 Direct Current Fan.

The electrical design of this motor follows closely that of the '96 model. The field core is a ring of iron punchings with inwardly projecting poles carrying the field coils. The armature is a laminated core through which, near the periphery, are run bare copper rods riveted to copper discs at each end the core.

There are neither commutator nor brushes, rotation being produced by inductive action. This permits the core to overhang the bearing to such a degree that, together with the fan, a balance is effected and the motor has but one long bearing, provided with a self-oiling device, so that it does not heat. The inconvenience of flying oil is entirely done away with by this method. The fan is 10 inches in diameter.

The direct current fan motor, Fig. 2, also has but one self-oiling bearing. The commutator is completely enclosed and the small carbon brushes are encased in tubes which may be readily unscrewed for inspection. A regulating resistance and switch on the base allows of changes in the speed of the motor. The fan is 12 inches in diameter.

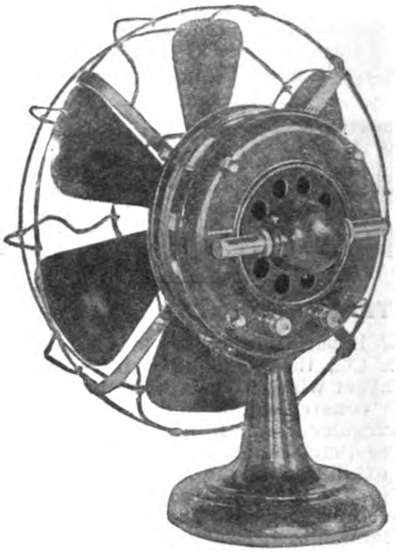


Fig. 2.—General Electric Alternating Current Fan.

The finish of all '97 fan motors and fans is black japan, the guard, bindings posts, nuts and screws being nickelled.

EMERSON "1897 MODEL" INDUCTION DESK FANS.

THE accompanying engravings illustrate the "1897 model" Emerson induction desk fans for alternating circuits. In external appearance the 1897 models of induction motors will present the same general design as the well-known "Meston" motors, which have become known in almost every part of the world where the alternating current is used.

The finish, however, will be slightly different. The illustrations, Figs. 1 and 2, show the fan motor in perspective and in section respectively. F indicates the oil well, showing the felt packing; G the oil hole; H, the double bronze bearing, and I, the switch handle. The armature, in common with all motors of the induction type, has no insulation, and it is, therefore, impossible to burn out.

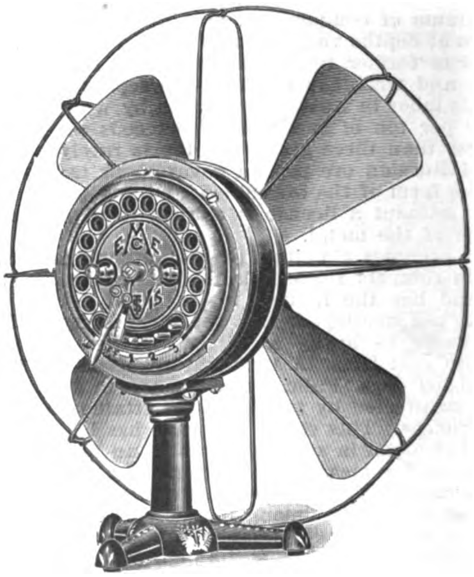


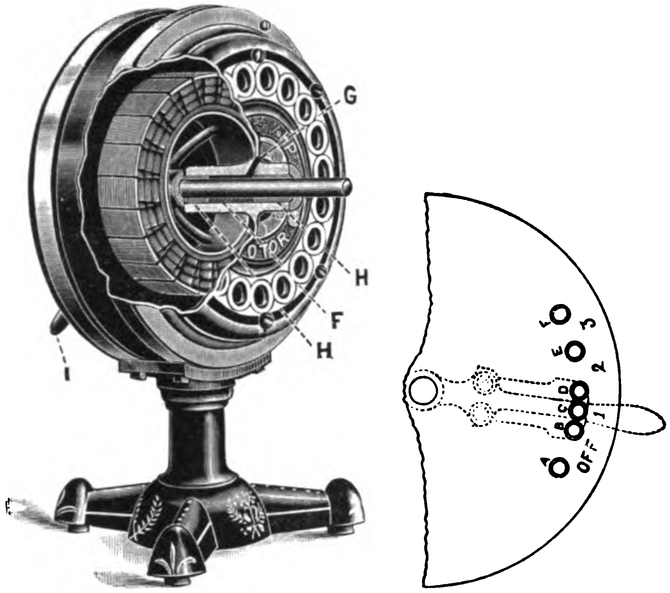
Fig. 1.—Emerson Alternating Current Fan.

The regulating switch, Fig. 3, comprises six contact pins and a contact lever, to make the proper connections; and there are four stops, namely: off, one, two, three. When the handle is opposite "stop" the switch makes contact with pins A and B, and A being the black pin and having no connection, opens the circuit.

When opposite No. 1, the lever makes contact with pins B, C and D, and the motor starts and runs up to full speed, and (for the 12-inch fan motor) takes approximately 65 watts.

When opposite No. 2, the "economy stop," the lever makes contact with pins D and E, and the motor will not start; but if running at full speed, will continue to run at this same speed and take only approximately 45 watts, or the current of less than one lamp.

The motors are double bearing motors, combining the advantages of the perfect alignment of a single bearing motor with the perfection of operation and wearing qualities, which can only be secured by a double bearing. The bearings are bronze and the shaft steel, a combination which is unexcelled for wearing qualities, and the design and proportions are carefully worked out to withstand the speed and wear.



Figs. 2 and 3.—Emerson Alternating Current Fan.

A large chamber has been left between the two bearings for lubricant, and this is filled with a special graphite lubricant, which is supplied to the shaft as required by a strip of the finest felt. This lubricant will not throw oil, and will last indefinitely.

The fan is a very important part of a fan motor, and must be carefully and correctly made to insure smooth running. The pitch of each blade must be just right; it must be in perfect running balance in all its parts. The Emerson Company were the first to support the blade rigidly, and the first to use a rigid fan hub, which cannot be bent out of shape. Many of these points are small in themselves, but it is the perfection of each detail which makes a perfect motor.

The 12-inch Emerson motors take 45 and 50 watts.

THE FLAGG IMPROVED MICA INSULATING JOINTS.

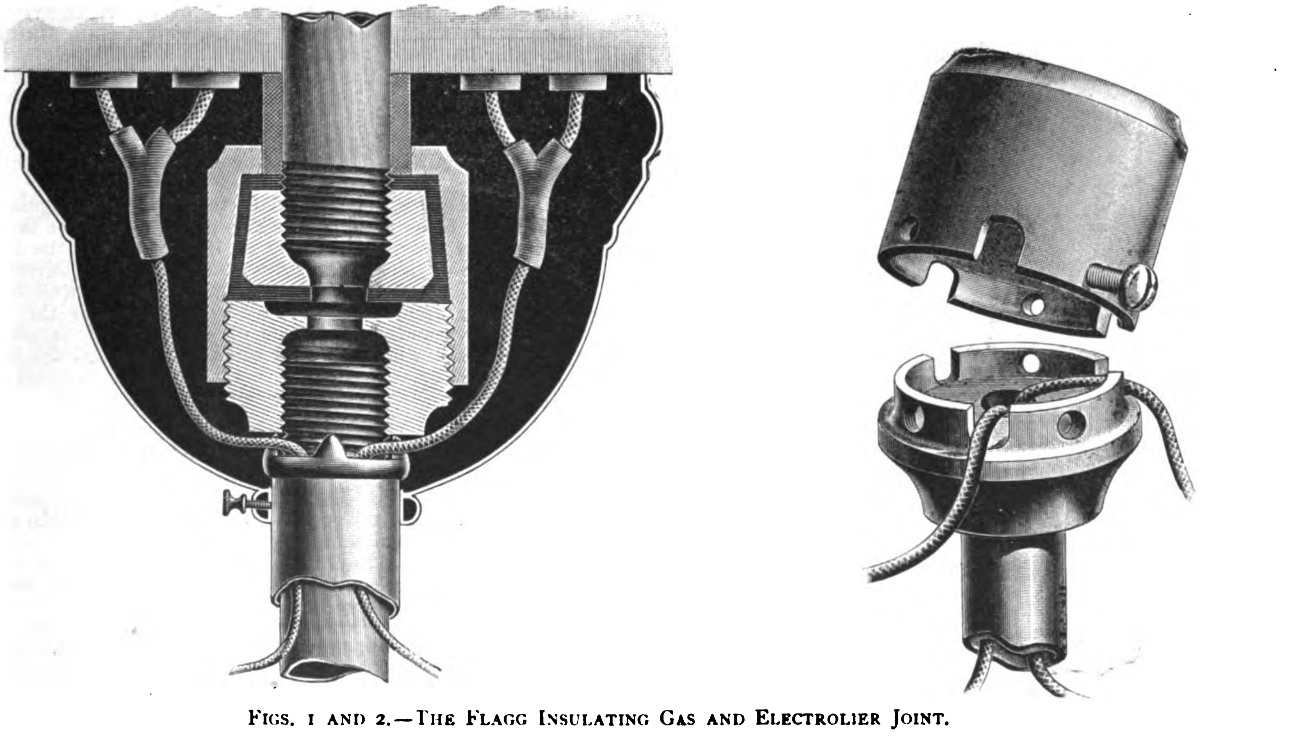
Perhaps more "troubles" are developed in fixtures than in any other part of electric house circuits, and a fruitful source of annoyance are defective joints. Messrs. Stanley G. Flagg & Co., of North Nineteenth street, Pennsylvania avenue and Hamilton street, Philadelphia, have brought out the "Flagg" improved mica insulating joint which possesses a number of excellent features. Our illustration, Fig. 1, shows the joint detached and Fig. 2, as applied to a combination fixture.

The joint for combination fixtures is so constructed that the "grounded part" is concealed in such a manner as to allow an insulated tube or ring to be placed over the gas pipe extending from the wall or ceiling surface into the top section of the insulator resting on the mica insulation, thus preventing the electric wires or taps from coming in contact with either the gas pipe or the grounded part of the joint. This dispenses with unnecessary tubes or tubing, which at present are required to be placed over the electric wires or taps extending from the wall or ceiling surface below the grounded part of the joint, and requiring an extra large canopy or shell to conceal the same, which makes an unsightly, bulky appearance, and greatly detracts from the beauty of the fixture.

This joint is capable of withstanding such strains as would be necessary in straightening the fixture after it is hung in position, without danger of causing a leakage of gas or injuring the insulated part.

The joint for electric fixtures is constructed so that when the joint is taken apart the electric wires or mains in the electrolier may be brought through the bottom part of it. The screws which connect the upper and lower section are so placed that the joint may be connected and disconnected after the fixture is in position, whether a plain or telescoped canopy is used, and an electrolier may be easily adjusted to an outlet in a corner or in an inconvenient place.

By the use of this joint the grounded part is thoroughly insulated, and it is not necessary to bring the circular loom tubing or the covering of the wires to the bottom of the joint. As will be noted in the engraving, this is cut close to the ceiling; this gives complete protection on the upper part in connection with the gas pipe and removes all liability to ground, and by the use of this joint the expense for extra tubing is done away with, and at the same time a much smaller canopy can be used.



Figs. 1 and 2.—The Flagg Insulating Gas and Electrolier Joint.

These joints have been approved by the inspectors in all the leading cities, as also by the United States Government and by the National Board of Fire Underwriters.

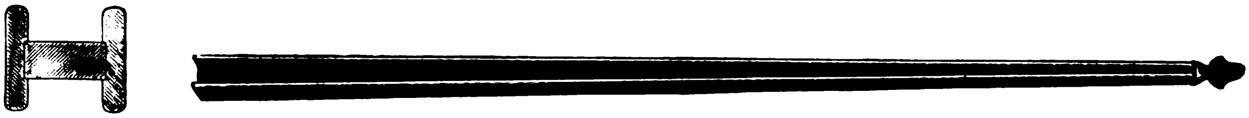
THE BROWNLEE BUILT-UP WOODEN POLES.

A DECIDED novelty which has commanded the immediate attention of electric railway, lighting and other companies, owning distributing conductors, is the Brownlee built-up wooden pole illustrated in perspective and in cross section in the accompanying engravings.

The pole is built up of three pieces, which construction gives it great strength and stiffness, while at the same time lending to the pole a handsome appearance. The construction also results in low cost.

The lasting qualities of these poles must be apparent. The construction permits of the use of seasoned timber which takes the paint well and, of course, lasts much longer than unseasoned stock. For ordinary purposes the Brownlee Company use a wood preserving paint, containing a large amount of creosote.

Messrs. Brownlee & Co., of Detroit, Mich., the makers of these poles, also furnish poles which have been creosoted under pressure. While such are more expensive, they are claimed to be superior to iron poles, and, under ordinary conditions, to last from thirty to fifty years. These creosoted poles absorb no moisture, and this, in connection with the fact that creosote is a non-conductor, adds largely to the insulating properties of the pole.

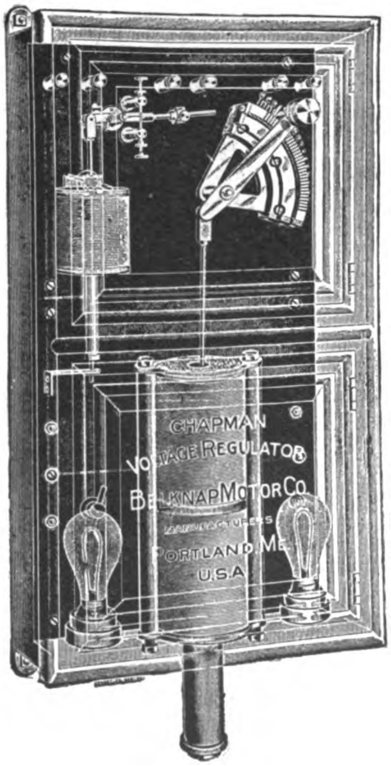


Figs. 1 and 2.—The Brownlee Built-Up Wooden Pole for Railway and Lighting.

Messrs. Brownlee & Co. have been in the pole business continuously for twenty-seven years, and were the originators of the "octagonal pole," now so generally used. Their plant covers over 30 acres. They own large tracts of standing timber in Northern Michigan and Canada, cut it themselves and manufacture it at their works in Detroit. Their facilities for shipping by both rail and water are all that could be desired.

THE CHAPMAN VOLTAGE REGULATOR FOR DIRECT AND ALTERNATING CURRENT GENERATORS.

THE high watt incandescent lamp is necessarily expensive in the item of power and the low watt lamp is also expensive in the item of lamp renewals when the regulation is poor.


CHAPMAN
VOLTAGE REGULATOR
BELKNAP MOTOR CO.
MANUFACTURERS
PORTLAND ME.
U.S.A.

Chapman Voltage Regulator.

But the low watt lamp combined with perfect regulation is the perfection of economy with incandescent electric lighting. Every intelligent station manager fully appreciates this fact and a good voltage regulator is the urgent demand of the times, and this demand is aimed at in the new Chapman voltage regulator, which the Belknap Motor Company, of Portland, Me., are now putting on the market. A large number of these have been put out and are in practical operation and have proved to be all that could be desired. The regulator is a magnetic device and acts very promptly, being only limited in quickness of action by the ability of the generator it may be regulating to respond to change on a field rheostat.

The device, illustrated in the accompanying engraving, is essentially a field rheostat whose operation is entirely automatic. The moving of the rheostat arm is accomplished by the action of a working solenoid, and the actions of the working solenoid are determined by those of an auxiliary solenoid which operates a set of contacts that control the admission of current to the sections of the working solenoid. The working solenoid is differently wound and is composed of four distinct coils, two of which have a small continuous current flowing through them, in electrical opposition to each other; the contacts close the circuit of one or the other of the remaining coils and so neutralize the action of one of the continuously acting coils.

This manner of connecting secures a rise of magnetism in the iron core of the solenoid whenever a break occurs at the contacts and so avoids any injurious sparking at the contacts that would naturally occur by the magnetic discharge of the core. The arrangement completely neutralizes the induction discharge, and no induction spark can occur. All of the usual objection to contact points is therefore entirely removed.

The entire work of the auxiliary solenoid is to move a lever arm with contact attached through a short space of say one-thirty-second inch, and a very slight change of voltage is sufficient to do this. It is often desirable to have the voltage at the generating station rise a little with the load so that it becomes greater than the voltage at the distributing center where it remains constant with changes of load. This result is aimed at in the compound winding of the generators, but, in most cases, is far from securing the result desired on account of changes of speed, which no compounding of the generator can compensate for. The compounding of the auxiliary solenoid, however, secures the desired result, and a plain shunt wound generator becomes just as effective as a compound wound generator. The use of the regulator enables the old style alternating current generators having no compound coils to do just as good work as the more modern apparatus. Thus many machines that have been discarded as out of date can be utilized with good effect. The same is also true of direct current generators.

As to the energy consumed in the Chapman regulator, it is so small as to be negligible. The operation of the large working solenoid only requires 60 or 70 watts, and the rheostatic part of the device is concerned only with the current in the shunt winding of the generator which, as is well known, is only a very small percentage of the output of the machine; so that the regulator may be operated on a machine of 150 kilowatts with an extra expenditure of energy, not exceeding 1-4 horse power.

H. W. JOHNS MFG. CO.

The announcement of the removal of the H. W. Johns Manufacturing Company from their 87 Maiden Lane offices to the new Woodbridge building, at William and John streets, serves to call attention to the enormous development which has taken place in the asbestos industry since its introduction in this country. Mr. Johns has been called the "Apostle of Asbestos," and the title has been well earned, for not only was he the pioneer of the industry in America, but all the various asbestos firms of Europe are indebted for what success they may have achieved to the development of the possibilities of the material to Mr. Johns' insight, study and enterprise.

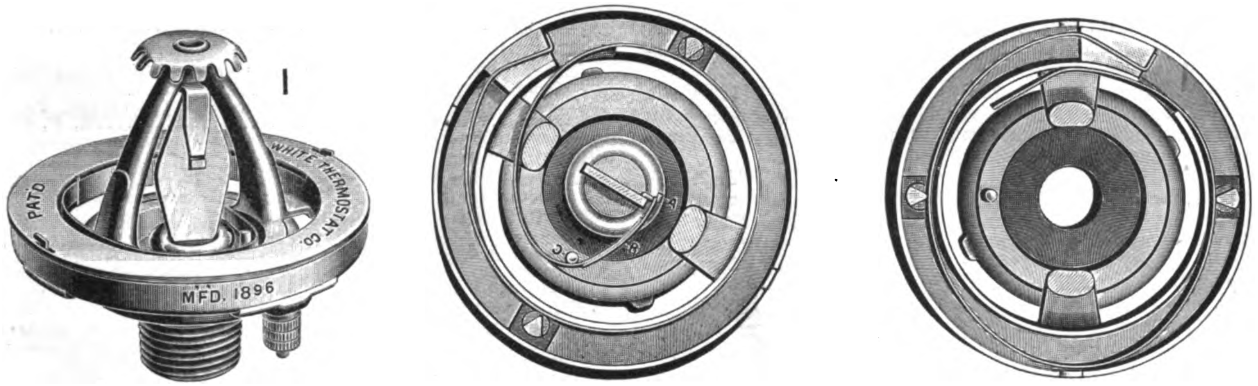
These qualities have built up the H. W. Johns Manufacturing Company to the largest asbestos house in the world, and we heartily wish it continued success.

PURITAN ELECTRIC COMPANY are moving from one floor to another in the American Tract Society building, Nassau street, New York City, in order to get better accommodation, and will be found hereafter comfortably settled in room 733 on the seventh floor.

THE COMBINATION WHITE THERMOSTAT AND GRINNELL SPRINKLER, AND INSULATED WIRE SUPPORTER.

EVERY building equipped with automatic sprinklers in order to obtain a reduction in rate of insurance must maintain an approved automatic fire alarm system or a reliable watchman and watch clock. The difference in expense and protection is greatly in favor of the former; consequently where an automatic system is employed a watchman can be dispensed with.

The White Thermostat Company, of Providence, R. I., in order to meet the demand for a simple and reliable system of fire protection, brought out a short while ago, a combination of the White thermostat with the well-known Grinnell sprinkler, thus combining in one apparatus both the elements essential to fire protection.



FIGS. 1, 2 & 3.—COMBINATION WHITE THERMOSTAT AND GRINNELL SPRINKLER.

The engraving, Fig. 1, shows the combination, and Figs. 2 and 3 show the inner parts in two views, the former showing the position of the spring before, and the latter after the release of the spring by heat.

The active agent is a coiled spring composed of two parts soldered together at B, with the same quality of fusible solder as that used to hold the sprinkler closed. One end of this compound spring is hooked to the movable part of the sprinkler, the part called, in the case of Grinnell sprinklers, the "Strut," which has to be removed to allow any water to flow. The spring can therefore be released in two ways—by the melting of the solder at B or by the opening of the sprinkler, releasing the spring at A. Either one of them will allow the spring to come into contact with the two v-shaped electrodes inside the thermostat, as shown in Fig. 3, and this gives the alarm.

The first important result of this construction is that the sprinkler cannot open and discharge water without instantly giving an alarm, for no water can flow until the "strut" falls out, and this releases the end of the thermostat spring at A.

The second result is that when a dangerous heat developes the thermostat will give an alarm before the sprinkler opens. An incipient blaze may be put out with chemicals before the sprinkler throws any water. The reason is, that although the solder used for the thermostat spring and the sprinkler are the same, the former is attached to very thin pieces of metal and is exposed on all sides to the air, while the latter unites pieces of considerable thickness, and has besides, the sprinkler, pipe, and water in the pipe, to draw away heat and retard the operating point. This radiation of heat away from the solder of the sprinkler makes a difference between the operating point of the device and that of the sprinkler from 40 to 60 degs. in favor of the thermostat, heat rising 1 deg. per second. Numerous tests before the New England Insurance Exchange show this. This feature of greater sensitiveness is a great point in favor of the White thermostat; but of the first importance is the fact that no sprinkler can open without instantly giving an alarm.

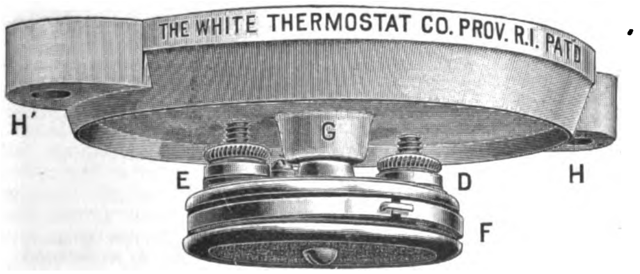


FIG. 4.—WHITE THERMOSTAT FOR USE IN UNSPRINKLED PLACES.

Sprinklers are opening occasionally on account of some fault of construction, by blows, freezing of water, and from various other causes not undue heat. This device, by giving immediate notice of such event, insures against anything but trifling water damage in such cases.

This ingenious combination has already proved its value in a number of instances. Where it is desired to install a thermostat alarm system without sprinklers the thermostat shown in Fig. 4 is well adapted. In this device, the porcelain base G is fastened to the ceiling by screws passed through holes H and H^1. The strap F is raised from the body of the thermostat by being soldered, not directly to the wall of the thermostat, but to a thin piece of metal raised on knees from the case. This allows air to circulate both behind and in front of the releasing part of the thermostat, thereby reducing radiation of heat to a minimum and increasing the sensitiveness of the thermostat. The sharp edge of the porcelain disc, as shown in the engraving, is designed to shed water from the device, thereby avoiding water crosses and consequent false alarms.

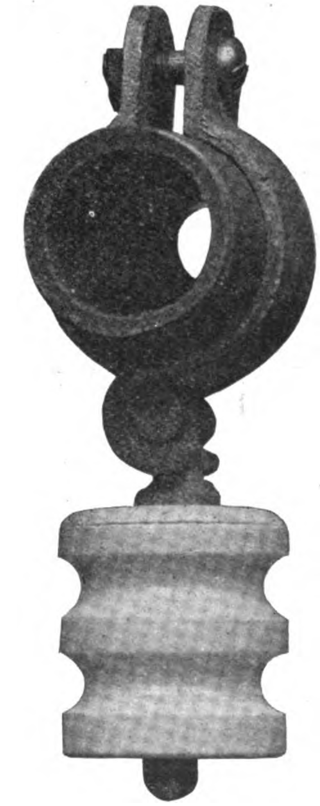


FIG. 5.—THE "JUSTIT" WIRE SUPPORTER.

Both this and the device described previously have been approved by various insurance underwriters' associations.

Another specialty of a very useful character, made by the White Thermostat Company, is the insulated wire supporter intended to be hung from pipes, shown in Fig. 5. This device termed the "Justit," consists of a brass clamp which is loose-jointed so that its two parts are readily and securely held in place by a single screw. The porcelain knob insulator is suspended by a split pin, the lower edges of which have offsets which hold the insulator in position. By pinching the spring pins, the insulator can be readily inserted in place or removed when desired.

ADVERTISERS' HINTS

THE VARLEY DUPLEX MAGNET COMPANY have removed from East Houston street, New York, to new quarters at 138 Seventh street, Jersey City.

A. L. BOGART, 22 Union Square, New York, says his dynamo-electric gas lighter is popular, reliable and a cheap substitute for matches.

F. M. LOCKE, Victor, N. Y., illustrates his "ad" this week with a cut of his insulator pin. This pin has been used on some very high voltage transmission lines and is proving itself strong and practically indestructible.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY, 1112 Samson street, Philadelphia, are advertising the Midget Jr. types of "I-T-E" circuit breakers. These devices have been found so thoroughly reliable wherever tried that the company have received a goodly number of supplementary orders as well as first orders.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., call attention to their system of testing every engine before leaving the shops. With a record of such economy tests the buyer knows exactly what he has to deal with and may accept or reject the engine, as he desires.

THE ELECTRIC ARC LIGHT COMPANY, 687 Broadway, New York, have something to say on the evolution of lighting methods.

HERMAN A. STRAUSS, E. E., 54 Maiden Lane, New York, makes a specialty of power-transmission work in all its branches.

THE GENERAL ELECTRIC COMPANY'S fan motors for 1897 are now on the market. The special advantages claimed for them are no heating, no oil-throwing, only one bearing, self-oiling and variable speed.

THOS. HILL, JR., 81 Pine street, New York, is the Eastern representative of the Ahlm-Edwards Electric Company, Medina, O.

THE WARD-LEONARD ELECTRIC COMPANY, Hoboken, N. J., are advertising automatic rheostats of the "I. A." type.

J. P. WILLIAMS, 39 Cortlandt street, New York, has a large variety of ceiling, wall and desk fans to suit all voltages.

THE COX-THERMO ELECTRIC CO., of St. Albans, England, cable that they have recovered from the effects of their recent fire and are now in good shape to fill all orders promptly.

NEW YORK NOTES.

WENDELL & McDUFFIE, managers, 26 Cortlandt street, New York, have issued a very clever and attractive circular in regard to the Hascall steam generator which they handle. The matter includes a letter from the Standard Rock Candy Company, of Brooklyn, testifying to a saving of from 20 to 25 per cent. in fuel, which will pay for the generator within the first year.

WESTERN NOTES

FLOOR GLASS INSULATORS.—As will be noted in the advertising columns of this number, the Electric Appliance Company are making a special drive on a lot of floor glass insulators which they are anxious to dispose of. The users of these insulators will find it to their advantage to get prices from the Electric Appliance Company, on what they have in stock.

K. McLENNAN & CO., sole manufacturers of the celebrated Gale's Commutator Compound, stated to a representative of this journal recently that there are few power and central stations as well as isolated plants, throughout this country, as well as in Canada, that are not at this time using Gale's Commutator Compound. They will, however, continue to furnish free sample sticks to the few who have not tried it. They have in contemplation the publication of "two thousand reports" from users, and they ask all who are now using this compound, who have secured same from their supply house and have not reported to them the results of their trial, to do so at once so that their report may be inserted in the forthcoming pamphlet. Free samples of Gale's Commutator Compound can be obtained of all supply houses.

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The Electrical Engineer.

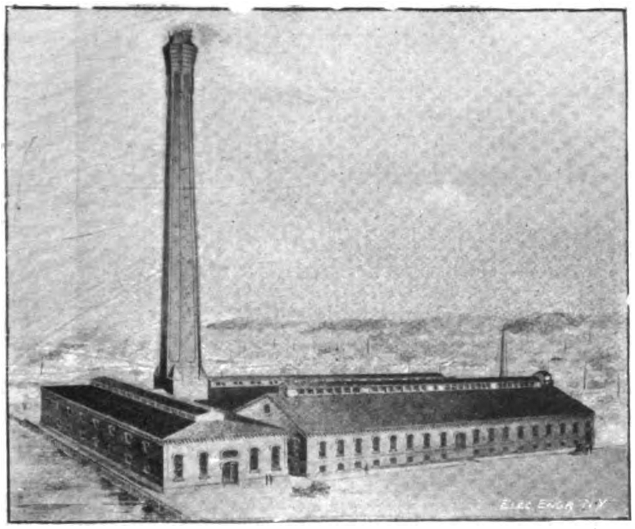
Vol. XXIII APRIL 7, 1897. No. 466.

ELECTRIC LIGHTING

THE NARRAGANSETT ELECTRIC LIGHTING CO.—THE EVOLUTION OF A TYPICAL COMPOSITE STATION.

BY JOSEPH WETZLER.

THE Narragansett Electric Lighting Co., Providence, R. I., was established by Edwards H. Goff in January, 1884, who brought from Lynn a single 25-arc light Thomson-Houston dynamo and operated it from an elevator engine in the cellar of one of the business blocks on Westminster street. He hung three or four lights in the corridors of this building and one at the street door. In the succeeding April he secured a city contract for 75 arc lights, and immediately proceeded to install a small steam plant of two 100-horse-power return tubular boilers, four 50-horse-power Armington & Sims engines, and eight 25-light Thomson-Houston arc dynamos. Meanwhile, he organized under a Maine charter, but in September of 1884 he secured a Rhode Island charter, with a capital stock of $100,000, and converted the whole property into the Rhode Island corporation. The plant was about half completed and the company had customers for ten commercial arc lights and seventy-five city lights, when, after three or four weeks of negotiation, a controlling interest was acquired by the present management, and the final papers were passed and delivery made on Friday, November 13, 1884.



THE NARRAGANSETT ELECTRIC LIGHT STATION, PROVIDENCE, R. I.

The new owners proceeded at once to complete the plant and develop the business. Considerable additions were made from year to year until 1888, when a rival company, known as the Rhode Island Electric Light Company, was absorbed by the Narragansett Electric Lighting Company. A new station was erected to receive the business of the two then existing stations. Not a single piece of steam machinery was removed to the new station. The steam plant installed was entirely new and is described later in this article. Every piece of electrical apparatus that was then in use has disappeared and been replaced by the most modern equipment. The steam plant which, when the present management assumed control, was 150 horse power, is now 7,500 horse power, and the electrical equipment, which was then a little over 100 kilowatts, is now more than 4,000 kilowatts. In 1884 the number of poles was 125, with about three miles of wire, while to-day there are 7,500 poles and 1,500 miles of copper wire.

BOILERS, FEED WATER HEATERS AND ECONOMIZERS, Etc.

Realizing that as much, if not more, can be saved in the proper equipment and management of the boiler room as in the engine and dynamo room, the company have spared no pains or expense to bring their boiler plant up to the highest point of efficiency according to the latest practice of the art.

In the construction of the boiler room or rather building, special pains have been taken to insure solidity and fireproof qualities. As shown in the sectional view on page 363 the walls, 32 inches thick, of brick, rest on piles upon which is built a heavy foundation of concrete. The boiler fronts likewise rest on heavy foundations erected on a double row of piling running through the center of the boiler room. The steel roof trusses are covered with tile at the sides and the monitor with glass, so that ample light is afforded. The trusses are made extra heavy so as to support the weight of the steam pipes.

The equipment of the boiler room consists of ten boilers of 300 horse power each. All of these are of the water tube type, six being of the Babcock & Wilcox make and four built by the National Water Tube Boiler Company, of New Brunswick, N. J. The National boilers have open hearth cast steel headers, which this company were the first to introduce in this country.

Situated in the rear of the boilers as shown in the sectional view of the boiler room on page 363 are five Green economizers, one for each pair of boilers, as shown in the plan view on that page. These economizers have about 5½ square feet of heating surface per horse power of boiler and deliver the water to the boilers at an average temperature of 250 degs. The scrapers of the economizers are operated by a 10 horse-power motor.

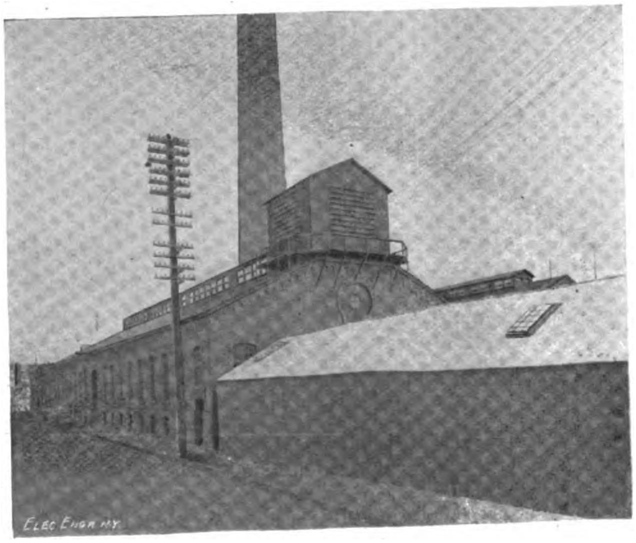
As shown on the plan, the boilers are arranged in three pairs on each side of a central aisle from which the firing is done. Space has been left for additional boilers when these shall be required, as indicated in outline on the plan.

The fuel employed is a mixture of New River semi-bituminous coal and anthracite dust. The firing is done by hand.

The draft is controlled by a Locke damper regulator and the boilers are fed by a duplicate set of Worthington pumps.

PIPING AND VALVES.

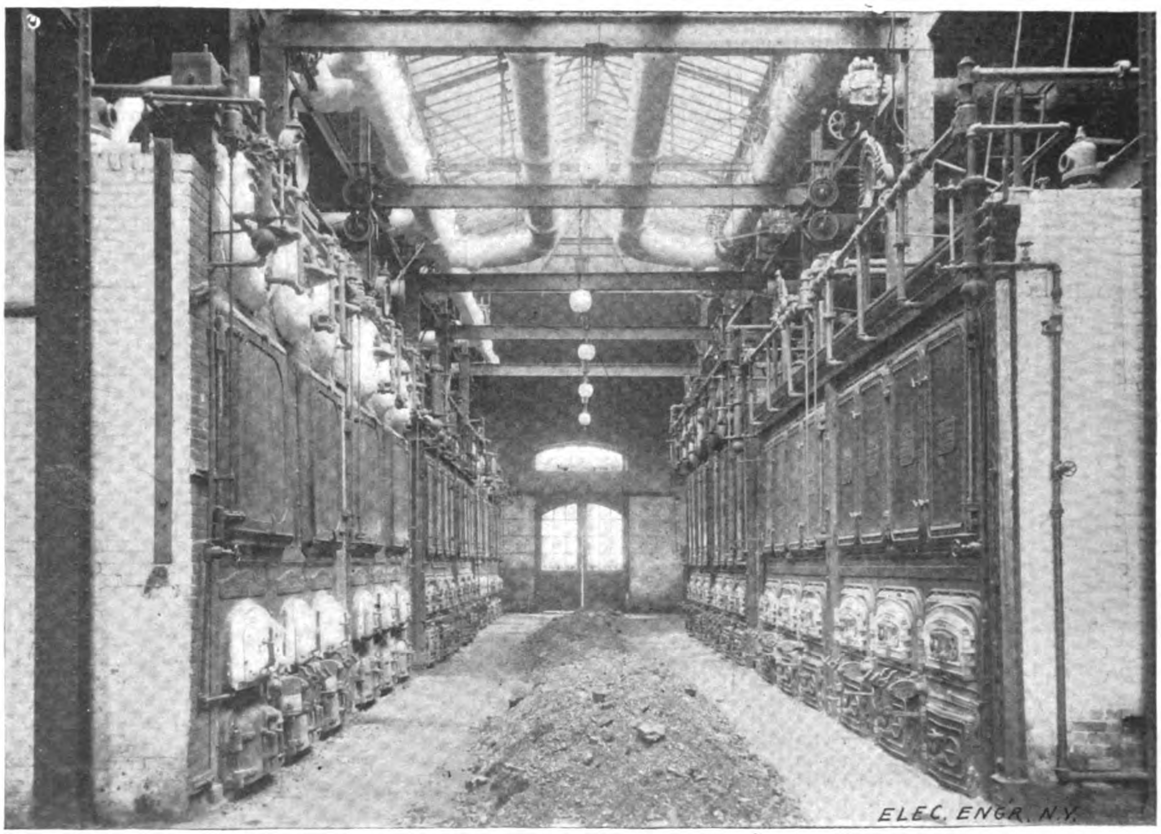
Having in mind the fact that the integrity of the steam distributing conduits within the station is quite as important a matter as the integrity of the outside electrical circuits, the Narragansett Company gave particular attention to the design of the piping in its station; indeed they were forced to adopt extraordinary means to meet their requirements. Having determined upon high boiler pressure, it was deemed advisable in the original installation, to employ wrought iron pipe, riveted and flanged. It was soon found, however, that even with the best attention this type of pipe could not be kept steam tight, and it was finally determined to take a new departure in stationary steam engine practice and to install steel piping. This was done and the result has been most satisfactory in every way, not a leak being visible anywhere throughout the station.



THE WIRE TOWER.

The arrangement of the piping is shown on the plan. As will be seen, each boiler feeds into a line of pipe running directly above the boiler heads and each of these lines is tapped at the center by two mains which run parallel and join at the end of the boiler room delivering their steam to the large 20-inch main steam pipe leading past the chimney to the engine room. Just after passing the chimney, the pipe is deflected downwards below the engine floor so that the steam is well drained before entering the engines above. The main steam pipe as it comes from the boiler room is 20 inches in diameter and ¾ inch thick. From this are supplied two main branch pipes, each 16 inches in diameter and ⅝ inch thick. This piping is made of open hearth cast steel, with the joint cast right on the pipe. As shown on page 364, the piping is provided with very heavy flanges, heavily bolted with male and female joints and copper ring gaskets, the latter being furnished by the Taunton Locomotive Works. All the steel piping is the product of the Penn Steel Casting and Machine Company, of Chester, Pa., and is tested up to 1,000 pounds pressure per square inch. As the boiler pressure carried at present is 165 pounds, there is thus an ample margin of safety. As shown on page 363 all the steam piping in the boiler room is suspended from the roof trusses.

All the valves controlling the steam in the main piping are of the Chapman type with an extra heavy pattern of gate. They are provided with bronze valve and seat, with outside screw and yoke and bypass.



Boiler Room, Narragansett Electric Light Station, Providence, R. I.

The throttle valves controlling the engines are peculiar in that they are of the globe type with bypass. Their construction will be readily understood from the engraving on page 364, which gives a sectional view of the valve.

THE CHIMNEY.

The great chimney which carries off the waste gases after they have passed through the economizers is one of the land marks and sea marks of Providence, being 260 feet high. Its construction is illustrated on page 364. It rests on 231 piles each 50 feet long, which are covered by a base of concrete 48 feet square and 7 feet 6 inches thick. The weight of the chimney is 4,600 tons and the pressure per square foot of foundation is 2 tons, and per pile, 20 tons. Since its erection not the slightest settling has been observed.

The chimney is of square section for a short distance from the base, and then takes an octagonal form to the top, ending in an ornamental cornice. The core is 14 feet in diameter. A feature of the design is an interior ladder extending from the base to the top of the chimney, to facilitate inspection.

THE POWER EQUIPMENT.

There was a time, not so very long ago, when in describing the power equipment of an electric central station a sharp line of demarkation could be drawn between the engines and the dynamos with the countershaft as the connecting link between them. That time is now past, and it stands to the credit of the Narragansett Company that it was among the pioneers in the adoption of direct connected units. Indeed, it was the first electric lighting company in the United States to install a direct driven alternator. This was, for the period, far more of an important innovation and new departure than it might appear to be now, even at so short a distance of time. It will be remembered that there was considerable talk and experiment on the subject in Europe, and the Narragansett Company looked across the Atlantic for their first machines of this character and size. American manufacturers were not, however, wanting in enterprise, and thus it came about that a radical change in practice was inaugurated that has been of immense benefit in central station operation.

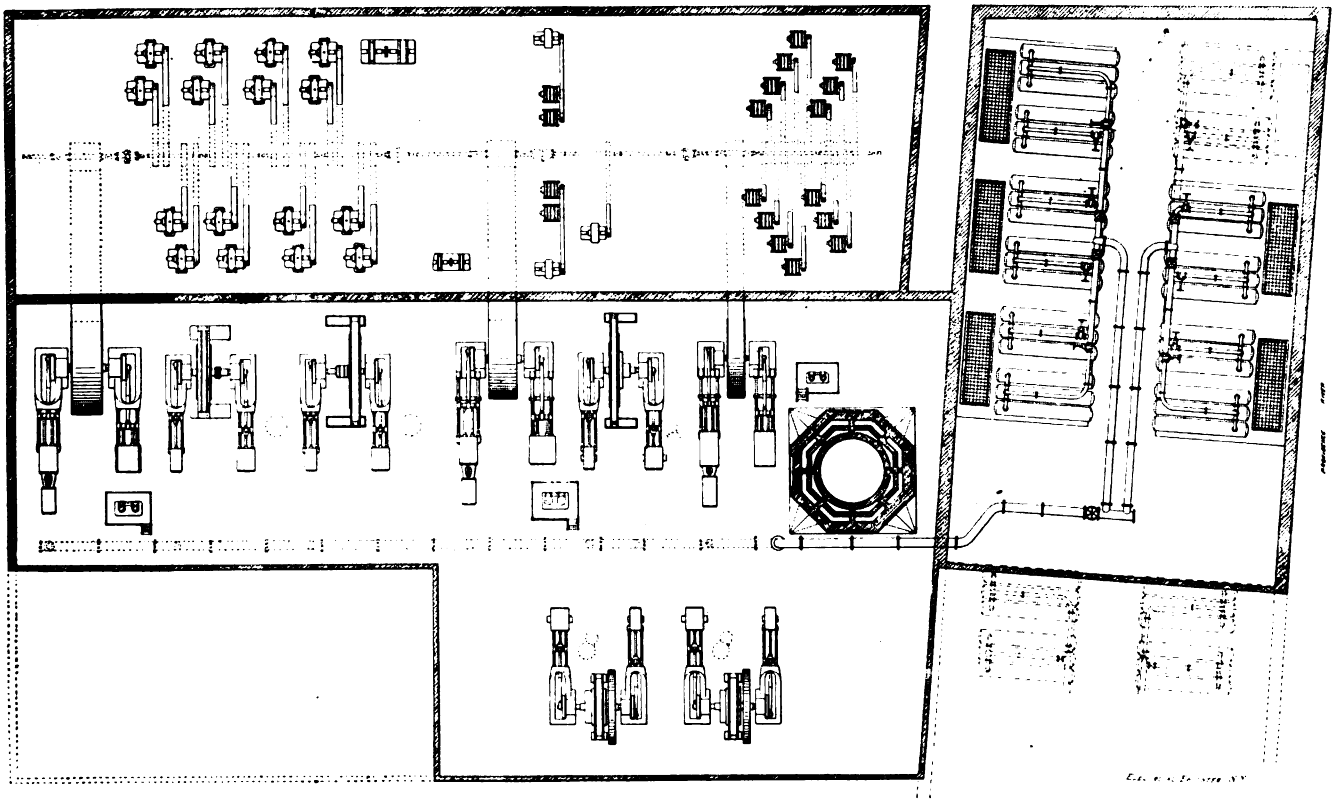
The foregoing remarks refer particularly to the direct connected units intended for constant potential service both alternating and continuous current. But as will be seen presently the countershaft is also met with in the Narragansett station for arc service—a remnant, as it were, of an ancient régime, but whose reign may be ended at any time. For the purpose of a better understanding of the nature of the power equipment, we may divide it conveniently into the three classes of service which it gives, namely: A 500-volt power service; alternating incandescent service, and arc lighting service.

The general arrangement of the engine room is shown on the plan on page 363. The present shape of this room is a notched rectangle whose greatest length is 200 feet, with a width of 102 feet, the notched unoccupied space of the lot being held in reserve for future additional equipment.

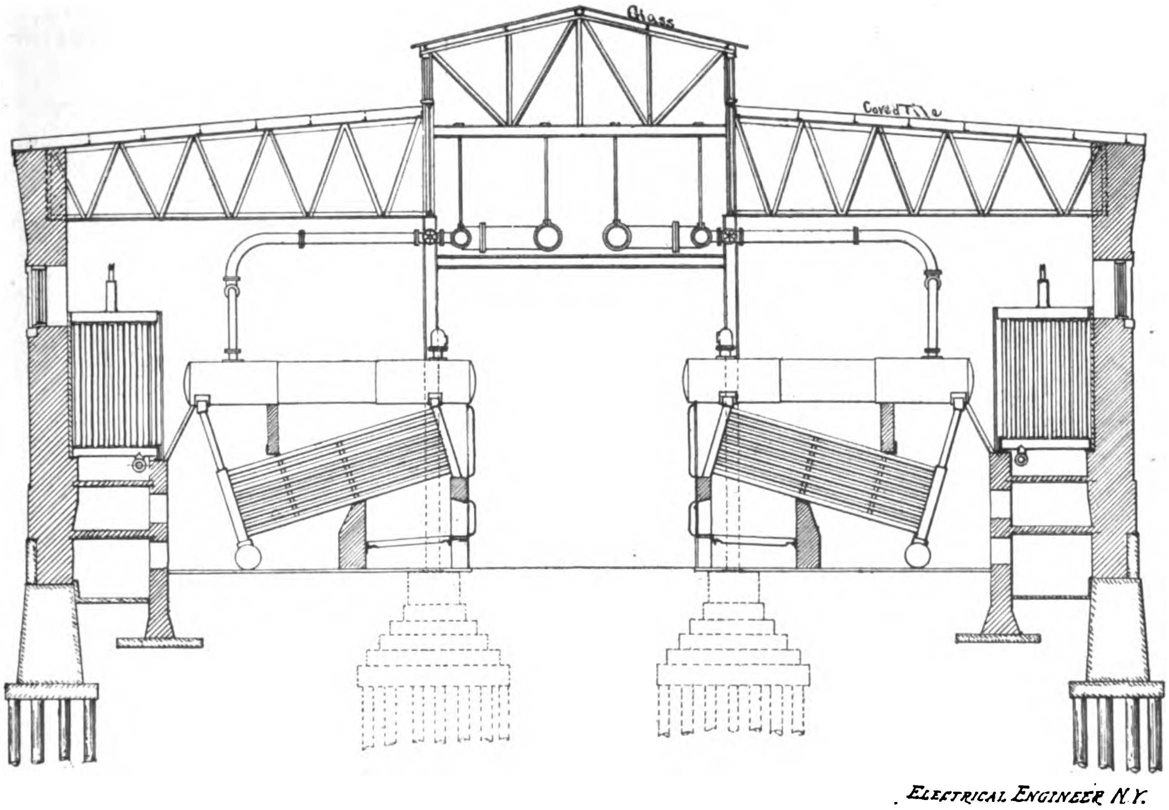
THE 500 VOLT POWER UNITS.

Looking from the boiler room to the left of the smoke stack will be seen two direct connected units, two views of which from opposite sides are given on page 365. The engines shown here are typical of all the engines in the station. They are of the 1890 Allis pattern of bed with wrought iron guides. This construction permits the engineer in charge to take in at one glance a whole row of engines, which he could not do with the usual style of box girder frame.

The engines are of the cross-compound Corliss type, all the cylinders being full steam jacketed and rather heavier than the standard pattern, with extra heavy journals. These, as well as the other cross-compound engines in the station, are fitted with direct connected air pumps. This pair of engines, built by the Corliss Steam Engine Company, of Providence, are directly connected to a pair of 500-kilowatt, 500-volt General Electric direct current generators. Each of these units is capable of supplying the present demand for power, one being kept as a reserve. The engines run at 90 revolutions per minute and so smooth has been their operation that in nearly two years no repairs of any kind have been found necessary, on either engine or generator, not even the commutator of the latter having been touched.



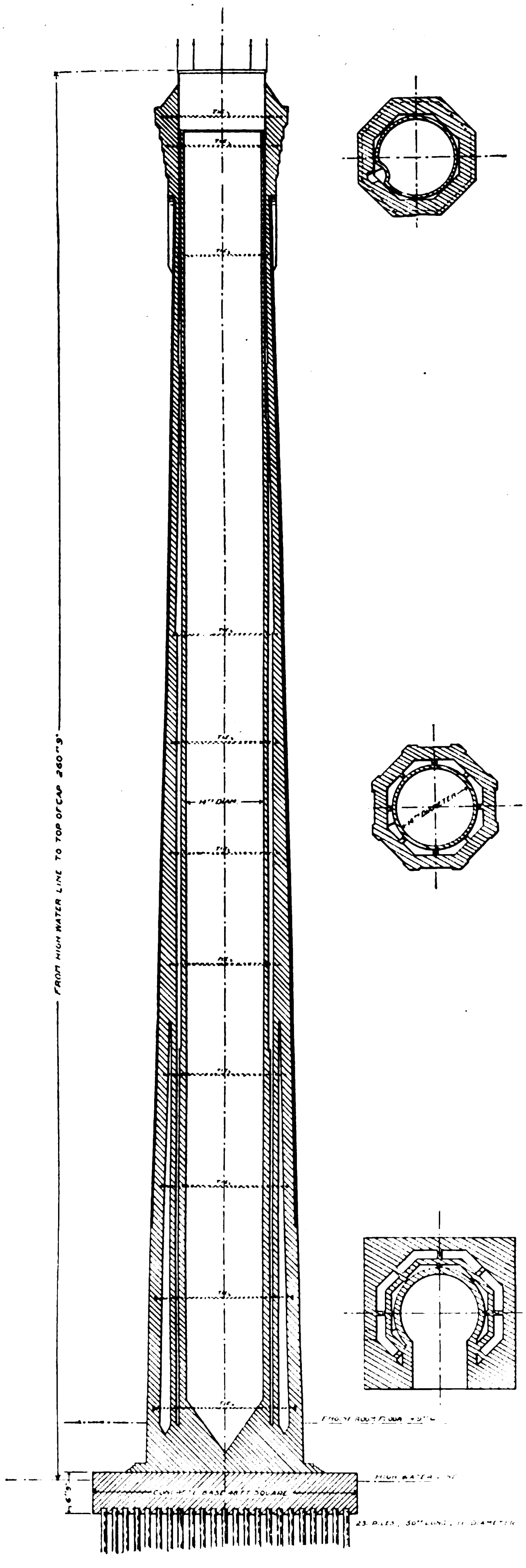
PLAN VIEW OF NARRAGANSETT ELECTRIC LIGHT STATION, SHOWING ENGINES, BOILERS AND DYNAMOS.



SECTIONAL VIEW OF BOILER ROOM, NARRAGANSETT ELECTRIC LIGHT STATION.

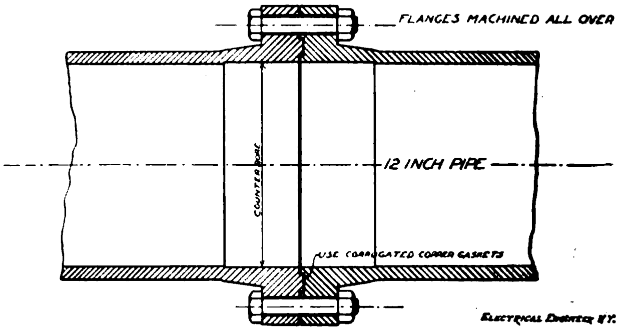
THE ALTERNATING INCANDESCENT UNITS.

It was in reference to these that the previous remarks regarding the steps which led to the building of the first direct connected alternator in the United States applied.


FROM HIGH WATER LINE TO TOP OF CAP 260'-9"
6'-9"
HIGH WATER LINE
23 PILES, 30" LONG, 11" DIAMETER

SECTIONAL AND PLAN VIEWS OF SMOKE STACK.

The engraving on page 366 shows one of these pioneer units. It is of 400-kilowatt capacity with 80 poles and the armature revolving at 90 revolutions per minute, delivering current at 2,400 volts and 60 cycles, single phase, to the outside circuits. One of these alternators was built by the General Electric Co. Two other units of like capacity built by the Westinghouse Company complete the alternating current equipment. The exciters of these three machines are driven from their respective engine shafts.



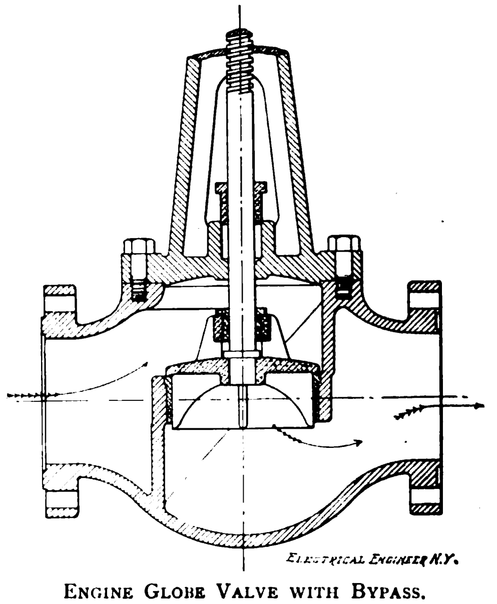
SECTION OF STEEL MAIN STEAM PIPING.

The engines driving the alternators are cross compound of 750 horse-power capacity each, and two were built by E. P. Allis & Co., the third engine unit being built by the Corliss Steam Engine Company. They conform in all essential particulars to the engines driving the 500-volt power generators described above. These three units are shown on the plan, page 363, forming a part of the line of engines running the entire length of the engine room. The total horse-power capacity of the station in steam units is 7,500.

THE ARC LIGHTING EQUIPMENT.

It is only when we come to the description of the arc lighting equipment that we are compelled to divorce the engines from the dynamos.

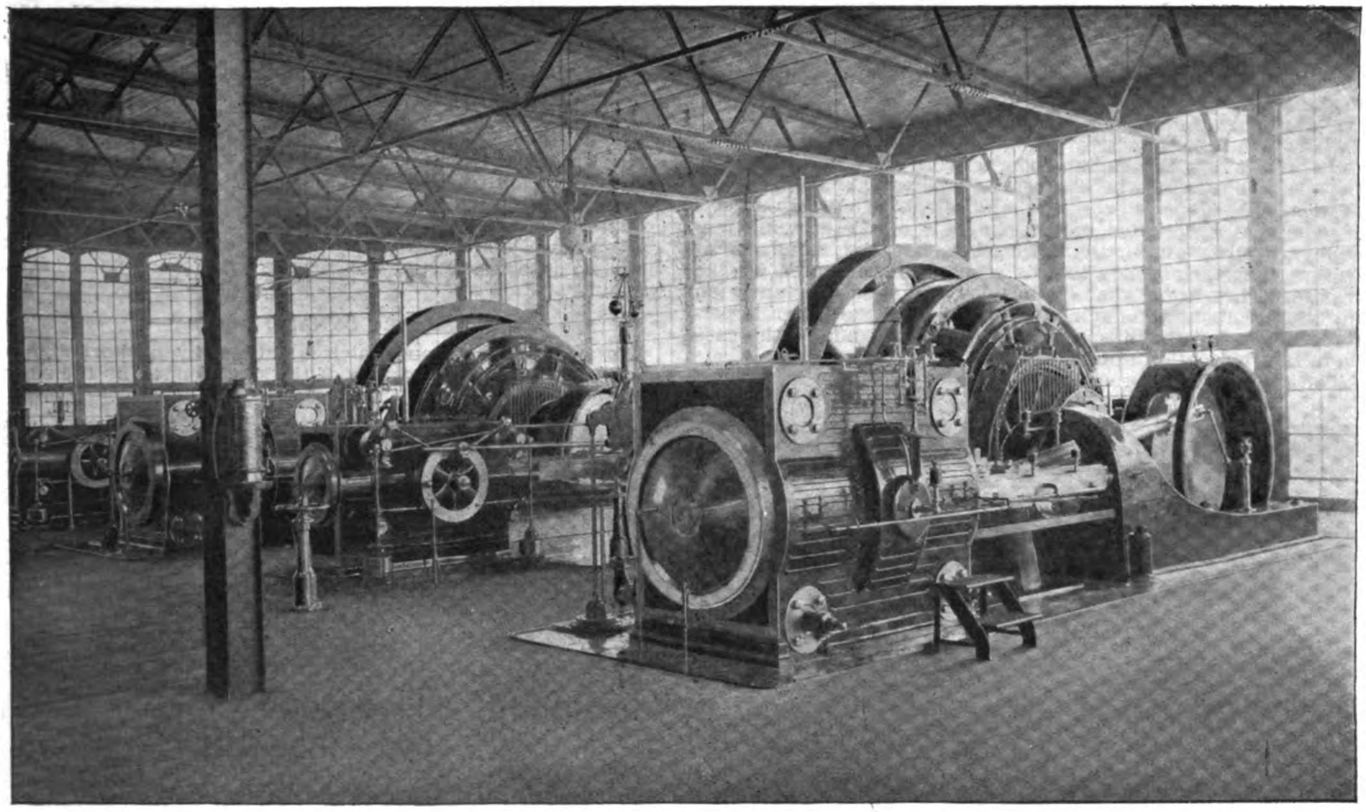
The nature of the load being a uniform one throughout the run, it was decided to install for this purpose triple expansion engines and, as a consequence, three of this type were erected, one of 750 horse power and two of 1,500 horse power each. These engines, built by E. P. Allis & Co., were the first triple expansion engines used for commercial purposes in this country, thus evincing once more the progressive policy of the company. These engines have independent air pumps and condensers of the G. F. Blake twin vertical type, and all the receivers are of the reheater type, steam at boiler pressure being circulated through wrought iron coils.



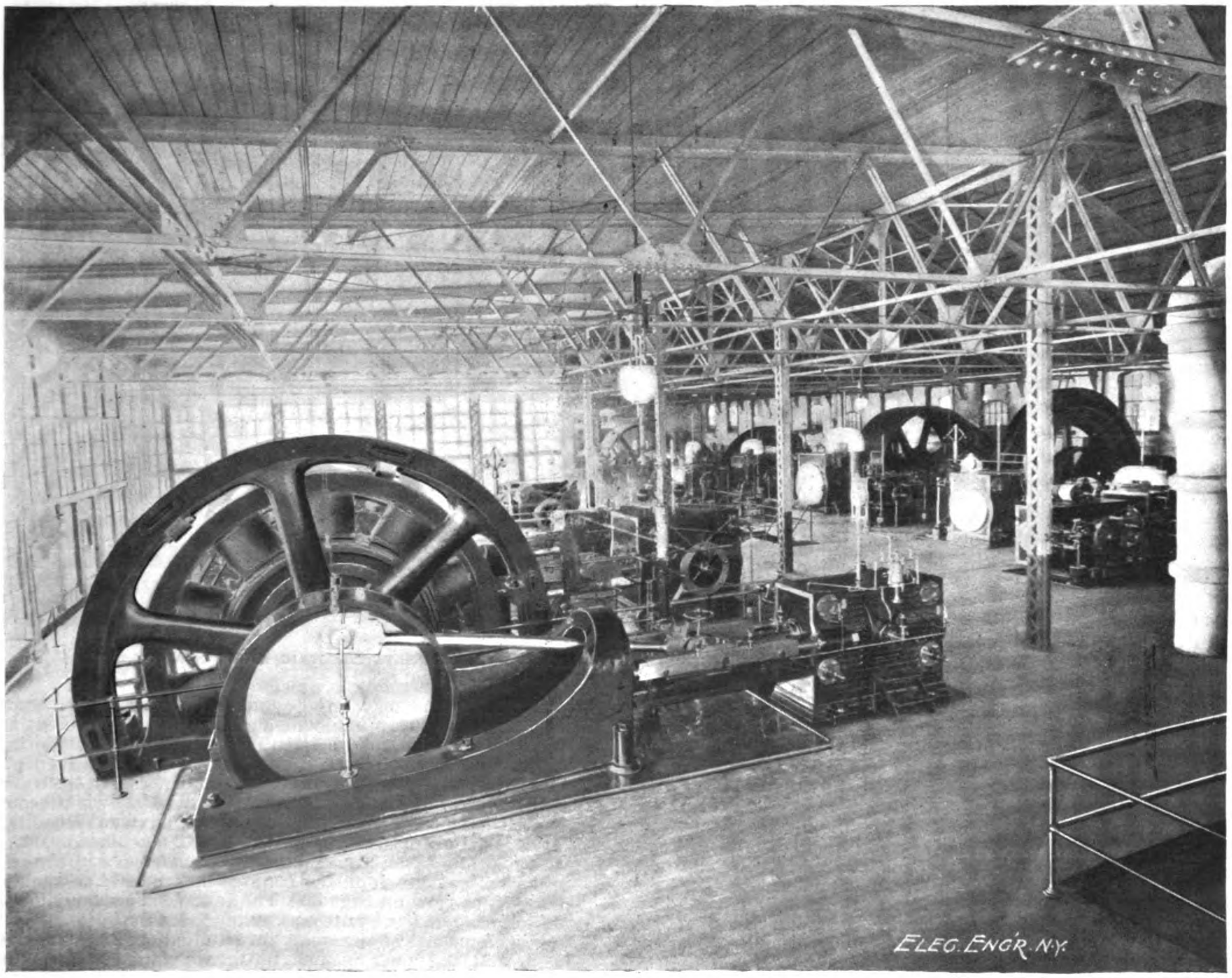
ENGINE GLOBE VALVE WITH BYPASS.

These three triple expansion engines used for arc lighting only, are belted to a countershaft running the entire length of the adjoining dynamo room, as shown in the sectional view on page 368. A view of the shaft alley is also given on page 367.

This main countershaft runs at 300 revolutions per minute. The shaft runs in ring oil bearings. No friction clutches are used, all clutches being positive. When it is desired to throw



500 Volt General Electric Power Units, Narragansett Electric Light Station.



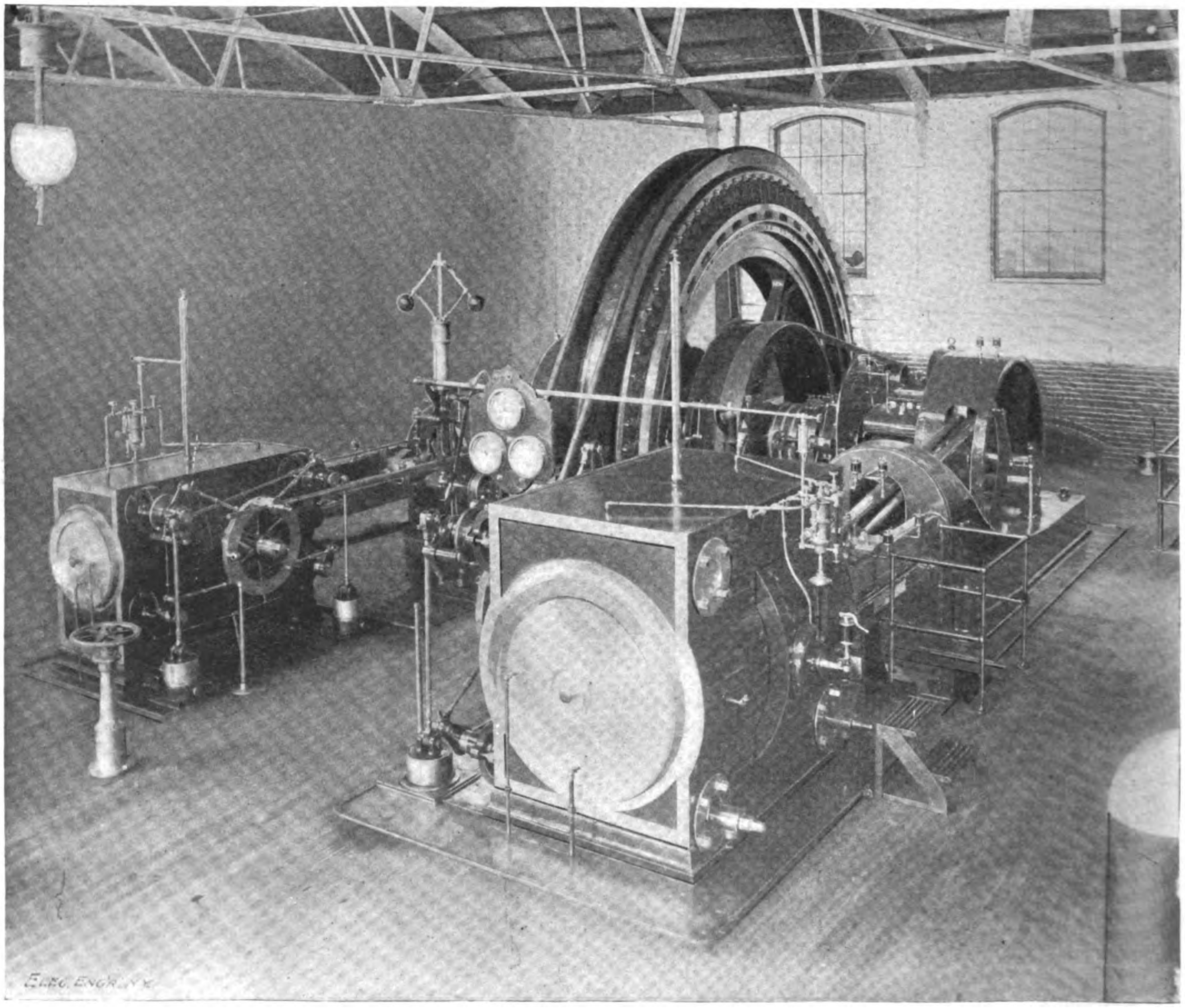
500 Volt General Electric Power Units, Narragansett Electric Light Station.

on additional machines, the engines are started up and coupled to the shaft when up to speed.

LUBRICATION, ETC.

Before leaving the engine room a word may be said about the general care of the engines and power apparatus. The lubrication is done entirely by hand oilers. This may appear a somewhat antiquated method in view of the growing tendency towards automatic lubrication, but the management believe that their policy in this respect is warranted by the results. They argue that by keeping the oiler constantly on his rounds about the engines, every part of the latter is perforce under constant inspection, which would not be the case were the lubrication automatic.

The lubricating oil required for the engine room is pumped up from below by a Holtzer-Cabot motor and Gould triplex pump to the oil stand, shown on the page opposite, and is thence distributed to the points required.



400 K. W. Direct Connected Westinghouse Alternator, Narragansett Electric Light Station.

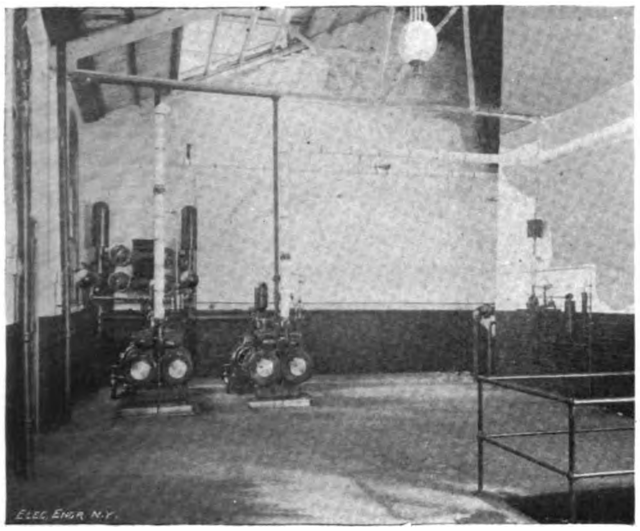
Much economy in oil consumption is effected by the use of a filter and purifier designed by the company's engineer and illustrated on the next page. The oil after use is led to the basement under the engine room floor into the large horizontal tank shown at the top, where it is heated by steam coils within the tank, and in which the heavy particles of foreign matter are precipitated. From this point the oil flows to the filters proper. Before entering the filter it passes through a body of water heated to 100 degs. and through a fine screen. The filtering material consists of wool waste and sponges. After passing through the filter, the oil drops through a pot of heated bone charcoal which clarifies it and at the same time evaporates all entrained water. The filter is cleaned periodically by simply pouring in hot water at the top and letting it run out at the bottom.

The belting employed at the station is furnished by the Page Belting Company, and Fayerweather & Ladew. The largest of the belts is 130 feet long and 6 feet 6 inches wide, three ply. It runs at a speed of 5,670 feet per minute, over a mile a minute. As indicating the efficacy of the methods adopted for engine and dynamo care, it is worthy of note that there has been no interruption of the service within a space of two years.

THE ARC DYNAMO ROOM.

The arc dynamo room which is entered by a short flight of steps from the engine room is of the same length as the engine room. Those who may have entered this part of the station less than three years ago will hardly recognize it now, such have been the changes in apparatus which it has undergone. Old types of arc machines of small capacity have given place to the more modern types and other changes have been made looking to economy of operation, as will be shown presently.

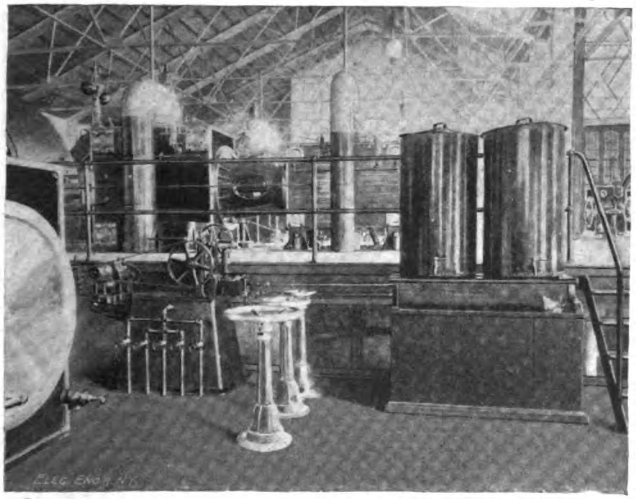
To the left of the entrance are situated sixteen Wood, Fort Wayne 125-light, 2,000-candle-power arc machines, each absorbing 65 kilowatts. These, like all the machines in the room, are driven by belts from the countershaft below, as shown in the sectional view on page 368. The new Wood arc machines are too well known to require any extended description. At the other extreme end of the room are situated eighteen Thomson-Houston MD_2 type ring armature arc machines. All these machines are employed for night lighting only. As it would evidently be poor economy to run the engines and counter shaft for the light day arc service, a special arrangement has been installed for this service exclusively. This consists of four Thomson-Houston arc machines driven two in tandem by two 500-volt General Electric M. P. 100 motors, which take their current from the 500-volt power generators in the engine room.



WORTHINGTON BOILER FEED PUMPS AND LOCKE DAMPER REGULATOR.

As stated, these arc machines carry the day arcs and the Sunday load, and also furnish current to the arc lamp testing and repair room. The economy of this method of operation must be obvious. A view of one of these pairs of motor-driven arc dynamos is shown on page 369.

Besides the arc machines there is a 100-kilowatt direct-current 500-volt generator driven from the main shaft which takes care of the commercial power service at night, a number of the Providence daily papers running their presses by electricity. This, it will be seen, allows the large 500-kilowatt generator units to be shut down completely at night.



OIL PUMP AND DISTRIBUTING STAND.

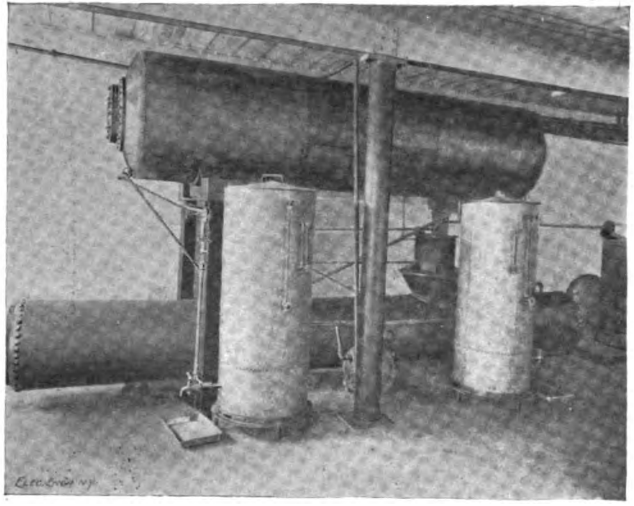
Tucked away at the side of the room finally is the small direct connected outfit shown on page 369. This consists of a 25-kilowatt G. E. induction motor direct connected to a 25-kilowatt direct current generator. The induction motor takes its current from the alternating circuits. This unit is intended to furnish current for testing wattmeters, and also for commercial purposes, when the power load is very light, as on Sundays and holidays. A similar outfit of 100 kilowatt capacity will shortly be installed, so that under no circumstances need the 500-kilowatt direct-current generators run under light load.

It will be noted that no wires leading to any of the machines are visible in the view, given on page 368. All wiring is, in fact, run below the floor on vertical racks, the conductors being supported on porcelain insulators mounted on slate.

THE SWITCHBOARDS.

The three classes of service, power, incandescent and arc lighting, are controlled by individual switchboards, ranged side by side at the end of the room facing the Fort Wayne arc machines. These are shown in perspective on page 369.

The board at the extreme left, ranged at right angles to the other two, controls the power circuits. It is of the simple, multiple type and provision is made for eight feeders and four generators. Weston ammeters are placed on each feeder and generator panel, and Weston differential voltmeter and potential indicators are plugged in on a tablet board shown in front of the switchboard. In fact, all the indicating instruments on all the switchboards are of the Weston type.

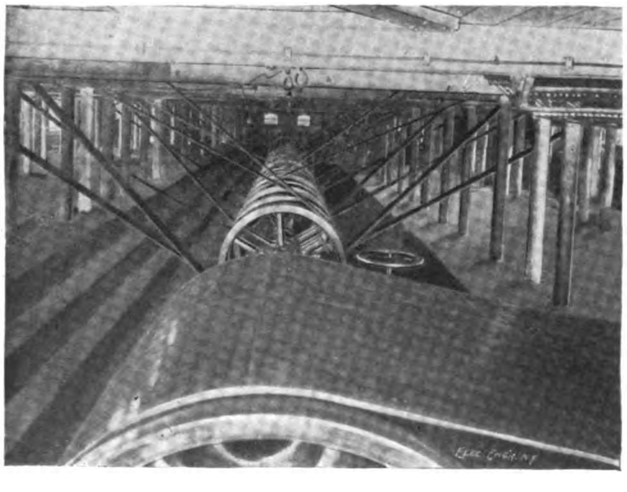


OIL FILTER AND PURIFIER.

The arc switchboard occupies the position at the extreme right hand. It consists of seven panels with provision for six circuits and six dynamos to each panel. The panel slabs, of white marble, are boiled in paraffine. All contacts are on the back of the board, which is of the plug type and was manufactured by the Allen Fire Department Supply Company, of Providence. It is noteworthy that this board was the first of its kind built in this country for service in connection with high tension (7,000 volts) arc work. Besides the usual ammeters and voltmeters, the board is provided with a voltmeter ground test showing the approximate location of a ground.

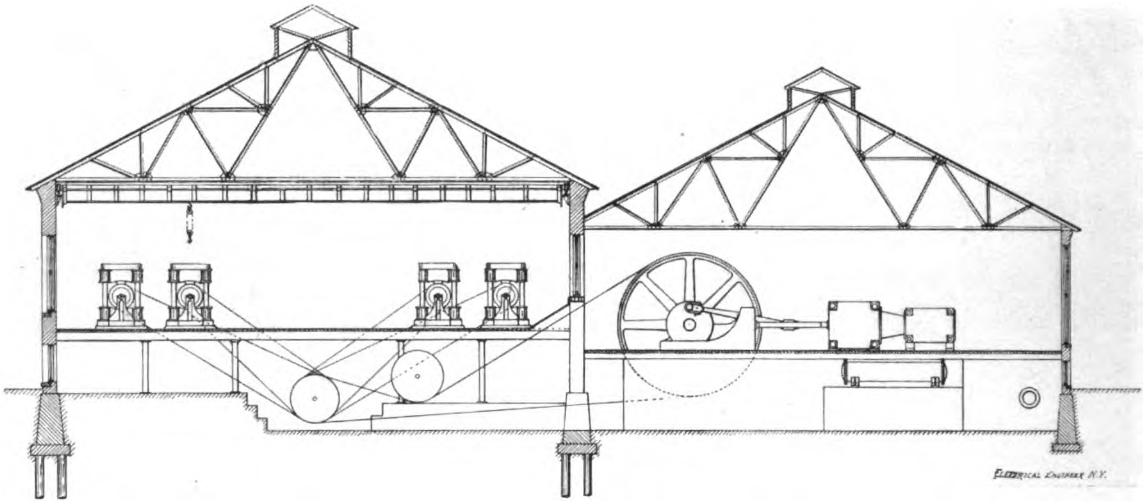
The alternating incandescent switchboard which stands between the two boards just described will soon be replaced by a new one and as the latter embodies the latest improvements in the art we believe our readers will prefer to have it described rather than the old one about to be discarded.

The new alternating switchboard now being built by the Stanley Electric Manufacturing Company, will be of white marble to harmonize with the adjacent boards, and the illustration on page 370 shows one panel of the board in front and side view. The board will stand 66¼ inches high with an



THE SHAFT ALLEY UNDER ARC DYNAMO ROOM.

overall length of 26 feet and 4 inches; this length containing four generator panels and ten circuit panels supported 6¼ inches from the floor upon 15 iron pipes 2½ inches in diameter. The ordinary pipe flanges are used for fastening to the floor and are covered with a neat polished brass shield, while each upright is provided with iron brackets to which the marble is bolted. Polished caps surmount each pipe from which hang goose necks with sockets and lamps for lighting the board and for use as pilot lamps.



SECTIONAL VIEW OF ENGINE AND ARC DYNAMO ROOM, NARRAGANSETT ELECTRIC LIGHT STATION.

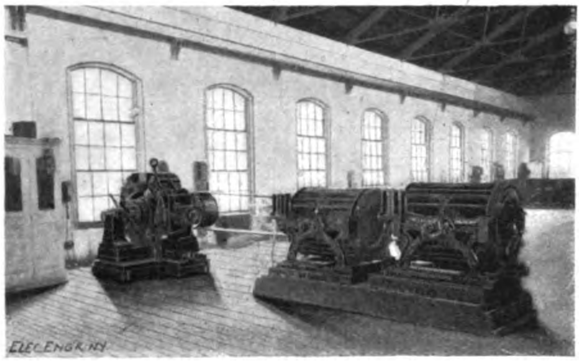
To guard against the attendant coming in contact with live metal (2,400 volts alternating are employed), all switches are placed at the back of the board and operated by thoroughly insulated handles at the front. The main switches used are two pole, single-throw, and have a capacity of 200 amperes, being so arranged as to cause a simultaneous break at four points of the circuit. Each of these four breaks is provided with an "enclosing box" or arc rupturing device, making an absolutely safe switch for handling these large units. The circuit switches, page 370, are similar in design to the main generator switches, but are double-pole, double-throw. In connection with the plugs and cables this arrangement enables the attendant to transfer any circuit upon any set of bus bars corresponding to any generator. The plugs and plug receptacles used are of a new design which makes it practically impossible for one to cause a wrong connection or to come in contact with any line terminals; the plugs are also provided with special, high insulation cables, insuring absolute safety. Perfect contact between plugs and receptacles is gained by corresponding tapering surfaces (the plug having a taper hole and the receptacle a cone-shaped projection) which are ground to a perfect fit. These surfaces are drawn tightly together by a locking device which also prevents jarring off by constant vibrations or other causes. The metal parts of the receptacles are back of the board and the corresponding hole through the marble is covered with a molded rubber cap.

THE ARC DYNAMO ROOM, NARRAGANSETT ELECTRIC LIGHT STATION.

The rheostats placed at the bottom of the four generator panels are of the wire-wound type for the back of the board and each is in circuit with the field of one of the exciters. At the back of the board and in connection with the field switch is a resistance for taking up the "kick" when the field circuit of an exciter is opened. The ammeters are provided with nickel covers and are of sufficient capacity for the several generators and circuits.

Static ground detectors of the Stanley make are provided for each generator or corresponding set of bus bars; a full description of these instruments will be found in The Electrical Engineer of February 17, 1897. Each generator and circuit is also provided with a static voltmeter similar in principle to the ground detector, those on the circuits being connected to pressure wires from the centers of distribution.

Supported from the back of the iron pipe framing is an insulated bracket for the bus bars, the arrangement being clearly shown on next page. The bus bars are of solid round copper one inch in diameter and are provided with special bus bar connectors for making connections to the main switches and the plug receptacles of the circuit panels; the arrangement of this and of the entire board is such as to permit of the addition of generator or circuit panels at any time. The marble used is clear white Vermont marble and in this case was all boiled in hot paraffine to improve its insulating qualities.

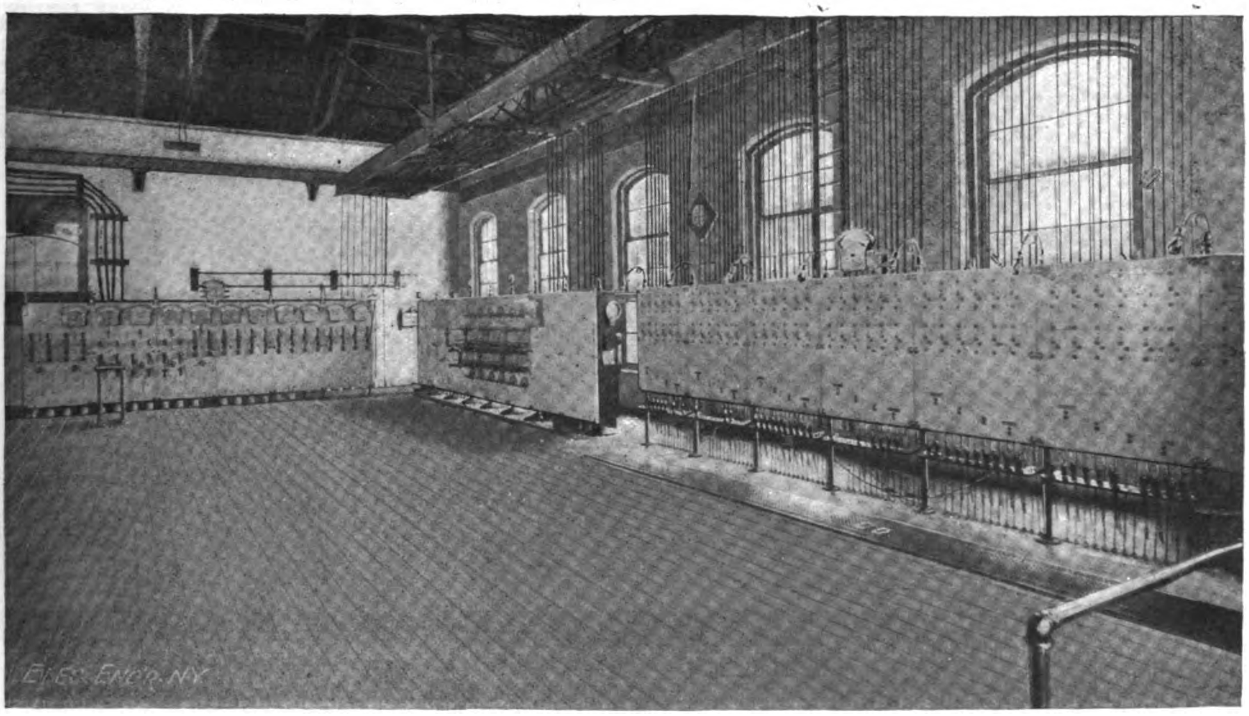


Motor Driven Arc Machines for Carrying Day Load.

Each circuit will be provided with a Holtzer-Cabot automatic regulator, connected to pressure wires from the centers of distribution.

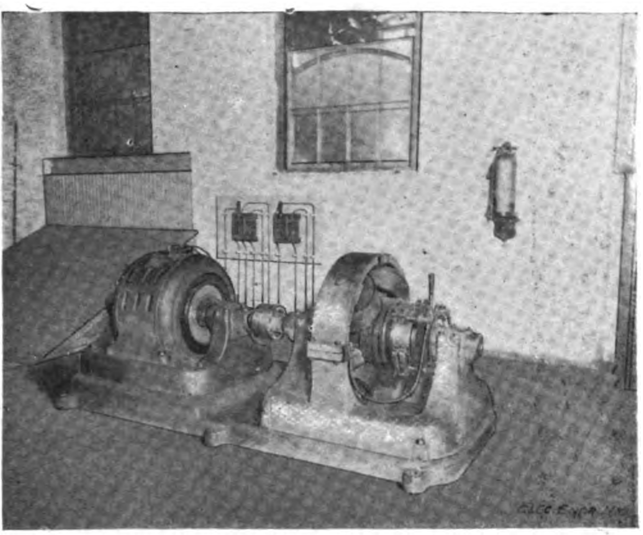
The booster regulator is a combination of the General Electric M. R. type, having a capacity of six kilowatts, and the hot wire, automatic regulator of the Holtzer-Cabot Electric Co.

In the booster regulator, shown on page 370, the variation in voltage is accomplished by moving a laminated iron core within the shunt and series windings of the alternate current main circuit, the increased or diminished voltage depending on the mutual induction of the windings, which induction changes continuously with a movement of the core. The core is driven by a shaft which is coupled by means of a worm gear to an iron-clad Holtzer-Cabot motor, in which the direction of rotation depends on the tendency of the voltage of the external circuit to increase or diminish. The motor is driven by a storage battery having a maximum potential of 230 volts and it has a constant speed of 2,000 revolutions.



The Arc, Incandescent and Power Switchboards, Narragansett Electric Light Station.

The operation of the system is as follows: If the voltage on the alternate current mains at the center of distribution on any one set of feeders increases, the hot wire indicator of the Holtzer-Cabot regulator, through the medium of the pressure wire, makes a contact that starts the motor, which in turn rotates the laminated core of the booster to such a position that the e. m. f. of the set of feeders controlled by that booster is brought to a normal point. When that point is reached the hot wire indicator is in contact with neither side and the motor is at rest. If the voltage at the center of distribution should decrease, the operation would be the inverse of that outlined.



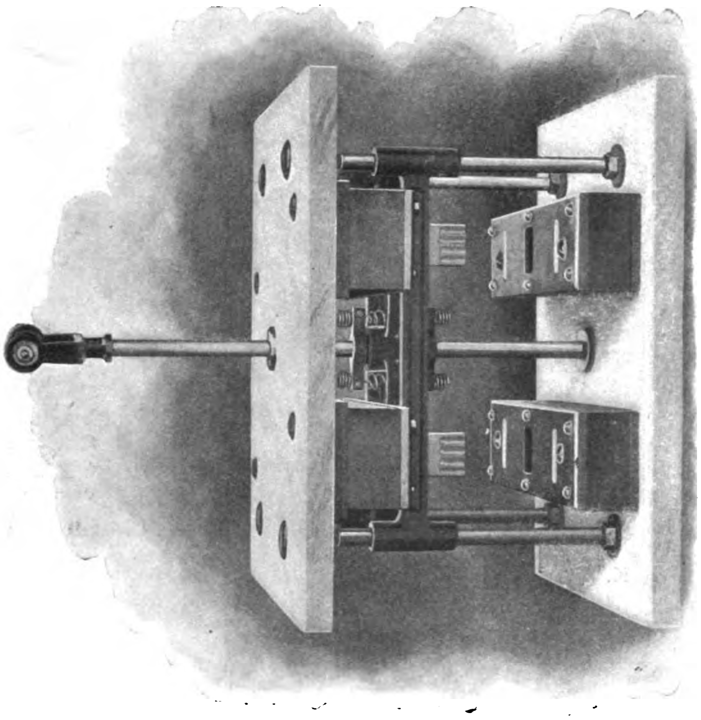
25 K. W. Combination Unit Induction Motor and 500 Volt Direct Current Generator.

This board will also be provided with Bristol recording voltmeters, giving a continuous record of the pressure at the ends of the feeders.

TESTING AND INSPECTION DEPARTMENTS.

The high standard of service maintained by the management of the company makes it necessary to provide means for the testing and inspection of all supplies furnished. This work is carried out in a building adjoining the station.

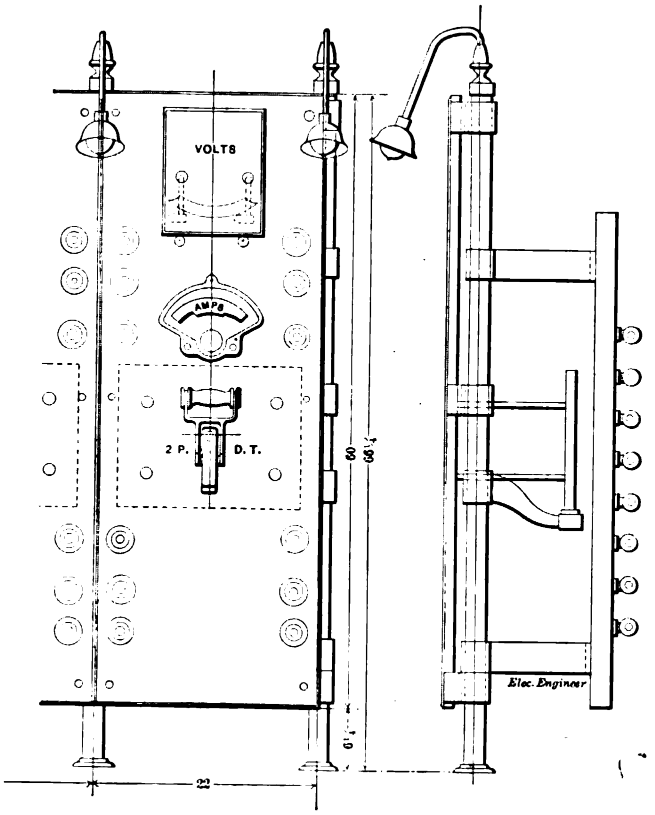
Situated on the ground floor is the meter testing room. Here the Thomson wattmeters employed on the power circuits and the Shallenberger meters on the lighting circuits are given a rigid time test before being sent out, the load being taken by Carpenter enamel rheostats made by the Ward Leonard Company. The meter testing room is illustrated on opposite page.



Stanley Co.'s 2-Pole D. T. Slide Switch—Out.

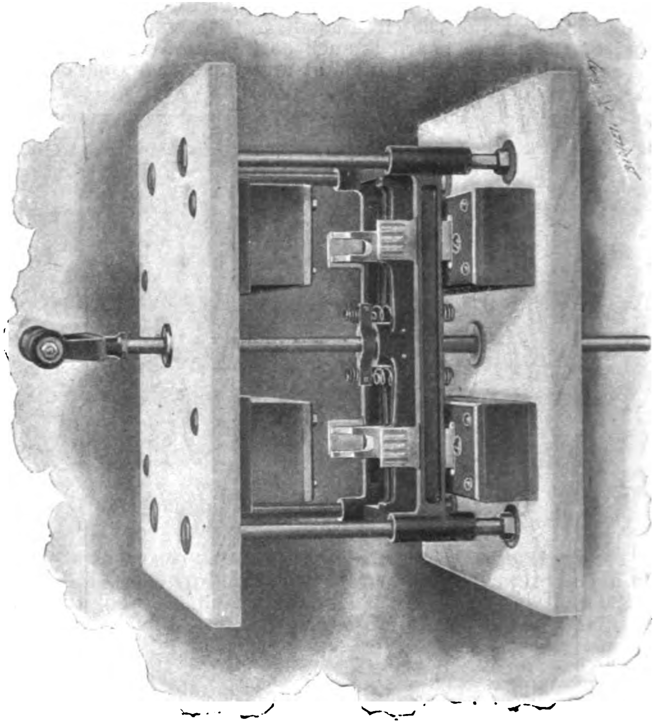
The incandescent lamps are tested in the room also shown on that page.

Every incandescent lamp bought by the company is tested for candle power and efficiency, and those not coming within the required limits are rejected. At stated intervals life tests are made.



The New Stanley Alternating Current Switchboard.

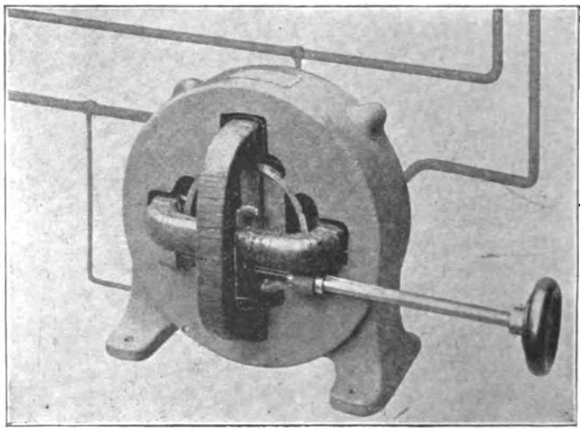
The photometer room is provided with the latest type of Lummer-Brodhun photometer and Methven screen. The Weston laboratory standard volt and ammeters are employed here, and indeed each department is equipped with Weston or General Electric instruments, which are regularly calibrated by standards. In fact, no expense has been spared to improve the efficiency of the service by the introduction of reliable high-grade instruments.



Stanley Co.'s 2-Pole D. T. Slide Switch—In.

The arc lamps employed by the company are of the T-H, M, type. These are tested in the room illustrated on opposite page, which also constitutes the repair shop, being provided with all tools necessary for the purpose. The shop is ventilated by an exhaust fan, which removes the noxious gases and the heated air, which rapidly accumulate in rooms devoted to arc lamp testing purposes. Here also the carbons are tested. At present the company is using the Crouse-Tremaine cored carbons on their commercial arcs and solid copper coated carbons on the city lights.

The building containing the testing and inspection departments also contains the offices of the mechanical and electrical engineers, as well as a store room for supplies of various kinds.



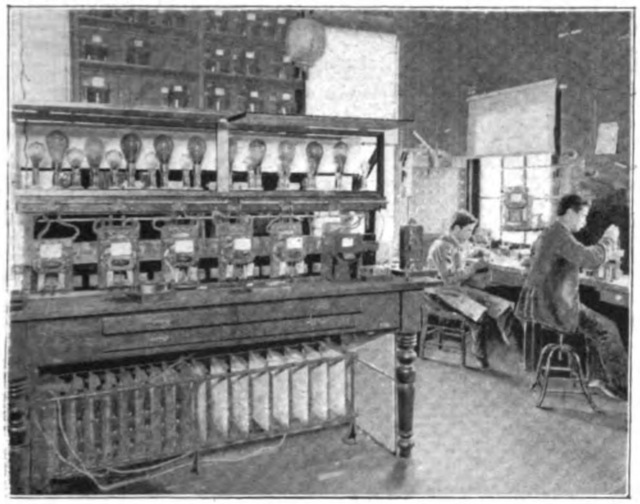
Feeder Potential Regulator.

LINE CONSTRUCTION AND OUTSIDE WORK.

The circuits as they leave the switchboard are taken directly up into the wire tower overhead, an outside view of which is shown on page 361. From this tower emanate 16 arc circuits of 125 lamps each; 15 arc circuits of about 50 lamps each; 6 sets of feed wires for power service, and 10 sets of feed wires for alternating services. The tower is readily accessible both inside and outside, so that every foot of wire is within reach.

The floors in the tower are of slate, laid on felt, so as to give absolute protection.

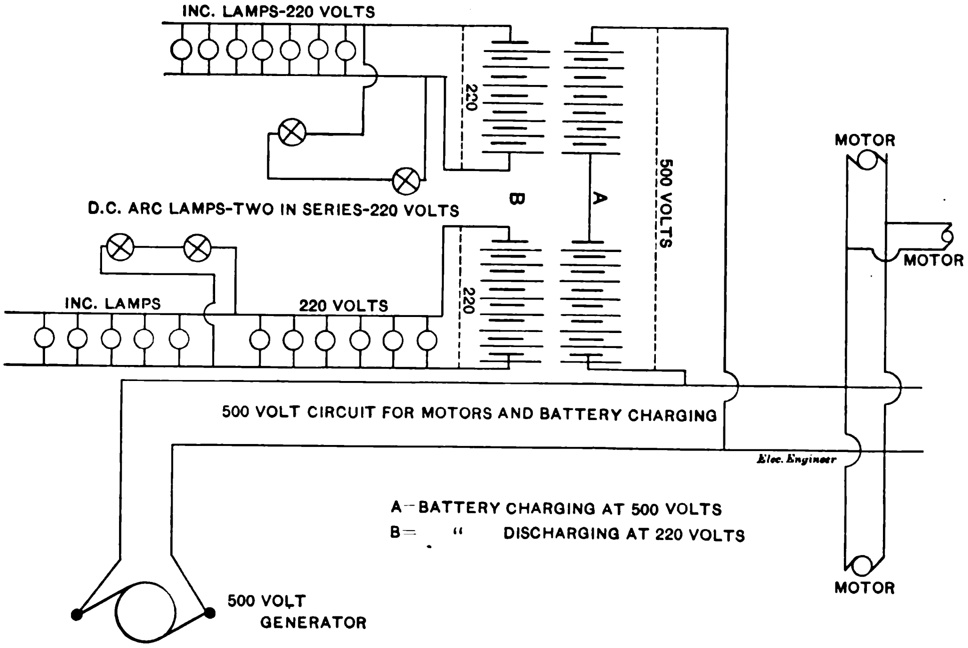
The distribution throughout the city for all classes of service is on pole lines. For this purpose poles of hard Southern pine are used, varying, according to the number of circuits to be carried, from 16 x 16 inch square to 10 x 10 inch square, chamfered and painted green. They vary in height from 35 to 65 feet. The cross arms are of the same wood as the poles.


THE METER TESTING ROOM.

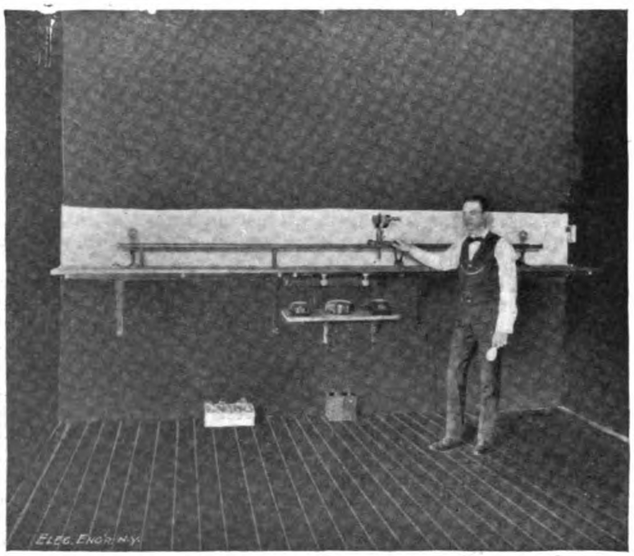
No wooden insulator pins whatever are used. In their stead there are employed malleable iron pins, screw threaded at both ends. One end screws into the cross arm and the other receives the insulator.

The line wires are of the 3-braid weather-proof type, made by the American Electrical Works; the motor and alternating taps are rubber covered, Okonite; and Okonite cable is used for crossing the river.

Each pole line is surmounted by three guard wires, one 12 inches above the top of the pole and the other two at the extreme ends of the top cross arm and supported by 12-inch irons at those points. Thus protected, foreign wires may fall upon, but cannot effect crosses with the company's live wires.


INC. LAMPS-220 VOLTS
220
500 VOLTS
B
A
MOTOR
D.C. ARC LAMPS-TWO IN SERIES-220 VOLTS
MOTOR
INC. LAMPS
220 VOLTS
220
500 VOLT CIRCUIT FOR MOTORS AND BATTERY CHARGING
Elec. Engineer
A – BATTERY CHARGING AT 500 VOLTS
B = " DISCHARGING AT 220 VOLTS
MOTOR
500 VOLT GENERATOR
PROPOSED SYSTEM OF STORAGE BATTERY SUB-STATION DISTRIBUTION.

The street arc lamps are supported on Russell mast arms. These have rigid hollow arms, with a trolley running inside. The lamp is pulled in when trimmed. All the lamp trimmers are provided with bicycles which are their own property, and the street circuits are regularly patrolled at frequent intervals by seven patrolmen. The result of this constant supervision is that during the past year the lamp outage on the city lights was less than 1-7 of one per cent., a record which, it may well be claimed, is the best as far as known. It is probable that the cost of patrolling the lines is greater than would be the rebates exacted by the city for outages, under the ordinary conditions, but the company's policy has always been to afford the best possible service.


Elec. Eng'r N.Y.
THE PHOTOMETER ROOM.

DISTRIBUTION DATA.

As stated above, the alternating current is distributed at 2,000 volts and reduced by transformers to 50 or 100 volt secondary lines. There is also a 5,000-volt service with step-up and step-down transformers which feeds the Warwick district, the extreme end of which is 14 miles from the central station.

At the present time there are connected to the motor circuits 395 motors, aggregating 2,500 horse power, at 500 volts, not including the motors in the station. This, it is believed, is the largest 500-volt motor service in the country. These motors supply power to almost all the many industries carried on in Providence, including numerous elevators and newspaper printing presses. Electric motors connected to the circuits also drive the calling generators at the Providence telephone exchange. Recently also the Western Union office has been equipped with a duplicate set of motors which drive generators that furnish current for all the principal trunk wires, Associated Press and railroad wires out of Providence. It is also interesting to note that the new bridge draw over the Seekonk River is operated by motors and the bridge itself lighted by the 500-volt current.

There are 2,800 arc lamps in circuit, of which 2,000 are street lamps, and 800 commercial lamps. All of these are of 2,000 candle power.

There are 47,000 incandescent lamps connected to the alternating circuits.

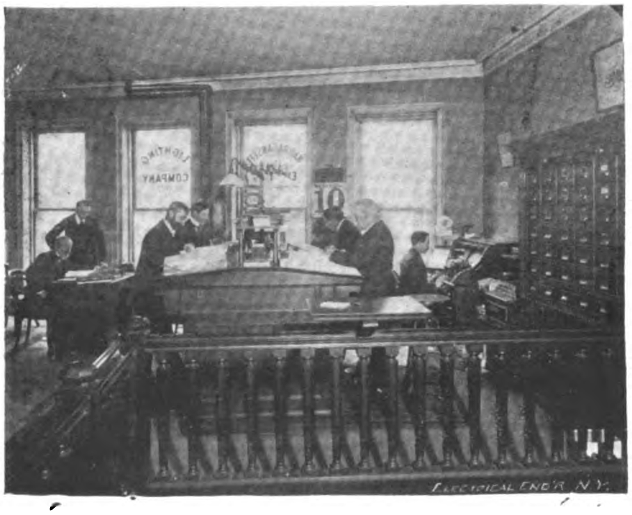
FUTURE DEVELOPMENT WITH STORAGE BATTERIES.

The progressive management of a central station to-day has but a small possible margin to gain in efficiency of apparatus, and the betterments of the system are mainly possible in the improvement of the service rendered the consumer and in the increased efficiency of the incandescent lamp, at the same time maintaining the present effective standard of life, say on an average 600 hours.

Fully recognizing the high standards that will be demanded in the immediate future for absolutely uniform regulation for incandescent lighting, for a service that shall be economical and almost exempt from possibility of interruption, and anticipating that the perfected storage battery and the high voltage incandescent lamp will soon play an important part in central station operations, Mr. Marsden J. Perry, the vice-president and general manager of the company, has suggested a plan of substation supply by means of the storage battery, the charging circuit being the present 500-volt power current, the battery to discharge at lamp voltage and independent of the charging circuit.

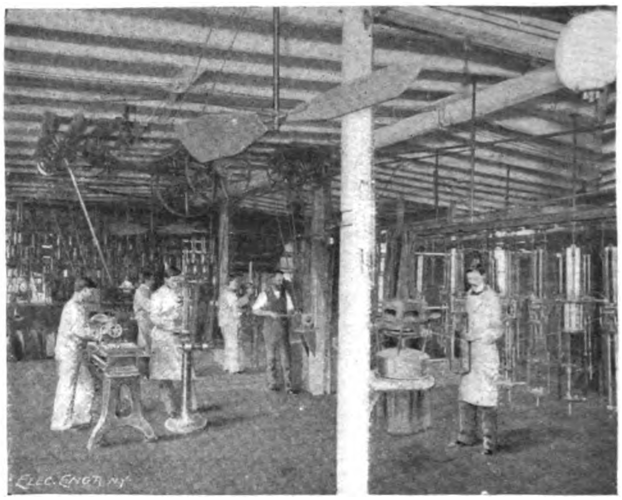
Briefly stated the arrangement is: A central station of 4,400 kilowatt capacity now operated as a composite outfit, that is, series arc service, alternating, single phase, incandescent lighting, and direct current 500-volt motor service. The motor service at present represents an installation of 2,500 horse power in stationary motors; the arc service, 2,800 lamps, and the incandescent service 47,000 lamps.

In the load curve diagram of the Narragansett station at the present time the peak of the curve practically offsets the gap in it. It is proposed, therefore, to charge the battery substations during the light load period, making the storage battery virtually a motor load after 12 o'clock at night and substantially an additional motor load during the day, and thus practically operate the station at a nearly constant load throughout the 24 hours. The novelty in the proposed arrangement lies principally in the fact that the batteries are charged in series or groups from the 500-volt power service, and, when discharging, are switched over to low tension mains, as indicated in the diagram on page 371. This arrangement, of course necessitates two groups of batteries whose combined capacity is sufficient to supply the watt hour load of the system during the hours covered by the peak.


ELECTRICAL ENG'R. N.Y.

A VIEW IN THE MAIN OFFICE.

At first it is proposed to equip only one section of the city, but the developed idea would eventually include all commercial arc and incandescent lights within a two-mile radius of the station, the remaining outlying territory to be supplied as at present. The territory embraced is so arranged that four, or possibly five, substations would be required, the several stations being connected so that, in the event of interruption at any one station, the load of that station would be assumed by the others. This arrangement would also permit of the night load or light day load being operated from one point. The details of the system are yet to be worked out. Although storage substations charged in series from high tension circuits have long been before the public, yet this is possibly the first instance of substations operated when the charging circuit is 500 volts and treated simply as a big motor on the power lines.


ELEC. ENG'R. N.Y.

THE REPAIR SHOP.

Comparing this method of substation supply with that already in vogue, it may readily be seen that its chief merit lies in obviating the fluctuations always noticeable in composite circuits, that is, circuits furnishing current for incandescent lighting and motors, especially as motor loads are subject to a wide range of variation, such as stopping and starting elevators, driving circular saws, etc. The regulation may be made absolute by the introduction of a device which will automatically maintain a constant pressure at distributing points on the consumers' circuits. Such devices are already in absolutely successful operation at the storage battery station of the Edison Electric Illuminating Company, of Boston, and also on the alternating lighting service of the People's Edison Illuminating and Power Company, at River Point, R. I.

A second point in its favor is a commercial one. A large field for motors, many of the latter on the outskirts of the city and a long distance from the central station, may be reached with much less copper than would be required with the low potential at which the storage batteries are ordinarily charged and discharged, and a large amount of power business could be secured with this proposed high voltage charging current that the cost of copper at low potential would make absolutely prohibitive. Thus the public could be accommodated and the volume of business for the station be handsomely increased.

From 11 to 12 o'clock p. m., most of the commercial arcs or store lights are extinguished, the volume of the incandescent output is largely reduced, and from that time until the next morning the storage battery takes the place of these two factors and keeps the station load nearly uniform. In the morning the city arcs are discontinued, but the motor service begins and the charging of the storage battery takes the place of the city arcs and thus continues to act as a load equalizer until the afternoon, when the commercial arcs and incandescent load are resumed. The charging of the storage battery may then be discontinued during the peak hours. Thus maintaining a nearly uniform load for the whole 24 hours will enable the generating station to be operated at the highest possible point of economy and efficiency.

LITERATURE

STANDARD WIRING FOR ELECTRIC LIGHT AND POWER.—By H. C. Cushing, Jr. 93 pages. Pocket size. Flexible Leather cover. Price, $1.

Several new and valuable tables have been added to this work which will make it particularly welcome to central station managers and engineers throughout the country. This is the fifth edition, and, like all the previous editions, is gotten out in a soft leather cover and of convenient size for the pocket. We believe that the work is having a good influence everywhere towards standardizing electric light and power installation from a fire underwriter's standpoint.

TELEPHONY AND TELEGRAPHY

ANNUAL FIGURES OF AMERICAN BELL TELEPHONE OPERATIONS.

THE stockholders of the Bell Telephone Company held their annual meeting at Boston on March 30. One action taken was the substitution of T. Jefferson Coolidge, Jr., on the board of directors in place of Charles P. Bowditch. The other was the 10 per cent. increase in the capital stock of the company, or an increase of $2,365,000 to $26,015,000, making the total number of shares outstanding 260,150, of a par value of $100.

Treasurer William R. Driver and Clerk Charles Eustis Hubbard were re-elected. The following board of directors was also elected by a unanimous vote: Charles W. Amory, Francis Blake, George L. Bradley, Alex Cochrane, T. Jefferson Coolidge, Jr., William H. Forbes, Henry S. Howe, Charles Eustis Hubbard, Gardiner G. Hubbard, John E. Hudson, Charles E. Perkins, Thomas Sanders, Moses Williams.

President John E. Hudson, who presided, read the annual report of the company. In his opening remarks he said: "The adoption by many more of the exchanges throughout the country of the measured service and party line system, under which the service can be furnished at a lower yearly rate, has contributed materially to the gain in subscribers."

President Hudson also spoke of the growth of the telephone from year to year, and of the privilege of subscribers now to talk to almost any part of the country. He said that the increase in the number of long distance calls reflects the appreciation by the public of the value of the telephone.

The 32 subsidiary companies operating under license from the Bell company expended $8,271,929 for new construction and $1,160,924 for real estate.

In conclusion he touched upon the suit of the Berliner patent, which is still in abeyance, and expressed a wish for its speedy settlement.

"The Long Distance company has invested up to Dec. 31, 1896, in land, construction, franchises, equipment and supplies, $13,187,299. That company shows an increase in gross earnings in 1896 over 1895 of 20.6 per cent., the 1896 gross being $1,599,589. It will be remembered that the gross earnings for 1895 were $1,326,683, for 1894 $1,101,961, for 1893, $892,361, and for 1892 $643,436."

The statistical portion of the report for the fiscal year ended Dec. 31, 1896, makes the following comparisons:

EARNINGS.	1896.	1895.
Rental of telephones	*$2,458,484	$2,125,359
Dividends	2,616,307	2,523,150
Commissions from extra territorial lines	182,265	148,694
Commissions from telegraph business	34,047	32,423
Real estate	80,864	76,176
Interest	171,355	215,320
Miscellaneous	4,107	3,831
Total earnings	$4,327,324	$5,124,953
EXPENSES.		
Expenses of operation	$499,052	495,612
Legal expenses	100,744	182,755
Real estate	40,118	37,453
Interest and taxes	303,731	245,537
Commissions	....	296,284
Royalty	....	1,452
Concessions	....	649,508
Miscellaneous	97	2,592
Total expenses	$943,744	$1,911,193
Net earnings	3,383,580	3,213,760
Dividends	3,361,233	3,132,453
Balance	$22,347	$81,307
Reserve account	22,347	81,307
Surplus account, Dec. 31	$2,151,012	$2,151,012

*$1,220,106 commissions and concessions to be deducted.

The company's balance sheet of Dec. 31 compares thus:

DEBIT.	1896.	1895.
Telephones	$1,537,761	$1,285,946
Real estate	1,046,126	1,045,926
Stocks	50,511,149	44,121,680
Merchandise and machinery	17,484	14,054
Bills and accounts receivable	1,490,930	3,463,213
Cash and deposits	900,271	1,337,892
Total assets	$55,503,723	$51,268,715
CREDIT.		
Capital stock	$23,650,000	$21,500,000
Premium accounts	3,561,200	1,398,435
Debenture bonds, 1888	2,000,000	2,000,000
†Bills and accounts payable	1,204,591	1,120,616
Patent account, profit and loss	12,397,621	12,713,809
Profit and loss	6,551,403	6,349,444
Reserve	3,987,896	4,035,390
Surplus	2,151,011	2,151,011
Total liabilities	$55,503,723	$51,268,715

The following are the figures of operation:

	1896.	1895.
Telephones Dec. 20	772,627	674,976
Exchanges Jan. 1	967	927
Branch offices	832	686
Miles wire on poles	286,644	260,324
Miles wire on buildings	12,597	12,861
Miles wire underground	234,010	184,515
Miles wire marine	....	2,028
Total miles wire	536,859	459,728
Number of circuits	264,465	237,837
Number of employés	14,425	11,930
Number of stations	325,720	281,695
Number daily connections	2,630,071	2,351,420

The Bell Telephone instrument statement for the month ended March 20, by the way, shows:

	1897.	1896.	Decrease.
Gross	19,192	19,283	91
Returned	6,495	7,331	836
Net	12,697	11,952	*745
Since Dec. 20:			
Gross	53,309	54,993	1,684
Returned	20,911	22,132	1,211
Net	32,398	32,861	463
Total outstanding	806,247	709,397	*96,850

*Increase.

†Includes dividend payable Jan. 15.

TELEPHONY AT HARMONY, MINN.

An ingenious and enterprising scheme will be put in operation in Fillmore County, in the shape of a mutual telephone company, with headquarters at St. Paul, Minn. The company has already been organized, with D. E. Horton as president; H. Bellingham, treasurer, and H. J. Achatz, as secretary. The company will commence building as soon as the frost is out of the ground. The farmers take readily to the plan, as it will put them in daily communication with the markets and shippers. The fee for joining is $10, which is applied on construction and each pays for his own instrument. It will be run without cost to subscribers, except small assessments for repairs as they become necessary. There will probably be an exchange established in Harmony.

COULDN'T BEAT ELECTRICITY.

Policemen and watchmen had a running fight with a negro burglar on the levee at Chicago at an early hour on March 18. The fugitive inadvertently sent in an alarm and was surprised at work by Captain King of the patrol. At 3 o'clock a. m. an alarm was received by the patrol from the store occupied by Heyman Bros., tailors, at 380 State street. Captain King hurried to the rear of the store and as he climbed over a shed from the alley saw a colored man at work trying to cut through the iron bars which cover the rear windows. The robber ran. King fired. The robber returned the fire. Officers Kerwin, Vernoven and Reick joined in the fusillade, and a sensational running fight ended with the capture of the thief, who gave his name as William Brown. The window at which he was at work was protected with an alarm system which, when cut, opened a circuit and sent in a warning.

AN ELECTRICAL EXHIBITION is to be held at Como, Italy, in 1899, to celebrate the centenary of the Volta pile. Turin is to have a similar exhibition in 1898. The great trouble is, we don't have electrical exhibitions enough.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
203 Broadway, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription
United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, APRIL 7, 1897. No. 466.

Notice of Removal.

THE ELECTRICAL ENGINEER

on and after April 14 will occupy its handsome and commodious new suite of offices, entire south wing, eleventh floor, of the Beard Building, 120 Liberty street, New York City. It will not only thus be most advantageously situated at the heart of the machinery and electrical district, but will enjoy an increase of several hundred feet floor space. The offices are convenient to all railroads and ferries, and an invitation to visit them is cordially extended to all friends and patrons of the journal.

A MODERN COMPOSITE PLANT.

TEN years ago a visitor entering what at that time would have been called, and justly so, a model incandescent lighting plant, no matter what its size, would have beheld a row of high speed engines probably not exceeding in capacity 250 horse power each, belted to a like number of generators. This method of driving was an advance on the older system involving the use of countershafting and was made possible by the perfection reached in the building of high speed engines. But with increasing demands for generator units of large capacity for both arc and incandescent lighting, railway and power purposes, came the direct connected unit and its success, in turn, has reacted upon the smaller units so that even for these the direct connection has become a favorite method. But how many of the model stations of ten years ago can be rightly so designated at the present time. It takes courage, even where the means are available to carry out the work, to discard apparatus which is operating satisfactorily, and comparatively few companies have screwed their courage to the necessary sticking point. Among those few a most conspicuous example is presented in the Narragansett Electric Lighting Company, of Providence, R. I., whose magnificent station is described in detail in this issue. The enterprising manager of this company, Mr. Marsden J. Perry, from the very beginning, started out with the fixed purpose of maintaining the station under his charge at all times up-to-date and though that determination has necessitated several remodellings within the past ten or twelve years, the results both in the character of the service rendered, and from the financial standpoint have fully warranted the expenditures involved. But after all, the expense in keeping up to date, depends largely on the manner in which the process is carried out. If the old apparatus was bought ten years or more ago, its value will probably be little greater than that of scrap, but electrical apparatus and engines that have been well taken care of, after a period of three or five years would in but very few instances be entirely out of date and would consequently still possess a fair percentage of their original value, which would reduce materially the cost involved in the change. In these days of constantly decreasing prices for electric service the station that is struggling along with old apparatus ill adapted to the changed conditions of service demanded, and what is worse, of low efficiency, cannot hope to maintain the contest against the new and efficient apparatus now available. Those companies which have in the past made provision for the inevitable change, or those which have increased their capital to meet it will survive and be the better for the change, but the future is indeed dark for their less fortunate brethren who have neither of these resources to fall back on. And this constant necessity of keeping up to date is, it seems to us, one of the essential points, which those who advocate municipal ownership of electric lighting plants, as a rule, fail to take into account. The day will inevitably come when the present municipal plants must either be changed over to conform to the latest and most economical systems of current generation and distribution, or will be forced to that change by the natural wear to which all machinery is subject. This applies as well to the boilers and engines as to the electrical machinery. When that time comes,, as it must, and additional city bonds have to be issued to meet the expense, we may expect to note a sudden revulsion of feeling on the subject and a sudden desire to sell the municipal plant to some corporation which will undertake the necessary expense, and put the city in a position to know exactly what its lighting is costing it.

SPECIAL LIGHTING FOR BUSINESS STREETS.

HOW to make a given part of the business section of a city attractive, is a problem that merchants often have to deal with. Clean streets by day and bright streets by night are a help. At Columbus, O., in a part of the city that is a trifle tame during the evening, the merchants conceived the idea of resorting to the electric light in order to induce an increase of shopping trade. They put a series of arches therefore over a 50-foot roadway, from curb to curb, the arches being about 250 feet apart. Each arch contains 50 incandescent lamps of 16 candle power each. It is hard to tell whether they have or have not accomplished their purpose, but as the merchants at the other and busier end of the street now contemplate doing the same thing, it would seem that some beneficial effect has been gained. The effect is picturesque, and the merchants are the best judges as to the extent to which they accomplish their purpose. It is to be borne in mind that the street is also lighted by the city, and Mr. L. C. Newsom, manager of the Columbus Electric Light and Power Company, to whom we are indebted for our information, states that there are over 1,000 lights in public service throughout the city. The spirit of progress is evidently active in Columbus, despite dull times.

COPPER CONSUMPTION.

THE course of the market for copper is of great interest at all times to electricians generally, and at the present moment the conditions present a problem more than usually worthy of study. Copper enters so largely into all classes of heavy electrical work that a slight variation in price causes an appreciable difference in the calculations. The subjoined table gives an idea how things have been going in recent years:

Copper Consumption.—Metric Tons.

	1893.	1894.	1895.	1896.	Increase or decrease.
Germany	60.513	62,955	70,349	85,371	+ 14,922
France	33,886	31,837	40,323	49,007	+ 8,684
England	96,615	90,069	91,084	115,557	+ 24,473
United States	77,433	94,511	108,000	93,698	— 14,302
Totals	268,447	279,372	309,756	343,633	+ 33,777
World's product'n.	303,530	324,405	334,105	370,000	.....

The question arises, How far is recovery in consumption going this year in the United States, and what will be the effect on prices? The range has been as follows: For Lake Copper, 11.55 cents in 1892; 10.75 in 1893; 9.56 in 1894; 10.75 in 1895, and 10.88 in 1896. Prices have been stiffening here for some time, and apparently with reason, consumption having easily kept up with production so far. At the present time, electrical work here has been exhibiting many signs of renewed hope and activity, while in Europe the new régime of electric traction has but barely begun to be active.

THE annual report of the American Bell Telephone Company is a very interesting document, and the figures of the growth of the industry are remarkably impressive. At the rate of 2,630,071 connections a day, the grand total is reached, for the year, of just short of 1,000,000,000. Leaving out Sundays would bring this down, but on the other hand, the work of the numerous independent exchanges would bring it up again; so that as a reasonably approximate figure it will stand. And to think that men, not women, do all this talking—the women serving merely as intermediaries!

A GIGANTIC underground railroad scheme is proposed for Chicago, the object being to make a belt line connecting all the various steam railroads. It is said that the Illinois Central and Northwestern roads are interested in this project, upon the engineering preliminaries of which experts are already engaged. Cars would be run frequently on a 5-cent fare, and the general public would be admitted as well as transfer passengers, to whom the convenience and saving in time would be enormous. The plan for the interior finish is to use yellow enamel brick. A depth of from 30 to 60 feet and a diameter of 14 feet are contemplated. The lighting would be wholly electrical and the operation of the cars would in all probability be electrical also. The cost is put at about $10,000,000, and a gross income of about $600,000 per year is figured upon. There are many merits in the scheme; and it is to be hoped it may be carried out. The soft nature of the Chicago sub-soil should render tunneling easy, although water is likely to be abundant and the line of the Chicago River must be crossed.

BETWEEN this country and Venezuela relations tend steadily to become closer, not merely because we have intervened to protect a sister republic from apparent spoliation, but because the natural conditions of our Mediterranean make trade more and more desirable with the countries bordering its southern shore. We are now glad to note that Mr. Henry Clews and other well-known New York bankers have made a contract with the Venezuelan government under which they will control and operate cable, telegraph and telephone lines for a period of thirty years, with opportunity for renewal. It is obvious that this not only opens up a better market in Venezuela for American electrical material, but for skilled American electrical engineers and operators. The development of this work will be followed with much interest.

THE amount of "mental anguish" caused by late trains, slow telegrams, busy telephone wires, or dilatory mails, has always been difficult to determine from the standpoint of value to the injured party seeking redress in a court of law; and, as a result, while ready to grant damages provable concretely on a cash footing, the courts have looked askance on mere "mental anguish" claims. One man's torment may be another man's source of joy, and it is very hard at any time to ascertain to what extent a given occurrence may have caused pleasure or pain. Away off in Minnesota, however, they have clear notions on this point, and a bill has just been passed, aimed at telegraph companies, giving "mental anguish" a limit value of $400. We regret to note there is no provision in the bill for the use of the modern scientific instruments which help psychological experts to determine the exact effect on the mind of certain conditions and actions. With the use of these and a scale or gauge, the damages obtainable under the bill could be worked out to a nicety.

LETTERS TO THE EDITOR

ELECTRICAL ENGINEERING ON OLD STEAM ROADS.

THERE seems to be considerable comment regarding the use of the third rail and trolley by the N. Y., N. H. & H. R. R. I do not think anything has been published giving exact information as to the leakage and operating expense of these two experiments. The general statement that no appreciable leakage existed seems to be doubted by at least two electrical engineers, and if these two engineers are correct in what they say I do not suppose anything but a generalization of the subject can be given, even by the electrical engineers of the railroad company. I had occasion to look into the matter some little while ago in connection with adopting some of the good points of the N. Y., N. H. & H. R. R. experiment, if I found any. My conversation with the chief electrical engineer led me to believe that my best method to obtain the information was by observation, and what I could obtain from those under him. Taking all the views of these men into consideration, I found that my trip East was not productive of great results. In fact, a large company like the N. Y., N. H. & H. R. R. had gone into the subject without consulting with any practical engineer with the exception of the engineers of the contracting parties, and their judgment does not seem to have been given very much thought.

The junk pile of brass bonds and circuit breaker parts was quite formidable, showing that some errors had been made. The force of men employed in keeping the third rail in shape attested to some difficulties in this line. The care with which the laborers handled the cables connecting the ends of the third rail at the crossings showed that they at least considered it "hot stuff." The spare (?) armatures in the car house would witness to the carefulness of the railroad company in providing against burn-outs. But enough said! Railroads contemplating electrifying their steam equipment will do well to employ competent electrical engineers.

WESTERN ELECTRICIAN.

Chicago, Ill., March 26, 1897.

THE MORSE ALPHABET FOR DEAF MUTES.

I NOTE in your issue of the 24th, an article from the Boston "Transcript," saying that a physician in Texas proposes the use of the Morse alphabet—by touch—instead of the sign language for deaf mutes. The doctor thinks it would be a great improvement on the present sign method. Fifteen years ago, I was of the same opinion. While a member of the State Board of Charities, in Wisconsin, on a visit to the State Institution at Delavan, I put the Morse alphabet on a blackboard, and explained, through the teachers, how it could be used by touch—a practice that all old telegraphers understand.

The scholars were delighted, and quickly became expert in its use. But trouble arose very soon after. Naturally jealous as all deaf mutes are, when a student grasped another's arm, and began making the dots and dashes, by pressing with his fingers, another boy, looking on, became convinced that the boy talking was "making fun of him," or indulging in gossip at his expense.

With the deaf and dumb sign language, all who looked on could read; but with this secret process, it was impossible. Hence the suspicion and jealousy. The result was an order forbidding the use of the "touch talk," as the students named it.

I hope the Texas gentleman will have more success than I had.

C. H. HASKINS.

Buffalo, N. Y.

OBITUARY

COL. L. C. BAKER.

L. C. Baker, superintendent of the second district of the central division of the Western Union Telegraph Company, died at St. Louis on March 25 of heart trouble. He had been sick three weeks. Col. Baker leaves a widow and eight children. He was born in 1840 at Tuscaloosa, Ala., and entered the telegraph field as a messenger boy for the Atlantic and Pacific Telegraph Company at Louisville, Ky. His advancement was rapid. During the war Mr. Baker acted as superintendent of military telegraphs for the Confederate Army. He received the rank of Colonel. Shortly after the war Colonel Baker became identified with the Western Union Telegraph Company. He held several important positions, and in 1878 was appointed superintendent of the central division, with headquarters at St. Louis. A few weeks ago Colonel Baker fainted on the street. He was not thought to be seriously ill, and his sudden death shocked his friends.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—IV.

BY JOSEPH APPLETON.

(Copyright, 1897.)

INSTALLATION, CARE AND MAINTENANCE OF STORAGE BATTERIES.

THE success of a storage battery plant depends largely on the way in which it is installed and put into operation. This, of course, is true of any electrical apparatus, but especially so in the case of storage batteries where the operation depends on certain chemical action and reaction being repeated indefinitely. If the elements are once properly prepared for this action the repetition is a matter of course, provided a certain amount of attention is given to the battery; but it may be safely said that a storage battery does not require more attention than, if it does as much, as other portions of an electric lighting or power plant.

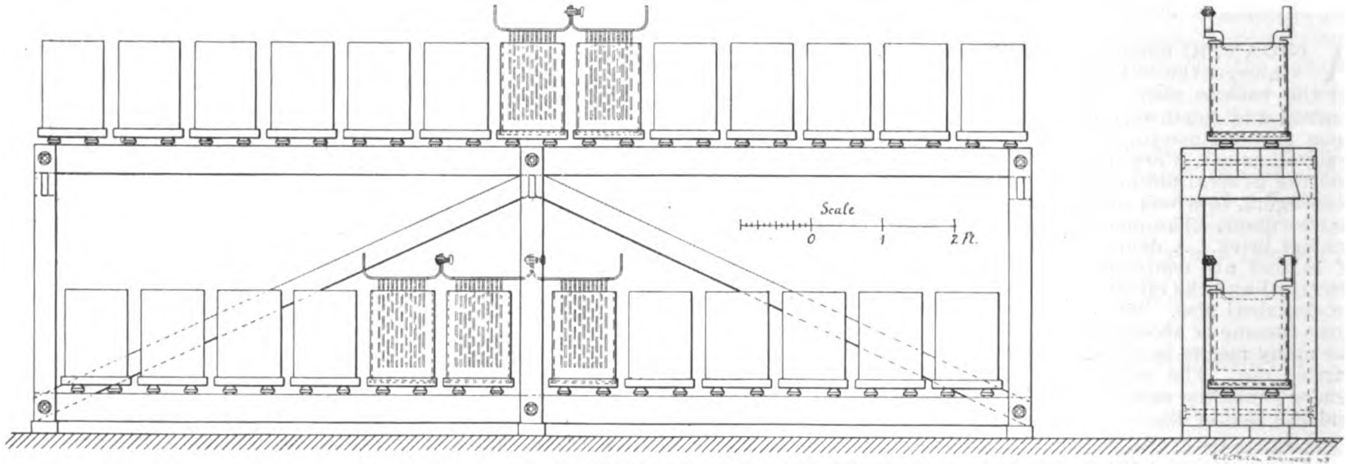


FIG. 11.—WOODEN STORAGE BATTERY STAND.

The work of installing or setting up a storage battery does not necessitate such skilled labor as the erection of engines, dynamos and similar high-class machinery, for the same accurate fitting is not necessary. It requires, however, just as much care on the part of the workman, together with strict observance of certain rules and precautions. The work differs from that connected with any other branch of electrical engineering as the principles involved are of a nature quite distinct; yet when thoroughly understood they are entirely within the province of the average mechanic.

In considering the installation or setting up of a storage battery, the subject may be conveniently divided into two sections, the methods employed being different.

1. Where the size of the cell is such that it can be handled and lifted when assembled.

2. Where the cells are too large and heavy to be handled in this way, and have to be assembled in position.

In the first case the containing cells are usually of glass, hard rubber being used occasionally where there is liability to breakage. For the larger cells, lead lined wooden tanks or solid lead boxes are used.

The selection of a suitable battery room is the first point to be considered, and in these days, when every cubic foot of space in buildings, especially those located in cities, is so valuable, the choice is very limited, and it requires much thought and ingenuity to find and utilize, to best advantage, what is available for the purpose.

The battery room should be dry, well lighted and ventilated and of moderate temperature; otherwise, the evaporation of the electrolyte is a troublesome item. Exposed iron work should be avoided as the acid fumes will in time, corrode or attack the same Whatever metal work there is exposed must be protected with an acid proof paint. The floor is best constructed of brick, tile or concrete, laid in such a manner that it will drain readily, an outlet being provided for the liquid. Where a wooden floor already exists, that portion on which the battery stands, should be covered with a lead tray to protect the woodwork from the action of the acid.

The battery room is preferably located as near the generating plant as possible, thus reducing the cost of wiring between battery and switchboard to a minimum. It is important that the cells be arranged so that all of them are easily accessible for the purpose of inspection and overhauling. The best arrangement, especially with large cells, is in one tier, but with smaller batteries there is very seldom sufficient space for this arrangement, and two and even three tiers are usually necessary. Suitable stands or racks are required to receive the cells. Figs. 11 and 12 show some designs which may be used for cells of moderate size and weight.

Where glass jars or containing cells are used they are generally mounted in shallow wooden trays filled with sand to form an even bed for the cell; these trays are supported on suitable insulators to ensure good insulation from the ground, also between cell and cell. Figs. 13, 14, and 15 show insulators of the single and double petticoat type, also an oil insulator, which is frequently used.

Where lead lined wooden tanks are used the trays are dispensed with, the tanks resting directly on the insulators. When the containing cell is of glass the elements, or plates, usually either rest on ridges which are molded in the bottom of the jar, or hang from the top of the jar by means of suitable lugs, cast on the plates for this purpose; the latter method is preferable, as it allows a perfectly clear space to be maintained between the elements and the bottom of the jar, where any sediment or deposit may accumulate.

In the larger types of cell which are provided with a lead-lined wooden tank, the same arrangement can be carried out by supporting the plates on pieces of glass which rest on lead strips placed in the bottom of the tank, Fig. 2, p. 322.

In the smaller sizes of cells, the plates of like polarity are usually connected together by means of a lead strap which is cast or welded on the plates, and forms a lug or terminal for connecting one cell to another in series, the connections between cell and cell being made either by a screw clamp or weld. In the larger sizes this method does not provide sufficient carrying capacity in the connections for the large amount of current which has to be carried; so different arrangements have to be made.

Attention may here be called to the great importance of providing sufficient sectional area in connections of storage batteries. It is, of course, imperative that for this purpose there be employed a metal impervious to the action of the acid, and the resistance of such metals is high; lead, for example, being seven times the resistance of copper. Therefore, the sectional area must be correspondingly large. If inadequate carrying capacity is allowed in the connections the various plates in the cell are worked unevenly and the full capacity of the battery is not obtained.

Probably the most satisfactory method in large cells is to burn or weld the positive plates of one cell and the negative plates of the next to the same lead strap or bus bar, thus ensuring a good connection between the similar plates in a cell, also between cell and cell in the series.

Where very heavy currents have to be carried, these lead bus bars can be reinforced by a copper conductor embedded in them, so that it is protected from the electrolytic action.

The welding or lead burning is accomplished by means of a hydrogen flame which has the special property of preventing the oxidation of the two lead surfaces which are to be fused or welded. This process is carried out as follows: Hydrogen gas is generated in a vessel from zinc and sulphuric acid, the gas is collected and passed through a water bottle to a burner where it is mixed with air forced into the burner by means of a pump, or bellows, the mixture being ignited and used as the welding flame.

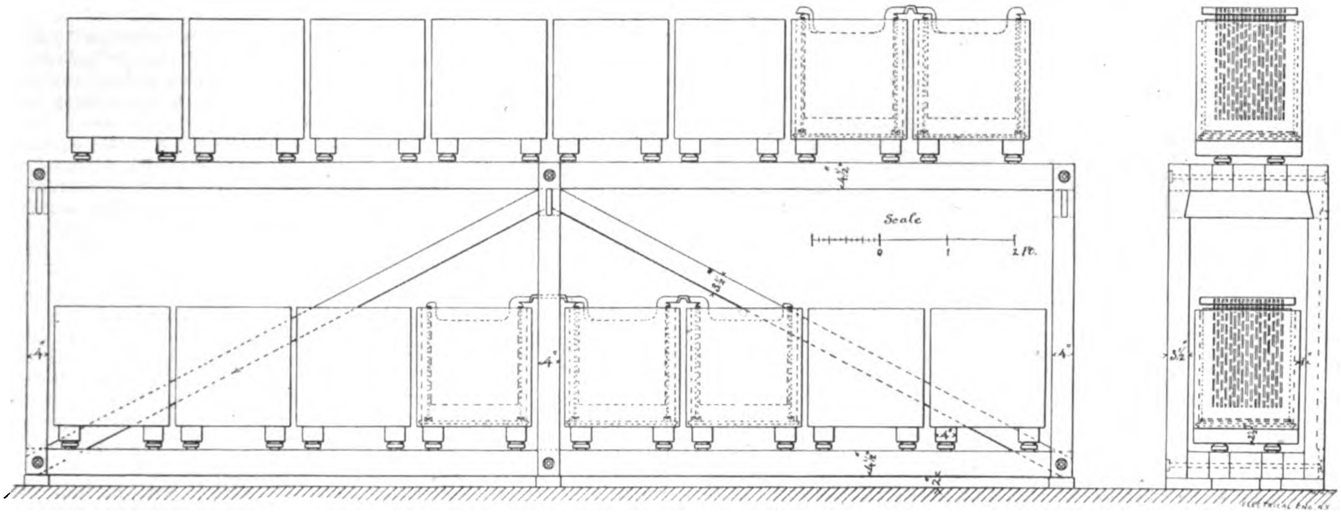


FIG. 12.—WOODEN STORAGE BATTERY STAND.

This method of lead burning is also used for making the seams in the lead lined tanks and is the only practical process by which a perfect and homogeneous joint can be made between two pieces of lead, without the introduction of solder or other substances which contain material liable to corrosion under the action of the acid. The process is quite simple and can be readily carried out by an ordinary workman after a little practice. The burning required for making seams in the 4 or 5-pound lead, such as is used for lining tanks, is more difficult on account of the liability to burn through the thin lead surface. Considerable practice is required for this work.

Fig. 16 shows a complete lead-burning outfit, such as is used for battery work.

The writer's experience, gathered from the handling of every well-known type of cell, in Europe and this country, has proved that certain simple points must be observed in setting up a battery in order to obtain the best results; naturally each particular type of cell has its peculiarities, yet the following general remarks apply to all storage batteries.

When the cells are received from the manufacturer assembled or "burned up," that is, with the plates connected in groups to form the complete element; it is best to proceed to set them up and prepare for the charging in the following way:

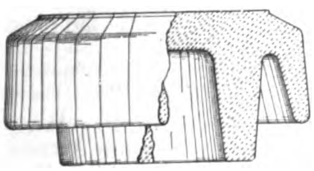


FIG. 13.—SINGLE PETTICOAT INSULATOR.

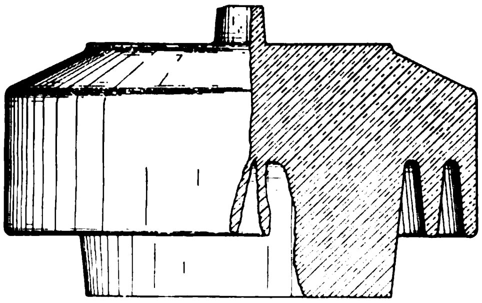


FIG. 14. - DOUBLE PETTICOAT INSULATOR.

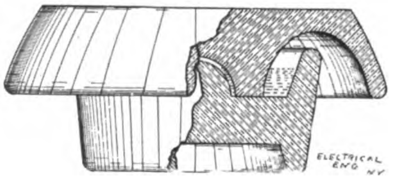


FIG. 15.—OIL INSULATOR.

Unpack the elements and containing cells carefully; see that all dust and foreign material is removed, especially any particles of metal which might accidentally lodge between the plates and form a short circuit.

Be sure that all the insulating pieces or separators are in their proper position between the positive and negative plates, and that all the plates are in proper alignment.

Place the element carefully in the containing cell on the stands or racks, taking care not to disturb the separators.

Connect the cells up in series, that is, positive terminal of one cell to negative of the next, and so on, being sure that the lead is scraped clean and bright before connecting; the positive terminal can always be recognized by the plates being a dark brown, while the negatives are gray.

When this is completed and the entire battery is connected up, it is ready for the addition of the acid or electrolyte and receiving the first charge.

If the cells are too large to ship from the factory assembled, the method of procedure is different. The plates are then handled separately and are so placed in position in the tank with the separators between them. They are then burned on to the lead bus bar as previously described.

A point of the utmost importance is the purity of the electrolyte. Ordinary sulphuric acid contains many impurities which are very injurious to the storage battery plate, notably, hydrochloric and nitric acids, iron, arsenic and copper. Only the best acid, manufactured from sulphur should be used, and tests should be made to ascertain if it is free from above mentioned substances before being accepted. The sulphuric acid made from pyrites is not suitable for storage battery work, as it contains far more impurities than that prepared from sulphur. The acid should always be diluted with distilled water, as ordinary spring or town water contains sufficient chlorine to be injurious. In diluting strong acid, always pour the acid into the water; never pour the water into the acid. The mixing should be done carefully on account of the heat which is generated. It is usual, however, to furnish the electrolyte ready mixed to the proper specific gravity. Too much care cannot be given to this question of pure acid and water as it affects very seriously the ultimate working and durability of the battery.

The following simple tests are sufficient to show whether the electrolyte is good enough for use before being put into the cells:

Test for Hydrochloric Acid.—Take a small sample of the diluted acid, which it is proposed to use for electrolyte, and add two or three drops of nitric acid, HNO_3; heat this in a test tube and allow to cool, then add two or three drops of nitrate of silver, $AgNO_3$. If the acid is pure there should be no precipitate or cloudy appearance. A very slight trace of hydrochloric acid may give a little cloudy appearance. If the solution is heated after the nitrate of silver has been added the test is more delicate. For ordinary practical use the acid may be considered satisfactory if there is only a very slight sign of cloudy appearance when the solution is cold.

Test for Nitric Acid.—Make a solution of diphenylamine, $NH(C_6H_5)_2$, made in the following way: ½ gm. $NH(C_6H_5)_2$, 100 cc. strong sulphuric acid, H_2SO_4, and 20 cc. of water, H_2O; put a small quantity of this solution in a test tube and pour on top a small quantity of the diluted acid to be tested. The presence of nitric acid will be shown by the appearance of a blue color. This test should only be used in the case of new acid; after the acid has been used as electrolyte for cells the results obtained will not be reliable, on account of certain electrolytic actions.

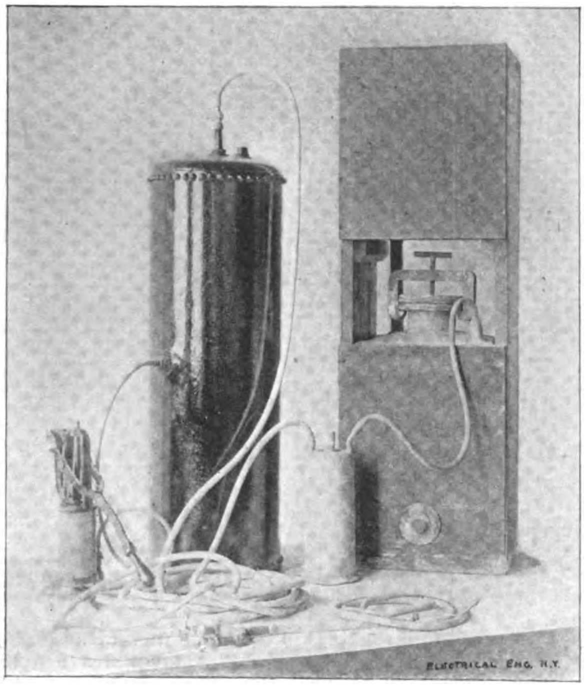


Fig. 16.—Complete Lead Burning Outfit, Consisting of Generator, Wash Bottle, Air Pump and Reservoir, with Rubber Hose and Burner.

Test for Copper and Arsenic.—Take a fresh solution of hydrogen sulphide, H_2S, add an equal quantity of the diluted acid. If the acid is not diluted a white precipitate is thrown down; this shows the acid is too strong and must be further diluted. If the sample of acid is free from copper and arsenic there should be no precipitate; if a black precipitate is thrown down it shows the presence of an impurity, generally copper; and if a yellow precipitate is thrown down it shows the presence of arsenic.

Test for Iron.—Take a small quantity of the diluted acid to be tested and add a few drops of nitric acid, HNO_3, and heat; when cold add a few drops of solution of potassium-sulphocyanide, $KCNS$; if iron is present it will be shown by the appearance of a deep red color.

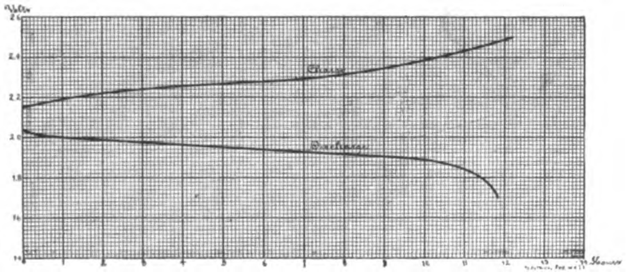


Fig. 17.—Charge and Discharge Curves.

The electrolyte should never be put into the cells until the charging current is available, as the plates are injured by being allowed to stand in the electrolyte in an uncharged condition.

The first charge differs from subsequent charges, inasmuch as it practically completes the formation of the plates and consequently has to be continued for a much longer period than is necessary for charging the battery in the ordinary work.

Before starting the charge, care must be taken that the polarity of the charging current is right. The positive pole of the battery must always be connected with the positive pole of the charging source. The voltage required at the commencement of a charge is about 2 volts per cell and this rises to 2.6 volts per cell at the end of charge, while the normal rate is maintained. Fig. 17 shows curves of voltage during charge and discharge of a cell, the current in each case being maintained at the normal rate. This curve is plotted from the readings of a test made by the writer, but being a laboratory test with a single cell, the efficiency is somewhat higher than usually obtained with a battery in ordinary commercial service.

It is important that the first charge be continued without interruption for at least ten consecutive hours; if practical a continuous run of 20 or 30 hours is preferable. The charge usually required in starting up a battery is about twice its capacity, and should be given at normal rates. This may vary somewhat with different types of cells.

The specific gravity of the electrolyte will drop during the first few hours after being put into the cells, but will rise as the charge progresses until it reaches its maximum point. For example, if the electrolyte is put into the cells at a specific gravity of 1,200, it will drop to about 1,180, and subsequently rise to about 1,210, when the first charge is completed. These figures will depend, of course, on the quantity of electrolyte in the cell, but under normal conditions are as above stated.

As the charge progresses and nears completion it will be found that bubbles of gas are given off from both plates; this is due to the fact that the active material is becoming fully formed and cannot take up all the hydrogen and oxygen gas set free by the decomposition of the electrolyte. If the charging current is reduced, this gassing will decrease, as the amount of gas liberated is in proportion to the current passing. It is always best to reduce the charging current when the gassing becomes very great, both in the first and subsequent charges.

With the pasted type of plate the question of the first charge is more vital than with the Planté type, there being danger in the former of a coating of sulphate of lead forming between the active material and the grid, if the plates are allowed to stand in the acid before the charge is commenced, or if the first charge is stopped before the plates are thoroughly formed. If a pasted plate is once allowed to become badly sulphated in this manner, it is very difficult, if not impossible, to get it back into first-class condition again, as the sulphate insulates the active material from the grid, causing all the action to take place on the grid instead of on the active material. Growing, buckling and disintegration of the active material will soon occur under these conditions. This applies to the positive plate, the negative not being injured in the same way, as it is possible to reduce the sulphate to a spongy lead more easily than to oxidize it.

This same trouble will occur with pasted plates during the regular operation of the battery if the cells are discharged too much, and allowed to stand in that condition, or if they are not fully charged at frequent intervals. The Planté plate is not liable to this trouble, the active material being a coating or portion of the plate itself, and not in the form of a layer which is dependent on the contact with the grid or plate to make and keep it active.

It will thus be readily seen that the Planté plate has advantages over the pasted plate, and now that manufacturers can give practically the same capacity for weight as with the pasted type, together with the capability of higher discharge rates, there remains but little in favor of the latter type.

Having described the method of setting up and giving the battery the first charge we will next proceed to the handling and operation in ordinary work.

THE NEW ELEMENT, "ELECTRATE."

Scientists are discussing a new element called "Electrate," the action of which is termed "Electrolysis." This is formed from free electricity, resulting from imperfect insulation, combining with foreign elements of the atmosphere.—Southern Architect.

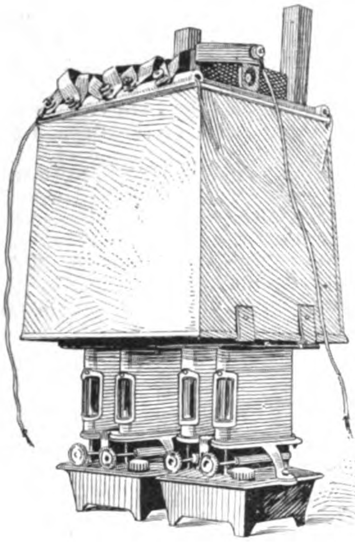
It is believed that stringent laws against undesirable immigration may produce beneficial results in protecting the body politic from the ravages of this new element.

THE CHAMPS-ELYSEES, Paris, is likely to have an electric road across it. The plan is defended by the Socialists, who say that it is a struggle between the frock coats and the blouses. People around the Rond Point don't like the idea.

THE ESSICK BLUESTONE HEAT CELL.

THE desire to convert the energy of heat directly into electric current energy has recently given birth to a number of devices for consuming carbon directly in batteries. Working in a somewhat different direction, Mr. H. V. Essick, of Yonkers, N. Y., has thought to utilize heat energy to increase the activity and output of the well-known copper-sulphate cell with zinc-copper electrodes, such as the gravity cell, and with that end in view has constructed and recently patented the battery illustrated in the accompanying engraving.

This generator is built up of units consisting of an outer cell of copper with a zinc plate suspended in the center and insulated from the copper. The copper sulphate is fed automatically to the cells in the shape of a solution and in proportion to the activity of the cell. A lamp or other source of heat is placed under the cells which heats the electrolyte to a temperature of 180 degs. Fahr., after which a small quantity of heat only is required to maintain that temperature.



THE ESSICK BLUESTONE HEAT CELL.

With cells occupying only 1 cubic foot of space Mr. Essick states that he is able to obtain 75 watts, for which, ordinarily, 150 gravity cells would be required. Each cell delivers 15 amperes at 1 volt, or 15 watts; some cells even show as high as 38 amperes. We understand that Mr. Essick will shortly place his cell on the market, arrangements now being in progress with that end in view.

FLUX OF FORCE AND COMMUTATORLESS DYNAMOS.

BY A. DE PUYDT AND M. PONCIN.

IN speaking of "flux of force," it seems to us that the following points are usually forgotten: 1. That it is the bodies themselves which act one upon the other, a flux of force being only the measure of that action at a point. 2. That one body in order to move another, must act as its fulcrum.

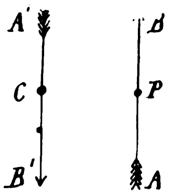
In other words, it seems to be forgotten that one material point cannot exert a force upon another material point in any other direction than that of the straight line joining them.

For example, in electro-magnetism it is said that if C is a rectilineal conductor perpendicular to the paper and carrying an electric current and P a magnetic pole, C will tend to make P move in the direction of the arrow A B, and P will tend to make C move in the direction A′ B′. (See diagram.) This, it will be seen, is impossible because there is no fulcrum in either of the cases.

Speaking generally, all the pretended actions of one body upon another are impossible, if they cannot be explained by the resultant of the attractions or repulsions in a straight line of each point of the one body upon each point of the other. Our opinion is that in the similar actions between conductors and magnets, every portion of the conductor acts as the fulcrum for the rest of the system.

These considerations have led us to make a non-polar dynamo, in which the bars wherein the electric current is induced revolve with the inductors, which renders the construction very simple and very strong. The fulcrum of the whole mobile system is here the external circuit, that is, the fixed part of the electric circuit mains, etc.

The result of these reasonings is that we are now able to make a commutatorless continuous current dynamo, essentially practical and strong, giving a very high efficiency, working without attendance, and without sparking, no matter what fluctuations there may be in the load, a very important point in a great many cases.[1]



ELECTRIC TRANSPORTATION

THE G. E. CO'S EXPERIMENTAL TRACK AT SCHENECTADY.

THE trend taken by the electric railway industry in the direction of the field hitherto occupied exclusively by the steam locomotive, as evinced by the recent developments on the New York, New Haven and Hartford and Baltimore and Ohio Railroads, has caused the General Electric Company to provide itself with its own special line of track upon which to carry out electric traction experiments. The line of track lies between the works at Schenectady and the Erie Canal. It has been laid upon the heel path, is 6,700 feet long, and is of the regulation New York Central Railroad construction, the service rails being standard rails, 85 pounds to the yard. It is upon this track that almost daily equipments are tried under different steam road conditions and bursts of speed made and efficiencies recorded of a more than encouraging nature.

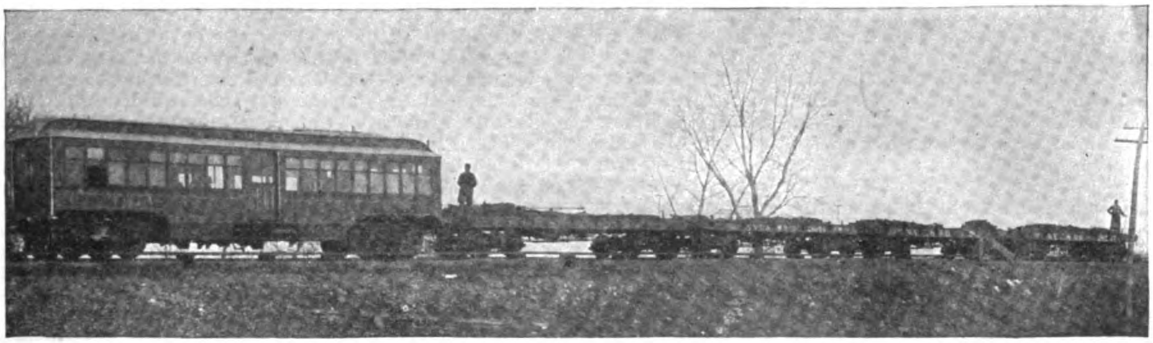


FIG. 1.—MOTOR CAR HAULING FOUR LOADED FLAT CARS ON GENERAL ELECTRIC EXPERIMENTAL TRACK.

The track is laid from the side of building No. 7, and crossing the river road rises on a gradient of 4 per cent. to the level of the heel path. The first section of the line is a tangent 2,415 feet long, the second a series of short tangents and curves

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[1] See Elec. Engr., p. 213, Feb. 24, 1897.

1,635 feet long, and the third another tangent 2,730 feet in length.

Running beside the track on the far side from the canal are the conductor rails. Of these there are two, running parallel with each other and the track, from the top of the first gradient to the end of the line. They are of 30-pound rails, set on 8-inch ash blocks treated with bergtheer in vacuum pans and thoroughly impregnated. The two sets of conductor rails have been laid down for the purpose of experiment with alternating multiphase currents. For direct current experiments two rails are connected in multiple. Both service and conductor rails are bonded with No. 0000 copper bonds.

The current is taken from the works power house, over a line issuing from the back of the testing department. The feeder is a 500,000 c. m. insulated cable, running by the track for a distance of about 5,300 feet. The line is divided into three working sections, each controlled by its own switch and semaphore. When this switch is closed its section of conductor is made alive, and the movement of the switch handle sets the semaphore.

The experiments made so far have been carried on for the purpose of developing motors and systems of operation for elevated and surface steam roads. For locomotive a special eight-wheeled car is used. This resembles a regular passenger coach so constructed as to give an unobstructed access to the two motor trucks. The weight of this coach-locomotive equipped is about 30 tons empty. It is divided into three sections: a driving and testing department in front; a passenger division in the center, and a rear compartment in which are carried the air pump, tools, etc.

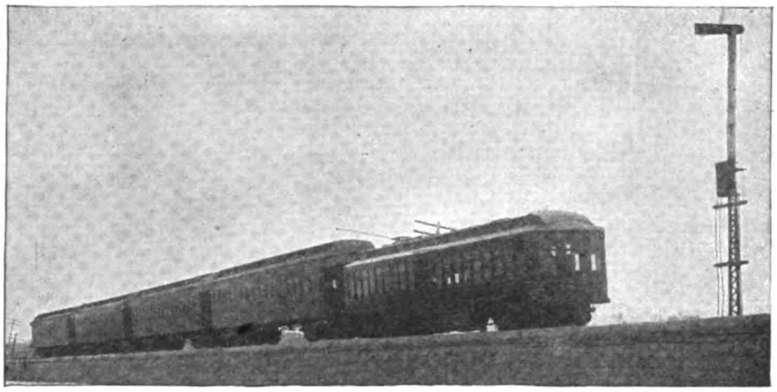


Fig. 2.—G. E. Motor Car Hauling Four Standard Passenger Coaches.

The equipment of the forward compartment consists of a skeleton wooden switchboard carrying the ammeters, voltmeters, wattmeters, etc., to enable the engineer to gauge exactly and record the performance of, the specific motor equipment which may be under experiment at any stated time. In addition the switchboard is fitted with the necessary quick break switches, magnetic blow-out, fuse boxes, automatic circuit breakers, etc. The controller is set in front of the right forward front windows, through which the driving engineer has an unobstructed view of the track in front of him. To his right is the valve handle of the air brake, and in front of him is an operating ammeter gauging the current output. The resistances are suspended from beneath the central compartment.

In the test during which the photographs from which our illustrations were made, the equipment of the car consisted of four G. E. 2,000 motors—each motor being rated at about 125 horse power—one motor to each axle, motion being communicated to the wheels through steel gear and pinion. The forward truck was equipped with a special speed recorder. The controller used was a K 16 series parallel controller.

From beneath the bolster of each truck set between the wheels on the conductor rails' side projects a heavy oak beam, to which is suspended the contact shoe by means of which the current is brought from rails to motors. This shoe is a flat piece of cast iron with the ends slightly curved. It is fastened by two loose links to an iron casting bolted to the oak beam. This method of suspension keeps the shoe continuously in contact with the surface of the conductor rail as it allows it to conform immediately to any inequalities which may occur in the latter.

The air for the brakes and whistle, one of which is set at each end of the car, is furnished by a vertical direct connected air pump, operated by a motor controlled automatically.

The first test made with the motor equipment, the total drawbar pull of which is about 15,000 pounds, consisted in the hauling of three flat New York Central and one flat Lake Shore freight cars each loaded with pigs of iron. This load, about 121 tons dead weight, was easily handled by the locomotive, and the records as to speed and power required showed most gratifying results. The flat cars were then switched back into the works. This train is shown in Fig. 1.

The locomotive was then coupled to four New York Central standard passenger coaches, making with the motor car a train of 130 tons. The controller was in charge of Chief Engineer W. B. Potter, and Mr. S. H. Libby acted as conductor. Several interesting runs were made with this train up and down the track, with equally encouraging results.

ELECTRIC TRACTION TRIALS ON BELGIAN RAILROADS.

According to "l'Electricien" the Belgian State Railway will this year experiment with electric traction on a line of railway from Brussels to Tervueren, a distance of about nine miles. Five large accumulator cars will be run in addition to the present steam service. They are to run at a speed of 18½ miles an hour on the steepest gradient (1.6 per cent.), and at 31 miles an hour on other parts of the line. Each car will be 52½ feet long, and will rest on two bogies. There will be room for 80 passengers. The cars are direct-driven, and there are two motors on each. The motors will weigh from eight to nine tons, the other electrical apparatus one ton, the cells twelve tons, and the car twenty tons. Three Julien and two Tudor batteries have been ordered, each of 264 cells. The former are designed to make three or perhaps four journeys without recharging, the latter only one journey. In the latter case, however, the time required for charging is limited to one hour, while for the Julien battery six hours are required. The cells are in 24 drawers, 11 being contained in an ebonite box in each drawer. Although the railway administration's specification, when ordering the batteries, was somewhat exacting, the object of the test is actually to compare various types of motors, to find which are the most suitable for drawing considerable loads at fast speed on ordinary railroads. The following firms are supplying motors for these trials: Jaspar of Liege, Pieper of Liege, Schuckert of Nuremberg, and Thury of Geneva. The motors will be compound-wound and connected long shunt, the winding in series with the armature constituting part of the starting resistance. The following are some of the conditions specified for the motors: At a pressure of 500 volts the two motors of a car when connected in series shall revolve at 116 revolutions per minute, when the current is 15 amperes, and the field-magnets are only excited by the shunt winding. Under these conditions they shall have an efficiency of at least 75 per cent. When connected in parallel at 500 volts, with the maximum excitation obtainable by the shunt alone, and a total current of 150 amperes, the motors shall make 231 revolutions per minute, and the commercial efficiency shall not be less than 80 per cent. The cells will be charged by a Willans engine and dynamo, erected on a car drawn by an old locomotive.

OPERATING ST. LOUIS UNION DEPOT BY ELECTRIC LOCOMOTIVES.

The Board of Directors of the Terminal Railroad Association, St. Louis, have under consideration the problem of changing the motive power of the terminal system from steam to electricity. The idea of the Terminal Association is to dispense with its steam locomotives entirely, and move by electricity all trains that enter the city. About 150 passenger trains per day enter the passenger station at Eighteenth street, and the number of freight trains is many times greater. All these will be hauled over the terminal tracks by electric locomotives if a practical solution of the problem can be had.

In addition to this, the company hopes to be able to do all of its switching in St. Louis, East St. Louis and Madison with the same improved devices.

In discussing the company's plans, President Walsh instanced the Baltimore and Ohio Company, which supplied its surplus power at the Baltimore tunnel to other users of electricity. "If we adopt the new motive power," he added, "I suppose we would follow the same plan. The cost of operation could be considerably reduced in that manner. It might be possible to furnish the current for street railways and other plants, and build up a profitable business. The coal consumption of a big station would not be any greater than, and possibly not so great as, that of our fifty locomotives."

ELECTRICITY ON ILLINOIS CENTRAL.

Since the World's Fair, the Illinois Central Company has given close attention to the developments in the electrical appliances for the operation of passenger trains, in the expectation that electricity might ultimately be substituted with profit for steam as a motive power for its suburban service. In 1892 reports on this subject were made to the company by its chief engineer and superintendent of machinery. Last autumn these officers, together with the general superintendent, were appointed a committee to investigate and report upon the practicability of introducing electricity in the place of steam power in the operation of the company's trains. The committee, after an exhaustive investigation, submitted their report, March 12, and at a meeting of the board of directors of the company, held in New York, on the 25th, the board formally approved the substitution of electric power for steam in the operation of its local suburban trains, and authorized the president to take the necessary steps to carry out the order of the board. It is said that preference is given to the third rail method.

WILL SHIFT CARS BY ELECTRICITY.

The Pittsburg, Bessemer and Lake Erie is understood to be arranging to shift cars at the Pittsburg end of the line by means of electricity. According to the reports they are preparing plans for great yards along the Union railway. Realizing the necessity for the most economical measures in order to enable them to handle ore and other freight at the minimum of expense they will erect a large power plant and use electric motors to move the cars. It is said that a great part of the expense incurred in handling freight destined for the mills and furnaces is occasioned by the necessity for using steam locomotives.

TROLLEY ON THE HUDSON FERRIES.

A new plan fostered by the Consolidated road of New Jersey and the Brooklyn Heights road is to connect directly by the Pennsylvania Annex ferry boats on the Hudson and interchange trolley cars and trips over the two great systems without change. Over 400 miles of track will be available.

SOCIETY & CLUB NOTES

NEW YORK ELECTRICAL SOCIETY.

Mr. E. E. Higgins, editor of the "Street Railway Journal," will lecture at Columbia University, New York City, on April 7, at 8 P. M., before the New York Electrical Society, on "Résumé of Financial and Engineering Practice in American Street Railroading." This is an excellent opportunity to hear an important topic discussed by a master of the subject.

THE FRANKLIN INSTITUTE, Philadelphia, is discussing a textile exhibition for September, 1897. Mr. J. M. Dodge advocates the use of electric and compressed air motors for driving the machinery, and proposes that all the apparatus on view should be kept running. The scheme has not yet passed beyond the stage of discussion.

LEGAL NOTES

SUB-TROLLEY FREEDOM FROM ELECTROLYTIC ACTION.

The Metropolitan Street Railway Company, of New York City, to satisfy itself not less than to demonstrate the fact to the State Railroad Commissioners, has recently made a large number of tests on its Lenox avenue conduit line, to ascertain if there could be any electrolytic action. The results show no action from the railway circuits.

THE CONSOLIDATED CAR HEATING COMPANY, Albany, N. Y., has appealed the cases involved in the recent Coxe decision in favor of the American Electric Heating Corporation, as to indicator switches, a decision which the Consolidated Company holds to be very limited in its scope.

REPORTS OF COMPANIES

ELECTRIC ENGINEERING AND SUPPLY CO.

At the annual meeting of the stockholders of the Electric Engineering and Supply Company, held at Syracuse, the following directors were appointed: H. C. Hodgkins, R. H. Sanderson, H. A. May, J. E. Zeublin, and J. V. Clark. At the subsequent meeting of the new board of directors, Mr. H. C. Hodgkins was elected president; R. H. Sanderson, vice-president, and H. A. May, secretary and general manager. Mr. May, the new manager, has been with the company since its organization, in 1889; employed at first as bookkeeper and latterly as cashier. Owing to the able manner in which he has filled his position, in handling the finances of the company, and his thorough knowledge of every detail of the business, his promotion is a fitting tribute to his acknowledged ability. The Engineer wishes Mr. May the best of success.

PERSONAL

MR. N. D. WEBSTER, who has for the past five years been one of the most successful advertising solicitors on the staff of a well-known electrical journal, has resigned and has accepted a position with the "American Electrician." Mr. Webster is deservedly popular among the electrical trade not only in New York City, but throughout the Eastern States, and should prove himself a success in his new position.

MR. E. P. COOK, assistant superintendent of the western division of the Western Union Telegraph Company, at Dallas, Tex., has been appointed to succeed the late Col. L. C. Baker, as superintendent, with headquarters at St. Louis.

PRESIDENT F. NICHOLLS, of the National Electric Light Association, has made twelve trips to New York during his term of office, making 12,000 miles traveled by him in ten months in its interests.

MR. J. MOFFAT, secretary of the Salt Lake and Ogden Gas and Electric Light Company, has resigned in order to devote his entire attention to his mining interests.

MR. RUSSELL B. HARRISON, president of the Terre Haute, Ind., street railway, has been in the East lately, and has had to undergo an unceasing run of interrogatories as to his taking office under the McKinley administration.

Mr. H. M. BYLLESBY, of St. Paul, Minn., has been an Eastern visitor in connection with certain electrical enterprises under development.

MR. GEORGE ROSS, electrician at Union Station, St. Louis, Mo., has been tendered the position of electrician for the East St. Louis Electric Railroad, which was lately purchased by the company which operated the line on the Eads bridge. He will also act as superintendent. Mr. Michael Harrold, who has been superintendent of the East St. Louis line under the old management, will be made superintendent of some of the Scullin lines in St. Louis.

MR. J. CARL MAYRHOFER, E. E., is producing some very fine electrical effects in connection with the spectacular lecture given by Mr. Garritt P. Serviss at the Carnegie Music Hall, New York City, on "The Evolution of the Earth." The lecture is being repeated several times. The novelty and the brilliance of its effects are worthy of the highest praise.

MR. JACOB CLOOS, of Milwaukee, who is well known in the West as an expert mechanical and electrical engineer, has been appointed electrical engineer for the city of Beaver Dam, Wis.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 23, 1897.

Alarms and Signals:—

ELECTRICALLY OPERATED SIGNAL OR SEMAPHORE, J. N. Newson, St. Louis, Mo., 579,170. Filed Sept. 14, 1896.

Electrically controlled mechanism, whereby the levers are operated in opposite directions.

Batteries, Primary:—

ZINC FOR ELECTRIC BATTERIES. F. A. Lane, Torrington, Mass., 579,273. Filed Oct. 22, 1895.

Employs a protecting coating encircling the major portions of its periphery and a limited exposed portion extending along its length in the longitudinal space left in the encircling coating.

Batteries, Secondary:

METHOD OF MANUFACTURING ELECTRODES FOR SECONDARY BATTERIES. L. Epstein,, London, Eng., 579,361. Filed Sept. 5, 1896.

Consists in first rendering porous the surfaces of the lead plates, then treating them with a mixture of lead oxide and caustic alkali, then drying, and finally converting certain of the plates into negative electrode and ethers into positive electrodes by immersing them in an electrolyte.

Distribution:—

DEVICE FOR HOUSE WIRING. H. R. Young, Lakeport, N. H., 579,213. Filed Jan. 31, 1896.

Consists of a magnetized body having provision for attachment to a fishing wire and magnetized and provided at one end with hooks.

ELECTRICAL TRANSFORMER. F. H. Jeannin, Arcadia, Fla., 579,395. Filed April 1, 1895.

A core made up of soft iron wires lapped over at the ends.

Dynamos and Motors:—

ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINE. C. P. Steinmetz, Schenectady, N. Y., 579,283. Filed March 20, 1896.

A transformer having primary and secondary circuits wound on its main core, a core forming a magnetic shunt to the part of the core on which the secondary is wound and a coil through which a variable current flows wound on the magnetic shunt core.

Electro-Metallurgy:—

ELECTRO-PLATING HOOK. J. Bossard, Dubuque, Iowa, 579,124. Filed April 25, 1896.

Details of construction.

ELECTRICAL AMALGAMATOR. W. Wright, New York, 579,211. Filed July 8, 1895.

Means for electrically controlling the deposit surfaces of the amalgamator.

Lamps and Appurtenances:—

VEHICLE, LIGHT, AND GOVERNOR FOR SAME. D. W. Stinson, St. Louis, Mo., 579,190. Filed Nov. 23, 1895.

Consists of an electric generator adapted to be operated by a friction disc in conjunction with a drive wheel.

ELECTRIC ARC LAMP. J. A. Mosher, Chicago, Ill., 579,161. Filed Oct. 22, 1896.

Means for mounting a small arc-inclosing envelope, so that the carbons may both be reciprocated by the regulating mechanism of the lamp.

ELECTRIC INCANDESCENT LAMP. F. L. Fowler, Philadelphia, Pa., 579,227. Filed Nov. 5, 1896.

Designed to permit the renewal of filament without difficulty.

CARBON HOLDER. C. E. Harthan, Lynn, Mass., 579,267. Filed Oct. 14, 1896.

Details of construction.

ARC LIGHT CUT-O UT. C. E. Harthan, Lynn, Mass., 579,268. Filed Oct. 14, 1896.

Details of construction.

Measurement:

ELECTRICAL MEASURING INSTRUMENT. E. J. Houston and A. E. Kennelly, Philadelphia, Pa., 579,344. Filed Oct. 27, 1896.

Consists of a permanent magnet provided with pole pieces, one of which encloses the other; a coil capable of moving in the polar channel about a fixed axis into positions corresponding to definite current strengths under the action of electromagnetic forces opposed by a definite torque and a pointer rigidly attached to the coil and moving over an indicating scale.

Miscellaneous:—

ELECTRICAL GAS COCK. F. W. Ackerman, Corning, N. Y., 579,249. Filed July 11, 1896.

Comprises a casing, an oscillating valve mounted therein and adapted to control the gas supply, an armature mounted upon the valve, and electro magnets applied in the casing so as to exert their force upon the armature at a tangent to its direction of rotation.

MEANS FOR TRANSPORTING ARTICLES OF MERCHANDISE. M. C. Mengis, Brooklyn, N. Y., 579,158. Filed April 10, 1896.

Designed for the transportation of mail matter and other small packages.

APPARATUS FOR BLEACHING FIBROUS MATERIALS. C. Kellner, Vienna, Austria-Hungary, 579,236. Filed Feb. 1, 1892.

Consists of a vessel for containing a suitable electrolyte, electrodes arranged relatively to one another to cause the electric current to follow a zigzag course, and means for bringing the material saturated with the electrolyte into contact with the electrodes.

DIAPHRAGM FOR MANUFACTURING CHLORIN AND CAUSTIC SODA BY MEANS OF ELECTROLYSIS. E. Baker, Winchester, Mass., 579,250. Filed April 6. 1895.

Composed of a body of sand having its particles united by a binder.

ELECTRIC FURNACE. W. S. Hadaway, Jr., New York, 579,324. Filed May 8, 1896.

Designed for use in burning the finer qualities of porcelain.

PROCESS OF MANUFACTURING PERCARBONATES. E. J. Constam and A. Von Hansen, Zurich, Switzerland, 579,317. Filed Sept. 4, 1896.

Consists in electrolyzing a saturated solution of carbonate at a temperature below zero centigrade.

ELECTRIC SUNSHINE ANNUNCIATOR. L. Hunt, St. Louis, Mo., 579,393. Filed Oct. 17, 1896.

Details of construction.

ELECTRIC HEATER. G. H. Whittingham, Baltimore, Md., 579,459. Filed Jan. 30, 1896.

A tubular heater in which the resistance wire has its entrance and exit at the same end of the tube and means for relieving the resistance wire of the heat generated by the passage of the electric current.

ELECTRIC TIME CHECK AND RECORDER. A. Davidson, New York, and C. G. Armstrong, Chicago, Ill., 579,473. Filed Jan. 25, 1896.

Details of construction.

ELECTRICALLY OPERATED SEWING MACHINE. J. S. Biggar, Chicago, Ill., 579,511. Filed Jan. 8, 1896.

A pair of solenoids operate the needle reciprocally, and a rotary motor rotates the shaft.

Railways and Appliances:—

ELECTROPNEUMATIC LOCOMOTIVE. G. Westinghouse, Jr., Pittsburg, Pa., 579,526. Filed March 4, 1892.

Comprises an electric motor, a vehicle driven thereby, an air-compressor, a compressed air reservoir, a fluid motor for assisting in driving the vehicle normally operated by air under pressure from reservoir.

ELECTRIC RAILWAY. E. Lachmann, Hamburg, Germany, 579,300. Filed June 12, 1895.

Embodies a main underground conduit provided with the usual surface slot, and an auxiliary conduit open at its lower end insertible into the main conduit through the slot for the purpose of drainage.

TROLLEY SUPPORT FOR ELECTRIC RAILWAY CARS. J. F. S. Branth, New York, 579,380. Filed Nov. 20, 1888.

Employs curved plate springs upon which the trolley support rocks.

CURRENT COLLECTING DEVICE FOR RAILWAY VEHICLES. G. Westinghouse, Pittsburg, Pa., 579,506. Filed June 8, 1896.

Embodies a contact head, an extensible and normally vertical supporting frame therefor, a base to which the frame is pivoted, and means for locking the contact head in its lowest position, the means being actuated by the movement of the supporting frame upon its pivot.

SYSTEM OF CIRCUITS AND APPARATUS FOR ELECTRIC RAILWAYS. G. Westinghouse, Jr., Pittsburg, Pa., Aug. 20, 1891.

Adapted for conduit systems.

ELECTRIC RAILWAY SYSTEM. G. Westinghouse, Jr., Pittsburg, Pa., 579,527. Filed Feb. 19, 1894.

A street railway built with two flat rails on one side constituting electric supply and return conductors, and grooved supporting and guiding rails on the other side.

Switches, Cut-Outs, Etc.:—

CIRCUIT BREAKER. F. C. Robertson, Toronto, Canada, 579,366. Filed July 22, 1895.

Designed for low voltage currents.

AUTOMATIC ELECTROMAGNETIC CIRCUIT BREAKER. W. E. Harrington, Philadelphia, Pa., 579,431. Filed May 5, 1896.

Comprises switch of two cores, a solenoid coil and a ratchet device, the cores movable in the magnetic field of the coil and adapted to be actuated by the current passing through the coil to actuate the switch, the ratchet device adapted and adjusted to hold the switch out of contact after having been actuated.

Telegraphs:—

TELEGRAPH CALL BELL. J. N. Newsom, St. Louis, Mo., 579,169. Filed April 27, 1896.

Details of construction.

Telephones:—

TELEPHONE SPRING JACK. W. O. Meissner, Chicago, Ill., 579,239. Filed Jan. 17, 1896.

Details of coustruction.

TELEPHONE EXCHANGE SYSTEM. J. E. Keelyn, Chicago, Ill., and K. B. Miller, Washington, D. C., 579,299. Filed April 27, 1896.

A divided-board telephone exchange system wherein the connection of two subscribers on different boards is effected by trunk lines interconnecting the boards.

TELEPHONIC MESSENGER SERVICE. J. D. Hobbs, New York, 579,482. Filed Feb. 18, 1896.

Means whereby a telephone and messenger call box may be employed in combination or independently of each other and working on the same circuit.

THE STOCK MARKET

IMPROVED CONDITIONS ALL AROUND.

The United States Supreme Court may give disquieting railway decisions and politics in Europe may continue charged with peril of war, but there can be no question as to the improvement in many conditions of American business. The first quarter of 1897 has shown a falling off of 11 per cent. in business failures over the like period in 1896 and a decline of 16 per cent. in liabilities. Bank clearings for March are the best for many months past, and 1.8 per cent. larger than for March, 1896. Recent investigations show that since November at least 100,000 persons have been added to the force at work in the main lines of industrial pursuits. This is below what was expected, but is a gain in keeping with the others. The passage of the Dingley tariff bill will take place soon and will relieve uncertainty that still holds the wheels of trade in inactivity. The high rate of duties proposed, exceeding the McKinley in some respects, gives great offense even in some Republican quarters, and there is a general wish for the settlement of the currency. What the country chiefly wants is peace.

Stock quotations have been lower through the week. Western Union on sales of 49,044 shares went off from 82½ to 80, and Mr. Sage is understood to be firm for a lower rate of dividend. General Electric on sales of 11,727 shares rose from 30½ to 31¾. American Bell telephone has gone off slightly, from 225 to 222.

TRADE NOTES & NOVELTIES

THE HOLTZER-CABOT AUTOMATIC PRESSURE CONTROLLER AND INDICATOR.

IN the article appearing in another place in this issue, describing the model station of the Narragansett Electric Lighting Company, of Providence, mention is made of the method of feeder regulation control which is about to be adopted. For this purpose, the Holtzer-Cabot automatic controller and indicator will be employed.

This apparatus furnishes the means of automatically controlling the various forms of pressure regulating devices in use at the present time, such as field rheostats, boosters, end cell switches, etc. The engraving, Fig. 1, shows its application to a field rheostat in which the driving shaft is coupled to a rheostat arm. This shaft is operated by a positive step by step movement as shown. The driving pawls are of hardened steel and engage with the phosphor-bronze gear, and are controlled by the electro-magnets so as to move the rheostat arm right or left by the engagement of one pawl or the other with the driving gear. The pawl lever is driven by a small motor, as shown, the speed of which may be varied to any extent desired. By this means the speed of regulation can be adapted to the size and corresponding lag of the generator fields. As the power of the motor is ample and the wearing parts are strongly built of the best material, it is possible to use this apparatus for operating end cell switches, feeder regulators having heavy contacts, with perfect success.

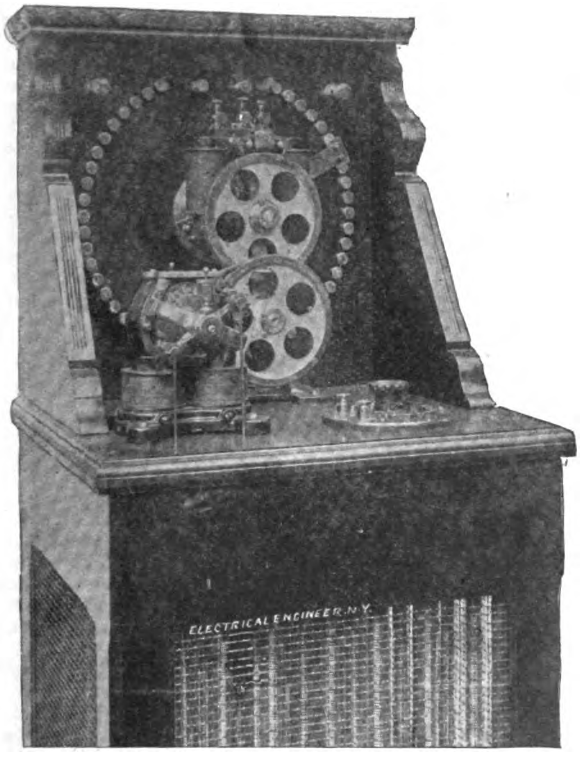


FIG. 1.—HOLTZER-CABOT AUTOMATIC PRESSURE CONTROLLER.

A pressure indicator or relay, Fig. 2, is used in connection with this controller, and recent improvements have been made which render it extremely accurate and durable. This instrument may be instantly set to operate the controller at any desired pressure and when so set the pressure will be kept at that point regardless of change in speed or load provided this variation is within the capacity of the dynamo or field rheostat. This instrument will operate the controller with a variation in pressure of half a volt on a 110-volt circuit and being of the hot wire type is free from the defects inherent to those instruments of the electro-magnetic or solenoid type.

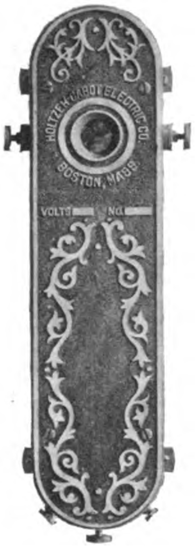


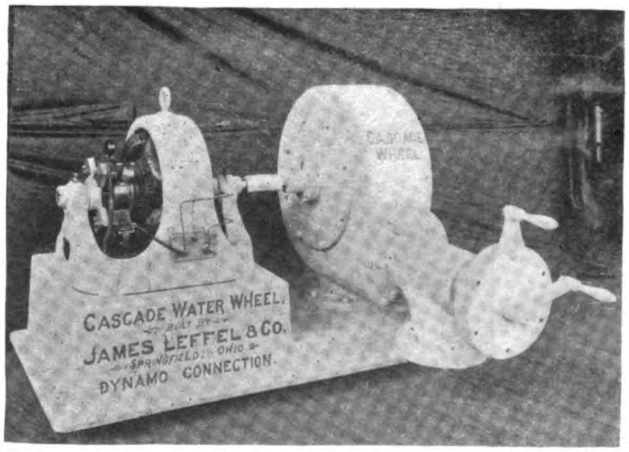
FIG. 2.—HOLTZER-CABOT AUTOMATIC PRESSURE INDICATOR.

The amount of energy required to operate the entire apparatus for the largest generator is from 60 to 65 watts. It is manufactured by the Holtzer-Cabot Electric Company, of Boston, in various forms from the step-by-step movement only, belt driven, and ready to attach to any form of rheostat to the more complete form with field rheostat, coils, slate or marble head and motor contained in one cabinet.

NEW LEFFEL CASCADE WHEEL.

A VERY neat electric light installation is that in the Springfield (O.) Water Works, which furnishes light for the pumping house and the residence of the superintendent.

The plant consists of one of the new Leffel "Cascade" 12-inch water wheels, built by James Leffel & Co., of Springfield, O., coupled direct to a dynamo, as shown in the accompanying engraving. The buckets of this 12-inch wheel, which is of the impulse or reaction type, are adapted to a round stream or



NEW LEFFEL CASCADE WATER WHEEL AND DYNAMO.

nozzle of .75 of an inch as a maximum. An ingeniously arranged apparatus is used for changing the size of the nozzle tips to suit the number of lights or the capacity of the generator, which is easily and quickly done by operating a lever by hand, so that five different capacities of nozzle tips are used.

The lighting plant has a capacity of nine to forty 16-candle-power incandescent lights, and a jet of .35 of an inch will run the smallest number, under a pressure of 70 to 80 pounds from the water works pipes. For driving the forty lights a .50 to a .60 of an inch stream of water is used.

This wheel is run without a governor, as the pressure from the water works is ordinarily quite steady, ranging from 65 to 85 pounds pressure in the pipes, but the generator bears some variation in speed, and the very steady motion of the Cascade wheel prevents any serious fluctuations in the lighting.

The Cascade wheel is specially adapted to high heads where the amount of water is limited. Its advantages are the great simplicity of its structure, its slower speed, for many purposes, its small frictional surface, and its almost entire freedom from wear. Besides the foregoing good qualities, this wheel is guaranteed to give a far higher efficiency or percentage of the use of water, than any turbine under similar conditions. The wheel is also applicable to heads ranging from 40 feet to 2,000 feet and upwards; head pressures so high, that they are absolutely impossible of application to turbines.

A test of the Cascade wheels was made recently under the superintendence of Prof. E. A. Hitchcock, of the Ohio State University, which showed the following remarkable results: Six tests of a 38-inch wheel gave efficiencies ranging from 87.06 to 91.02 per cent. A like number of tests on a 26-inch wheel gave efficiencies ranging from 87.76 to 91.85 per cent. In both instances the variation in efficiency noted was due to variation in water pressure which occurred during the tests. The showing is a very remarkable one.

NEWAYGO AUTOMATIC CIRCUIT BREAKERS.

FUSE wire has proved so unreliable to all users and electrical engineers as a safety device for protection from short circuits, overloads or grounds, and offering no protection from lightning storms whatever, that the electrical public has turned its attention to the use of automatic magnetic circuit breakers as a reliable substitute for fuse wire.

We illustrate in accompanying engravings the well-known automatic circuit breakers or limit switches made by the Automatic Circuit Breaker Company, of Newaygo, Mich., with their latest improvements. Fig. 1 shows the circuit breaker closed, and Fig. 2, a sectional view, after the circuit is broken.

As will be seen, the copper contact A has mounted upon it the carbon B with which the carbon B' makes the final break. The dash pot C gives the break frame R its sudden blow through the handle V; the latter has about one-eighth of an inch play, as shown at L, so that it gives the break frame a hammer blow, overcoming any possible chance for contact R and A to stick. D is a latch and E a small weight to return the armature to its place after the instrument has operated.

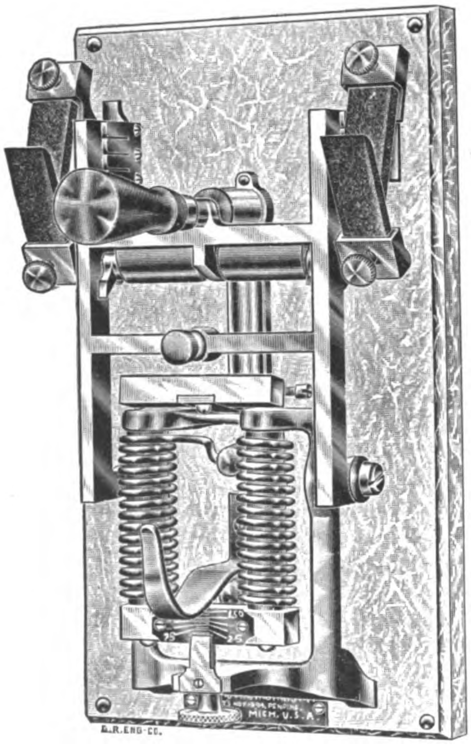

MICH. U.S.A.
B.R.ENG.CO.

Fig. 1.—The Newaygo Automatic Circuit Breaker.

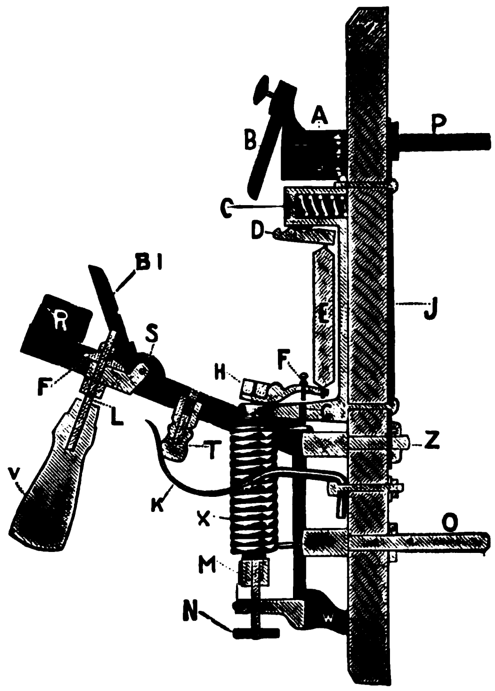


Fig. 2.—Newaygo Automatic Circuit Breaker.

The screw F through the armature holder, makes contact on the point shown at G, which is a piece of iron running to the magnet core and is magnetized so that it holds the armature up until the current exceeds the pre-determined point. Then magnet G releases the screw F, giving a hammer blow to E against latch D, and releases disc F, which is the catch on frame R, and a part of handle V, all movements being positive, knock-out blows. M is the graduation plate, the graduations being in amperes. The adjusting screw N adjusts the capacity, either increasing or decreasing to any pre-determined point between the minimum and maximum graduations. All springs and intricate parts are thus avoided by a novel use of magnetism, being points F and G, whose action is always positive and never varying in principle or operation.

The company guarantee that their instruments will operate within 1 per cent. of their set capacity under all circumstances. They have them in use on all systems and voltages and claim to manufacture the only successful alternating current circuit breaker now on the market.

TROPENAS STEEL FOR DYNAMO MAGNETS.

THE Tropenas pneumatic steel process is a modification of the Bessemer process. It consists in decarbonizing pig iron, melted in the usual way, by means of air compressed under a light pressure. To accomplish this a special converter different in many points from the Bessemer and other similar apparatus is used.

In brief the Tropenas process differs from the other pneumatic processes in the following characteristics. The compressed air does not penetrate into the metallic bath, but acts only on its surface. Contrarily to all other similar processes which have in view the agitation, more or less, of the metallic bath, all the arrangements of the Tropenas process tend to keep the bath as quiet as possible during the operation. By so doing Tropenas avoids giving to the metallic bath any further agitation than the natural one caused by the chemical reaction going on in the bath.

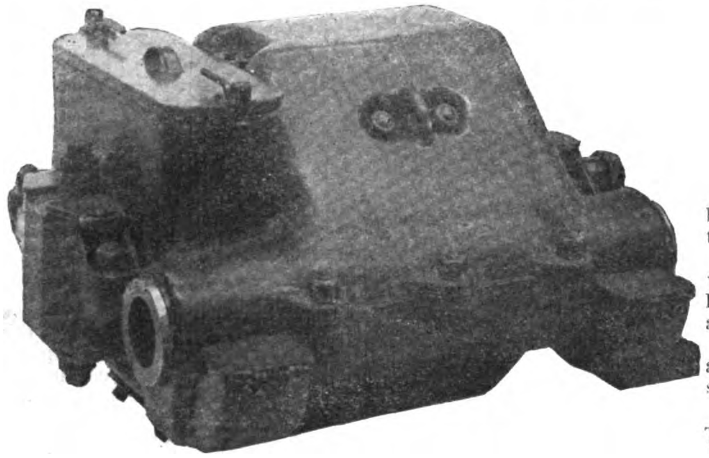
In the Bessemer operation nearly all the carbon, contained in the metal, is transformed into carbonic oxide, the proportion in volume reaching from 20 to 30 per cent. of the total quantity of the escaping gases, while in the Tropenas process, the top row of tuyeres allows of the rational burning, above the surface of the metallic bath, of all the carbonic oxide arising from the metal, thus increasing considerably the temperature of the final steel.

Tropenas steel has been found to be specially adapted for the magnets of dynamos. Tests made by Prof. J. A. Ewing on five samples, some cast at intervals of two years, show it to be of remarkable uniformity in its magnetic properties. According to Prof. Ewing, Tropenas steel may be relied on to take up, under the action of any assigned magnetizing force exceeding 30 units, an amount of magnetism which is not only absolutely very high, but is capable of being stated beforehand within narrow limits of probable variation. Prof. Ewing considers this steel an exceptionally good material for dynamo magnets. Messrs. Powell & Colné, of 27 Thames street, are the sole agents for the Tropenas steel process in the United States.

G. E.-51 RAILWAY MOTOR FOR HEAVY RAILWAY SERVICE.

Already suburban branches of steam roads and two elevated roads are operated entirely by electricity and the General Electric Company in anticipation of this new phase of electric railway work, has designed and developed, and is today prepared to furnish, every kind of apparatus for the complete electrical equipment of suburban railways now using steam. The G.E.-51 railway motor has been especially designed for high speed suburban and elevated railway work. It has a capacity of 80 horse power, rated according to the standard basis of a rise of 75 degs. Cent. above the temperature of the surrounding air after a run of one hour at rated load.

A large number of gear reduction combinations may be used to afford a wide range of speed and tractive effort. For high speed work a gear reduction of 1 to 1.74 is used, and at the present time trains of 25 to 30 tons equipped with two G.E.-51 motors having this gear reduction are operated at speeds of from 45 to 50 miles an hour with success. The G.E.-51 motor may be readily adapted to slow speed work, snow plows, freight locomotives and the like, by the use of larger gear reductions and the electric brake may be satisfactorily added to the G.E.-51 motor equipments.



G. E. 51 Railway Motor for Heavy Service.

In general appearance the G.E.-51 motor, as shown in the accompanying engraving, resembles the G.E.-1000. The field frame is two steel castings parted horizontally, but extended to the back to envelop the car axle. A large opening is provided allowing easy access to the motor for the adjustment of the brushes and the inspection of the interior. The motor, when closed, is dust-proof and water-proof. For the removal of any foreign substance that may become lodged in the bottom of the motor a handhole is provided in the bottom of the frame at the commutator end with a cover bolted on the outside.

An important and novel feature of the G.E.-51 motor appears in the bearings. The large size axle bearings are lubricated by the use of oil, and wool waste is packed in the oil reservoir underneath. The armature bearings are lubricated in like manner and all the bearings are essentially similar to those designed for steam railroad service according to Master Car Builder's specifications. A special feature of the armature bearing is the adjustment, the armature being raised and lowered by set screws at the top and bottom of the armature bearings. The range of axle diameters for which the motors may be fitted is from 4 to 5 inches. The armature construction is the standard adopted in all the G. E. motors.

PARAGON LONG BURNING ARC LAMPS.

A lamp long needed by central station people has been placed on the market by the Paragon Arc Lamp Co., 16 State street, Boston, in the form of a long-burning (100-hour) lamp for either a 6.8 or 9.6 ampere series circuit. As no resistance is used, there is in consequence no waste of energy. The lamps burn steadily throughout the entire life of the carbons, and will operate satisfactorily on any of the standard types of arc machines.

Paragon Arc Lamp.

One of the chief features of the lamp is an automatic cut-out which will do its work quickly and effectually, should the lamp from any cause receive an excess voltage, thus obviating any liability of burning out the coils.

The manufacturers are meeting with very gratifying results and look for a large business along this line during the coming season.

THE "IDEAL" AUTOMATIC INTERRUPTER FOR INDUCTION COILS.

Messrs. Willyoung & Co., of Philadelphia, have recently brought out an improved interrupter for induction coil work which they claim to be superior to other forms of automatic break.

That the scheme of this new interrupter is unique, is readily seen by inspection of Fig. 1, which shows the interrupter in diagram. The spring G is supported at its lower extremity, just as with the Apps vibrator, but is otherwise entirely free. Surrounding the spring, near the hammer-head, is a yoke H, rigidly attached to a stiff casting I, which is itself pivoted below. This casting carries the front contact point J. The back contact point K is controlled by a pair of set-screws L, while a lower adjusting screw M controls the tension of a helical spring N, itself attached to the casting I. The spring G is very stiff and, when vertical, stands entirely free of the yoke N.

In action the hammer-head is attracted by the core, but, quite otherwise than in the App's interrupter, is able to move a considerable distance and attain a very high velocity of motion before striking the yoke, and thus breaking the circuit. The magnetic pull on the hammer-head being thus released, the hammer-head flies back, partly by virtue of its own spring G and partly on account of the pull of the spring N. The contact points coming together close the circuit once more, and the core's magnetism immediately begins again to act upon the hammer-head, the motion of which, however, it can instantly stop, and the head swings on, being gradually brought to rest and its motion reversed again, striking the yoke while moving at high speed.

That the suddenness of this break is much greater than with the Apps break is evidenced by several facts. In the first place, the firing is practically nil, and when coils of 8 to 12 inch even are run with it upon a proper electromotive force, it is actually necessary often to look closely at the vibrator in order to see any sparking whatever. Furthermore, after continuous runs for thirty or forty-five minutes, or even more, there is no appreciable rise of temperature even at the contact points. A further evidence is that the same coil operated by the new vibrator, as compared with the Apps, it is claimed, requires not over one-half the current to produce results equally as good, if not better.

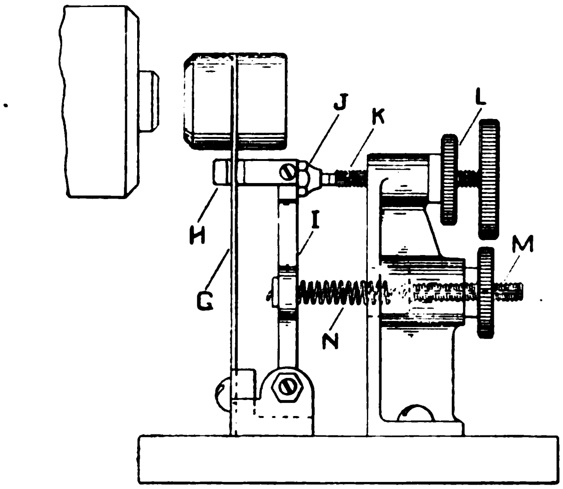


Fig. 1. - The Willyoung Interrupter.

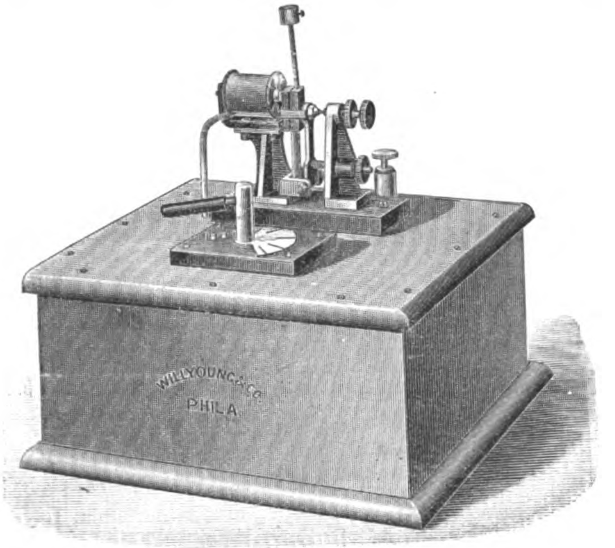


Fig. 2.—The Willyoung Interrupter.

Fig. 2 shows the "Ideal" interrupter combined with the Willyoung adjustable condenser. The "Ideal" interrupter is protected to Messrs. Willyoung & Co. by application for letters patent and is for sale, as is all Willyoung apparatus, by Mr. James G. Biddle, 910 Drexel Building, Philadelphia.

RECENT CHLORIDE ACCUMULATOR INSTALLATIONS.

The Electric Storage Battery Company has recently contracted to install a battery of chloride accumulators in the Queen's Insurance Company's new building, corner of Cedar and William streets, New York. During the day the battery will be operated as a regulator of potential, allowing the elevator and lighting services to be taken from one generator, and during the night and over holidays and Sundays, the battery will furnish all the current required by the lamps and elevators.

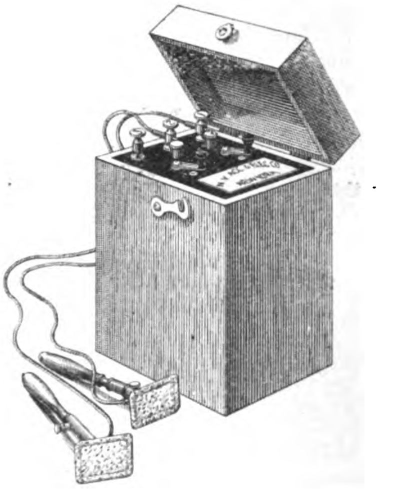
Other contracts recently closed cover batteries for supplying night lamps and elevator service in the building, being erected by Messrs. Jones Bros., Brooklyn; this plant will be operated at 240 volts throughout; a battery for lighting the casemates at Fort Wadsworth; another for use in connection with the gas engine dynamo plant to be installed in St. Paul's M. E. Church, New York; a battery for night lighting and lamp testing at the lamp works at Harrison, N. J. The Commercial Cable Company is installing a battery of chloride accumulators in its new building to be used for operating its ocean cables.

Chloride accumulators are also being installed upon the following named yachts: Marietta, Hiawatha, Althea, Hildegarde, and two other yachts which have not yet been named.

ELECTRO-MEDICAL STORAGE BATTERY.

A HANDY source of current has become a necessity to the surgeon and physician, and where patients have been taught to administer current themselves it is also important to furnish as convenient a battery as possible. The New York Accumulator & Electric Company, of 150 Nassau street, New York, has met the demand for such a source of current by designing and building the portable storage battery outfit, one form of which is illustrated in the accompanying engraving.

The outfit consists of a highly polished mahogany or oak cabinet, in which are fitted one or more cells of storage battery (of the company's manufacture), sealed in hard rubber boxes, a medical induction coil with hand or sponge electrodes and conducting cords, and the necessary connections for using either the primary or secondary current, or the two combined.



Electro Medical Storage Battery.

Some of the special features provided with these batteries are a graduated wire rheostat to regulate the strength of the primary current and a volt indicator—a low-voltage lamp—to tell when the battery needs recharging. The medical induction coil, with the necessary connections, switch device and accessories, is contained in a separate compartment, and is removable without disturbing the battery, or vice versa. The insulating parts are of polished hard rubber. The metal parts are all nickel-plated.

The outfits for physicians' use have the same general features, but are finer in the details of construction. The battery, too, is of larger capacity, so as to provide for light cautery work and for lighting a surgical lamp.

WESTINGHOUSE ALTERNATING CURRENT FAN MOTOR.

The Westinghouse Electric and Manufacturing Company has, it informs us, succeeded in constructing an alternating current fan motor for the season of 1897 that by its many advantages of construction and operation will bid fair to become the most popular fan motor of the coming season. It is of the induction type and differs somewhat from the mechanical proportions of the fan motors of recent years in being smaller and lighter. It retains the feature that was introduced in the Westinghouse fan motor of last year and which was found of great practical value, that is, "speed variable at will," which is effected by the use of a three-contact switch of simple construction located in the base of the fan motor. By means of this switch the motor may be run at full speed, at moderate speed, or it may be cut out of the circuit.

When the motor is running at full speed the breeze of air supplied is strong, steady and of wide range. When running at moderate speed, the motor successfully meets the requirements of the best desk fan, the breeze being considerably reduced and the current required to drive it being materially less. The motor is especially useful in a sick room or a bed room at night, securing effective circulation of air and operating almost without noise.

This fan motor has neither a commutator nor brushes, and weighs complete, ready for service, twenty-five pounds.

LUNDELL FAN MOTORS.

The Lundell fan motors, manufactured by the Interior Conduit and Insulation Company, of New York, are so well known that a description of them would seem almost superfluous. These machines have been sold all over the world and the name "Lundell' has become synonymous with "Highest Standard of Merit." The company has placed upon the market this season several new styles of ceiling and column apparatus and their handsome illustrated catalogue shows a varied and complete line. The "Lundell" is not a cheap affair, but is a machine well made in every particular, handsome in design and finish, and of highest obtainable efficiency. Illustrations of these fan motors are unnecessary, for the reason that the general public, as well as the trade, are thoroughly familiar with their design and appearance.

THE PIONEER ARC LAMP ABROAD.

Prof. Louis B. Marks is now on his way back from Europe, where he has been very successful in bringing the enclosed arc lamp to the notice of scientists and electric light people. The Electric Arc Light Company inform us that on Prof. Marks' return patent litigation will be vigorously prosecuted.

ADVERTISERS' HINTS

THE PHILADELPHIA ELECTRIC AND MANUFACTURING COMPANY, 2010 Jones street, Philadelphia, are advertising a clutch for which they claim perfection. It can be applied to Brush as well as T.-H. lamps. They also manufacture commutators, segments, blocks, brushes, arc cut-outs and all arc lighting supplies.

ANCHOR ELECTRIC COMPANY, 71 Federal street, Boston, say their snap flush switches are still in the lead.

FISHER & CRAMPHORN, Congress and A streets, Boston, are at all times ready to give estimates on switchboards of which they make a specialty. They also furnish station switches for low and high voltages.

MACHADO & ROLLER, 203 Broadway, New York, say the "A. E. G." incandescent lamps are "all extra good;" and suggest the trial of a barrel lot as a means of proving it.

THE KEYSTONE ELECTRIC INSTRUMENT COMPANY, of Philadelphia, have removed their New York office from 36 Dey street to the Smith building, 15 Cortlandt street.

JAMES LEFFEL & CO., Springfield, O., are building water wheels for heads of 3 to 2,000 feet. Among the installations which have attracted considerable attention is the plant of the Niagara Falls Hydraulic Power and Manufacturing Company.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, New York, ask if money is an object to electric lighting and railway companies, and if so why many of them permit thousands of dollars to escape to the atmosphere from their exhaust pipes, which might be saved by utilizing their waste steam for heating by the Holly system.

THE BRYANT ELECTRIC COMPANY are advertising sockets.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, O., call attention to their line shaft motors, direct connected and slow speed, as the latest development in power transmission for factories.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., note how the use of accumulators make possible the most modern methods of transmission and distribution.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., under the caption of "Large Westinghouse Alternators," present a list of large generators they have installed, among them being the direct connected engine type installed in 1890 in the station of the Narragansett Electric Lighting Company, described elsewhere in this issue.

THE ELECTRICAL ENGINEERING AND SUPPLY COMpany, Syracuse, N. Y., illustrate their "ad" with a cut of a double break knife switch specially adapted to switchboard work.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, say the Bryant-Cleveland arc light cut-out is the best on the market, and this is but one of the specialties in their arc light supplies stock.

THE STANLEY ELECTRIC MFG. COMPANY, Pittsfield, Mass., advertise the S. K. C. static ground detector. They are in use in many central stations, among them being that of the Narragansett Electric Lighting Company, described elsewhere in this issue.

J. G. BIDDLE, 906 Drexel building, Philadelphia, Pa., makes a specialty of central station photometers built according to the German Reichsanstalt pattern.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., have no less than sixteen of their constant current 125, 2,000-candle-power arc light machines in the Narragansett Electric Lighting Company's station, Providence,, R. I. They were selected after ninety days' trial.

SHIFF, JORDAN & CO., 39 Cortlandt street, New York, remark how useless it is to have good lamps unless the carbons are also good, and suggest that by using the "Ship" brand the second condition is met.

EDWARDS & CO., 144th street and Fourth avenue, New York, show the scraping contacts on the "New York" door and window springs, which are one of their many specialties.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING CO., 15 Cortlandt street, have something to say regarding that often discussed question, "Protection." In the electrical sense, they advocate the Habirshaw insulation as protection and perfection.

THE ARMINGTON & SIMS ENGINE COMPANY, Providence, R. I., have installed over 5,000 engines which are now in successful operation.

WALKER COMPANY, Cleveland, O., calls attention to the fact that every coil in their dynamos has a safety fuse as an effective means of preventing serious delays in their operation.

PARTRICK & CARTER, Philadelphia, have made arrangements with leading supply houses throughout the country for handling their goods.

THE NEW YORK DYNAMO AND MOTOR COMPANY, 257 Broadway, New York, have 1,000 fan motors for sale at $15, and they guarantee each one.

THE RUSSELL ELECTRIC MANUFACTURING COMPANY supplied 2,000 mast arms for the lines of the Narragansett Electric Light Company, and they have had no complaints from them.

THE GARTON DANIELS ELECTRIC COMPANY, Keokuk, Ia., quote a central station man who observes that the protection afforded by their lightning arresters is equal to a paid-up insurance policy.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 527 West Thirty-fourth street, New York, are ready with their 1897 styles of fans and a catalogue will be sent to those requesting it.

FABIUS HENRION, Nancy, France, publishes in his "ad" a price list of carbons for which he claims the highest reputation in the world.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., have an alternating current ceiling fan absolutely guaranteed against burning out, as well as many other advantages.

THE PARAGON ARC LAMP COMPANY, have recently brought out a 100-hour arc lamp for series circuits. The Conover-Goe Company, Monadnock Block, Chicago, are the Western agents. A card to either office will elicit full information and prices.

THE WESTERN ELECTRIC COMPANY, Chicago, manufacture a ceiling fan to consume but .6 of an ampere at 110 volts. They are ready to deliver fans for 110 or 220 volts and will furnish them upon order for 500 to 550 volts.

NEW ENGLAND NOTES

FISHER & CRAMPHORN, of Boston, have just brought out a new line of jack-knife switches for high voltage, which meets the high requirements of the local wire commissioners, and which has many improvements over the old style. These switches are made of composition metal, hard rolled copper blades and contacts, and are furnished with a spring, so that it is impossible for a switch to remain in a position where it will arc. It must either be fully closed or wide open. All users of switches would do well to inquire into their merits, as they are already having a large sale and are in demand. They have a neat, new catalogue which they will be glad to send on application.

THE BATES MACHINE COMPANY, of Boston, are meeting with great success with the Bates motor, and have already installed a large number in and around Boston, which are giving great satisfaction. So great, indeed, has been their success in New England, that they have arranged to open a branch office in New York, and have secured quarters at 136 Liberty street, New York City. Besides electric motors, the Bates Machine Company carry a full stock of power transmission machinery, including engines, boilers, pumps, shafting hangers, pulleys, etc., which enables them to furnish complete installations for either power or lighting.

THE ANCHOR ELECTRIC COMPANY, of Boston, have just issued a handsome new catalogue of electric lighting supplies, which should be found in every electrician's hands. It is of convenient size, and will be found to contain everything in the way of supplies necessary for the complete installation of an electric lighting plant. They make a specialty of Anchor snap switches, single and double pole 3 point and 4 point switches, 500-volt switches, flush switches and every other conceivable kind of switch. They also show a variety of Anchor sockets, cut-outs, rosettes, etc. The Anchor Company are steadily increasing their business and the outlook for the coming spring trade is exceptionally good.

THE RUSSELL ELECTRIC MANUFACTURING COMPANY, of Providence, R. I., are enjoying the success of years of application to the mast-arm trade, and have a number of nice orders on hand. Two thousand mast arms in the city of Providence alone, is a pretty good testimonial as to their successful operation; and Mr. Russell is to be congratulated on the success of the business with which he has been so long identified. They have some very pretty circulars to send to any one interested in this form of street lighting.

NEW YORK NOTES.

C. F. CROSELMIRE, Newark, N. J., manufacturer of platinum wire, sheets, etc., reports business satisfactory. Mr. F. A. Croselmire has just returned from an extensive trip among the electrical trade and booked some very large orders. Mr. C. F. Croselmire starts out the end of this month upon a three months' trip to the Ural Mountains, Siberia, for the purchase of crude platinum.

UHLING, STEINBART & CO., 61 Mulberry street, Newark, N. J., are putting on the market their new recording gauge in connection with their pneumatic pyrometer and gas composimeter which they guarantee to be absolutely accurate. It has the further advantage of making record on a rectilinear axis on a continuous roll of paper. The gas composimeter is a new instrument for continuously indicating and recording the percentage of CO_2 in the flue gases of boilers, thus making a perfect record of the combustion and incidentally the consumption of the coal. This firm will be pleased to give further information and prices of their apparatus on application.

STUCKY & HECK ELECTRICAL MANUFACTURING CO., Newark, N. J., are doing all the repair work on a number of electrical apparatuses damaged at the recent fire in the Newark Electric Light Company's plant. They report their factory busy also on a number of electrical specialties and railroad work.

THE FUEL ECONOMIZER COMPANY, Matteawan, N. Y., report their works busy on quite a number of orders. Among the many plants installed of recent date with their fuel economizer are: Chas. Spreckels' beet sugar refinery, at Salinas, Cal.; Anhauser-Busch Brewing Company, St. Louis, Mo.; Armour Packing Company, Kansas City, Mo.; Pfister Vogel Leather Company, Milwaukee, Wis.; Merrimac Chemical Company, Boston, Mass; J. W. Dimick, carpet manufacturer, Rifton Glen, N. Y.

WESTERN NOTES

THE McDERMID MFG. COMPANY, 205 South Canal street, Chicago, report that the demand for their battery coppers keeps steadily on the increase, and also that the prospects of good business in their other lines in the near future is very encouraging.

MR. J. E. KEELYN, of the Western Telephone Construction Company, has been in St. Paul, conferring with large Minnesota capitalists as to new telephone exchanges for that city and Minneapolis.

SALT LAKE CITY is going to buy and put up its own wires and lamps necessary for street lighting purposes, and the Utah Power Company is to supply the current and poles.

THE SHELBY ELECTRIC COMPANY, of Shelby, O., report an increasing sale of their incandescent lamps. They are running night and day and are enlarging their capacity. The Paragon Arc Lamp Company, of Boston, has taken the New England agency for their lamps. Mr. Smith, vice-president and general manager of the Shelby Company, was formerly manager of the Perkins Company, of Boston, and has had a great deal of experience in the sale of incandescent lamps.

SYRACUSE RAIL BOND.—The Metropolitan Electric Company of Chicago have taken the agency of the Syracuse rail bond. This bond is the only one on the market that utilizes the fish plate holes and requires no drilling. It is soldered fast to the rail, and the fish plate bolts reinforce the joints, making absolutely homogeneous contact during the life of the rail, and giving a surface connection between copper and rail of ten times the cross section of the bond conductors, thus making the best possible construction. The Metropolitan Electric Company have just issued circulars fully describing the rail bond.

THE CENTRAL ELECTRIC COMPANY has taken the Western agency for the Wagner alternating current ceiling fan motor. This motor is constructed on radically new lines and has many new commendable features. Notably, it is absolutely noiseless in operation and consumes 120 watts when running at normal speed of 125 revolutions per minute; is guaranteed to produce an external agitation of the atmosphere without producing the same result on the purchaser.

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The Electrical Engineer.

Vol. XXIII. APRIL 14, 1897. No. 467.

ELECTRIC LIGHTING

RECONSTRUCTION OF THE ALTERNATING CURRENT SYSTEM OF THE ROYAL ELECTRIC COMPANY, MONTREAL, CANADA.

BY P. G. GOSSLER.

To meet the general increasing demand for light and power supplied from central stations, it has, in many instances, been necessary to erect new generating stations or to reconstruct the existing plant, discarding the old, inefficient apparatus and substituting therefor equipment of modern design. In some of the larger cities this fact has apparently been appreciated, as recently there have been erected stations which are magnificent examples of modern generating plants, operating with the highest economy obtainable at the present time and giving evidence in their design of the highest engineering skill.

Many generating stations at present supplying a large output have attained their growth gradually, having from time to time installed additional apparatus as it was required by an increasing business and extension of territory supplied. These stations are now confronted by figures and results showing their cost of operation per unit of output to be much more than it should be, or would be, if the same output were produced by more efficient apparatus operating under modern conditions. Besides, there is generally a multiplicity and variety of apparatus, the operation of which is accompanied with danger and results in unsatisfactory service.

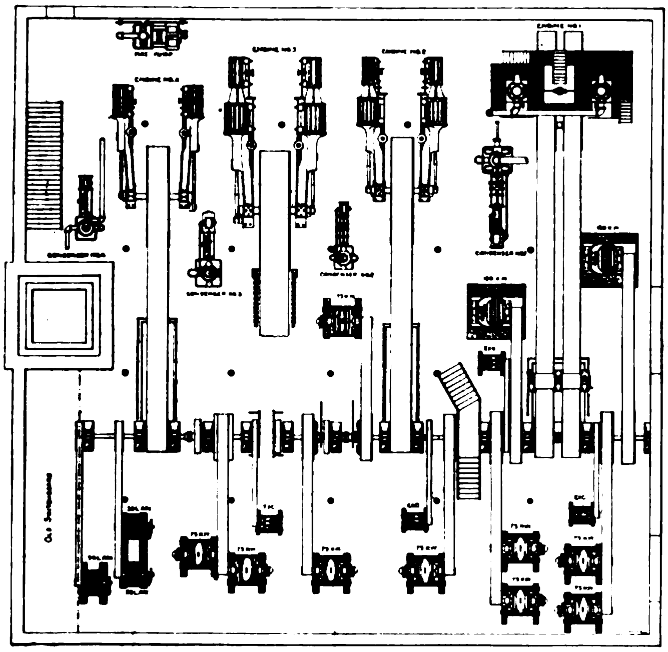


FIG. 1.—FORMER ARRANGEMENT OF MACHINERY ON GROUND FLOOR.

The necessity of giving satisfactory and uniform service, of reducing the cost of operation and of meeting the increasing demands for light and power being recognized, and the conditions being such as to permit of meeting these requirements, an investigation of the existing conditions generally results in the adopting of one of two plans. First, the building of a new generating station and equipping it with modern apparatus, utilizing the old plant for continuing the service during the course of the construction of the new one, and possibly retaining it afterwards as spare capacity; or, secondly, to reconstruct and re-equip the existing plant to conform to the aforementioned requirements.

The latter plan or reconstruction will, without doubt, be decided upon in the majority of cases, as the use of large units permits of the installation of sufficient capacity, in the same space occupied by the old apparatus, to meet future demands for a reasonable length of time.

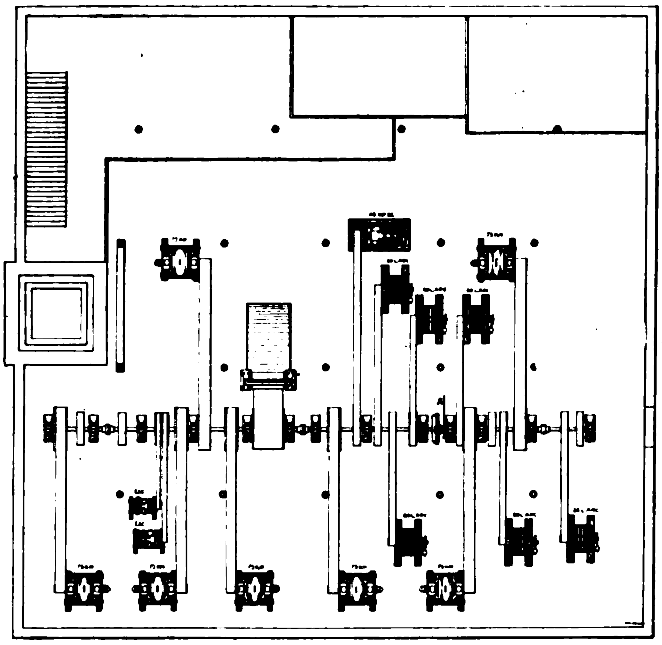


FIG. 2.—FORMER ARRANGEMENT OF MACHINERY ON FIRST FLAT.

There have been numerous descriptions published giving examples of plants erected to replace those found to be inefficient and giving unsatisfactory service. It is to be noted that, so far, these new plants with but few exceptions are direct current stations, serving light and power to congested districts and comparatively small areas; this account is of the reconstruction of an alternating current system supplying current to a large territory.

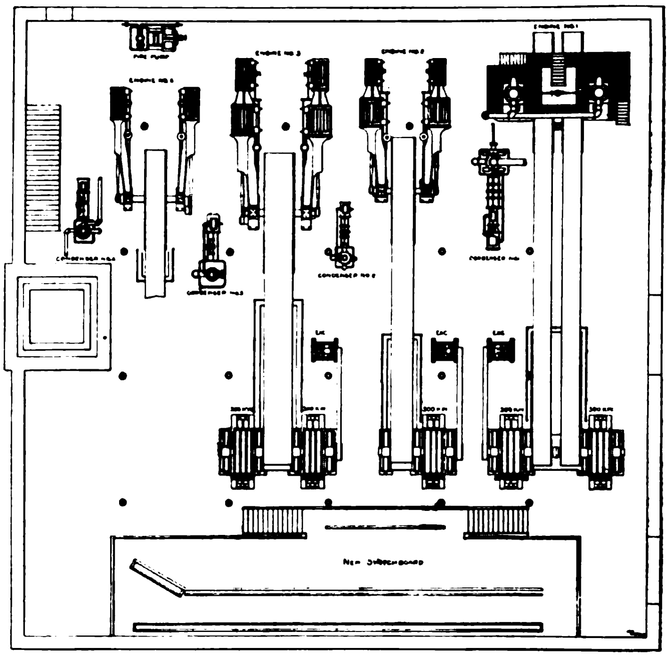


FIG. 3.—PRESENT GENERATING PLANT MASSED ON ONE FLAT.

The history of the Royal Electric Company, of Montreal,

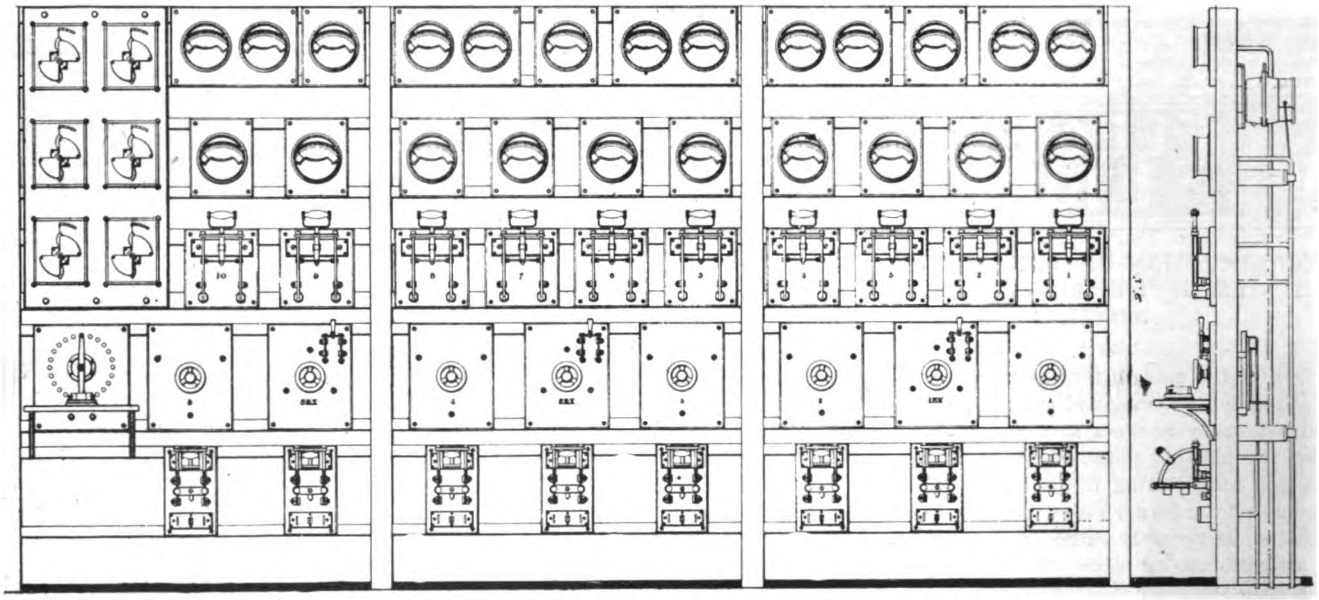


DIAGRAM NO. 4.

FIG. 4.—ARRANGEMENT OF SWITCHES, RHEOSTATS AND INSTRUMENTS ON SWITCHBOARD.

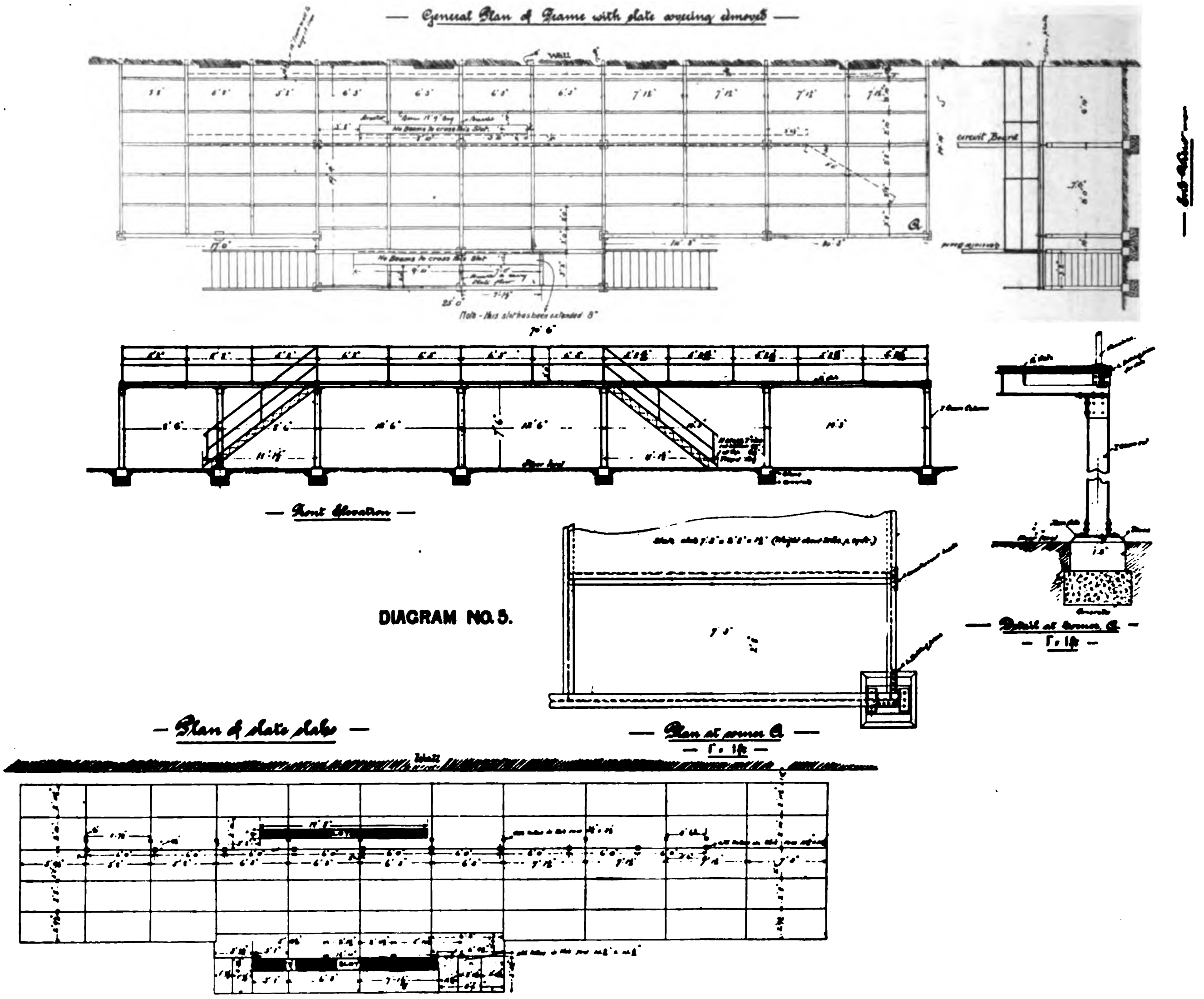


FIG. 5.—FLOOR PLAN OF SWITCHBOARD AND DETAIL OF IRON FRAME WORK SUPPORTING THE SLAB FLOOR.

and the growth of its lighting and power plants from a 12-light arc machine in 1884 to the present time, when it is serving about 65,000 incandescent lamps, 1,750 arc lamps and 750 horse power in motors, has been told before and need, therefore, not be repeated here. Early in 1896 the directors of the company, upon the recommendation of the general manager, Mr. W. H. Browne, authorized the entire reconstruction of its alternating current station and lines; this reconstruction to be carried out upon plans which would adapt the system to be served either with power from its existing steam plant or from the water power plant at Chambly, which is at present being rapidly developed.

The foresight shown in the recommendation and authorization of this wholesale reconstruction and re-equipment has been well established by results already obtained. The economy of replacing inefficient apparatus by apparatus which is the product of the highest grade of engineering, is, in this instance, no longer a possibility, but an established fact.

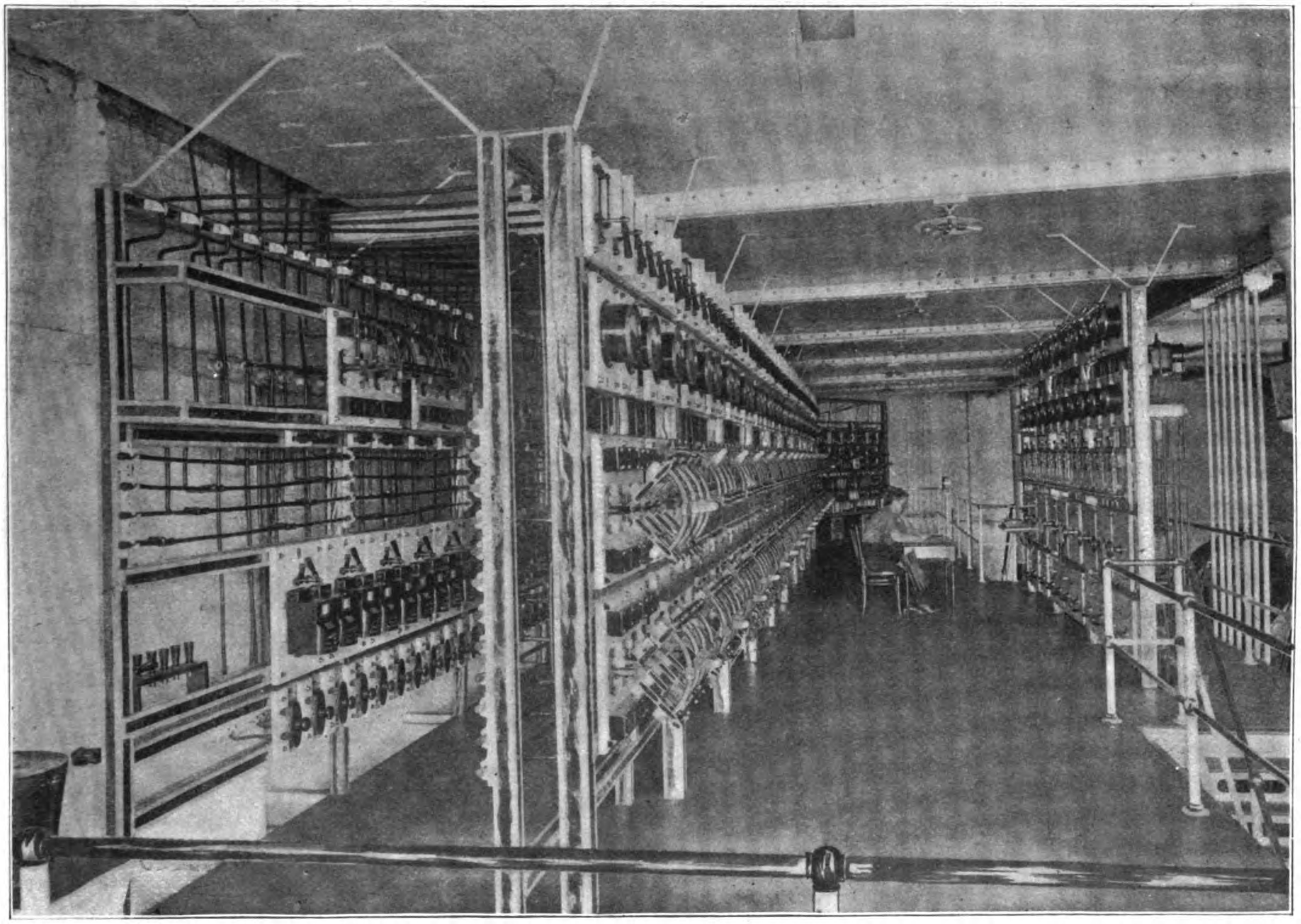


Fig. 6.—View of Circuit and Terminal Switchboards, Royal Electric Co., Montreal.

One of the two generating stations of the Royal Electric Company is devoted exclusively to supplying direct current arc service. The equipment of the second or Queen street station, for serving light from an alternating system, with a spare series arc capacity, prior to its reconstruction, consisted of 18 alternators, 6 exciters and 9 arc machines, with their numerous belts, pulleys and shafting, shown in Figs. 1 and 2, representing the apparatus on the ground and first flats. The direct current power generators and engines are located in a separate building. The upright engine, known as No. 1, shown next to Queen street, in Fig. 1, was connected by two 30-inch belts to a line shaft from which were operated four 75-kilowatt and two 150-kilowatt alternators and two exciters. Operated from the line shafting connected to No. 2 engine were three 75-kilowatt alternators and an exciter. No. 3 engine, located on the ground flat was belted by a 50-inch belt to a line shaft on the first flat, shown in Fig. 2. To this line shafting were connected seven 75-kilowatt alternators, two exciters, one 45-kilowatt, direct current generator, five 40-light and one 35-light arc machines. These latter were used only as spare capacity for the series arc system located in the East End station, and the 45-kilowatt generator as spare capacity for the direct current power system. The total capacity of the machines connected to this line shafting was much more than the capacity of the engine, consequently only part of the machines connected to No. 3 line shafting could be fully loaded at any one time. With that part of the shafting thrown out of service by the clutch shown at A, Fig. 2, there yet remained connected to the shafting in service three 40-light arc machines, which had to be up to speed whether they were required or not. To No. 4 engine were connected by line shafting two 75-kilowatt alternators and three 50-light arc machines.

It will be unnecessary to give in detail the heavy line shafting losses and the dangers and disadvantages of such an arrangement of machines as shown in Figs. 1 and 2, as they will be apparent at first sight. There was another danger which menaced the safety of the entire system—a wooden switchboard, the capacity and arrangement of which was entirely inadequate for the service required of it.

The alternators connected to the same engine were run in parallel, six operating in parallel from No. 1 engine, three from No. 2, seven from No. 3 and two from No. 4 engine. The ordinary advantages to be gained from operating in parallel were to a great extent offset by the fact of there being no clutches on individual machines. This also introduced irregularities and interruption to the service from armature burnouts. In running so many comparatively small units in parallel it was difficult to overcome the "idle" currents in the alternators, and the numerous belts and pulleys required a nicety of adjustment which was hard to maintain after synchronism had once been established.

The foregoing statements setting forth past conditions have been made to illustrate the results of a gradual growth. It is needless to state that had the present demands for light and power been foreseen, and the efficient apparatus of to-day been available, the station equipment, in all probability, would have been far different from that which necessitated its entire reconstruction.

THE OVERHEAD LINES.

The first step of this reconstruction was the rearrangement of the overhead lines. These had been divided into three routes, each taking approximately one-third of the station output. The relative positions of the wires on the poles forming these routes, were such as to cause serious fluctuations in the lights, due to mutual induction. This became so objectionable that it was necessary to operate all the circuits forming one pole line from one set of alternators running in parallel to get comparatively steady service. When the total load was too heavy to be run from one set of alternators, this condition of the pole lines necessitated the running of two or three engines underloaded, introducing a serious loss in coal consumption. The relative positions of the wires on the poles were changed to overcome this mutual induction and most satisfactory results were obtained, as after this change it was possible to operate any circuit from any engine without the slightest fluctuation resulting.

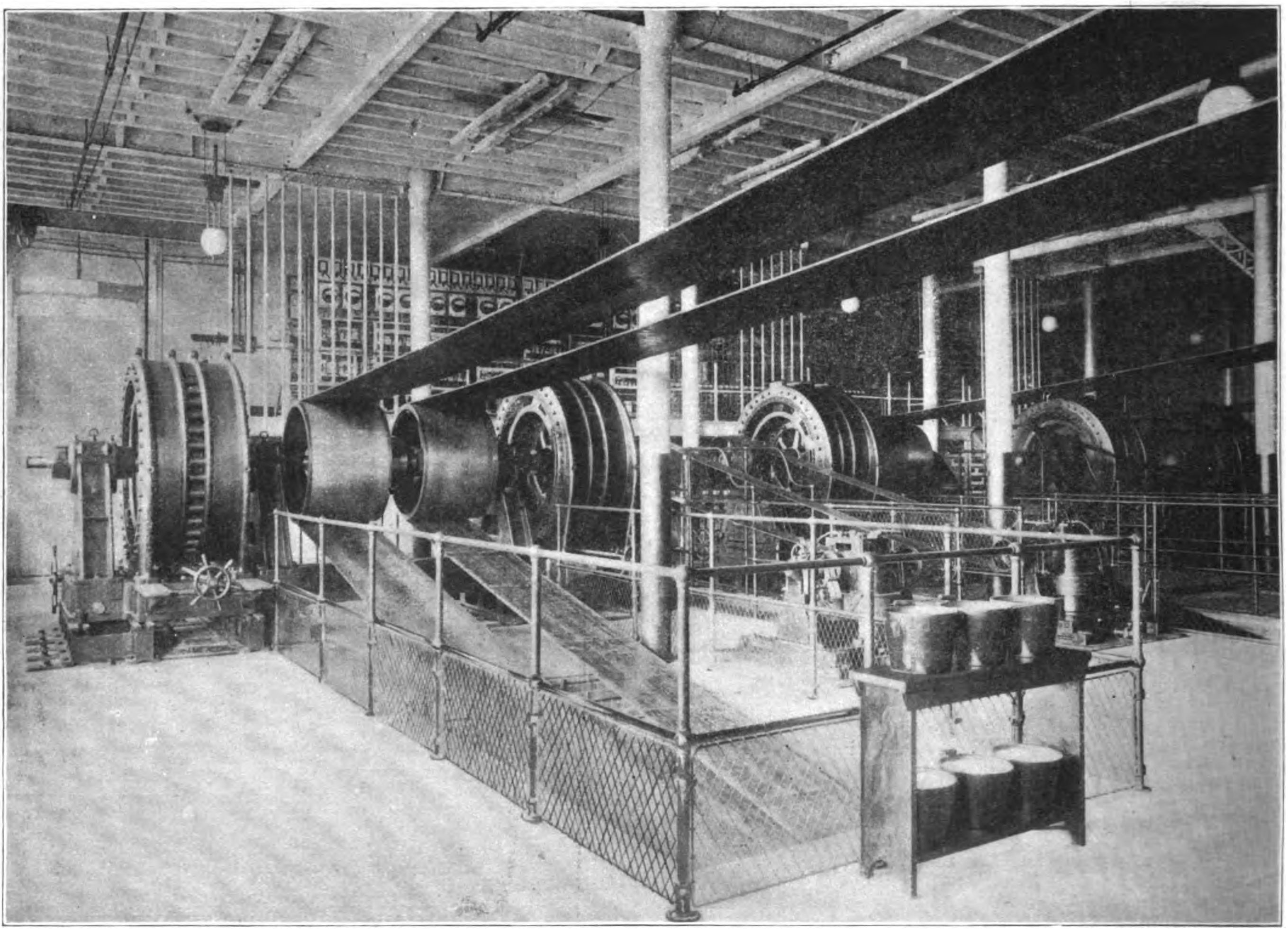


FIG. 7.—VIEW OF 300 H. P. S. K. C. TWO-PHASE GENERATORS, ROYAL ELECTRIC CO., MONTREAL.

THE TRANSFORMER SYSTEM.

The transformer system was next rearranged, the old transformers being replaced by others having close regulation and small core losses and secondary systems established wherever economical. The extent to which the latter was carried may be judged from the fact that 1,161 old transformers were replaced by 628 Stanley transformers, with a consequent reduction in leakage load of 245 amperes, representing a tremendous saving in coal.

THE GENERATING PLANT.

After getting the lines in shape attention was next directed to constructing a new switchboard and installing new alternators.

Figs. 1 and 2 show the generating plant prior to its reconstruction, occupying two flats. Fig. 3 represents the generating plant as it exists at present, occupying one instead of two flats, 18 old generators being replaced by five 300-kilowatt generators of the S. K. C. inductor type, the latter being belted directly to the engines. Also in Fig. 3 is shown the outline of the new switchboard, located overlooking the generator and engine room.

The five 300-kilowatt S. K. C., 2-phase generators were built in the manufacturing department of the Royal Electric Company. These various S. K. C. machines will be familiar to readers in the United States, as those of the Stanley Electric Manufacturing Company, of Pittsfield, Mass. To utilize the engines in their existing condition it was necessary to have the shafts of the two alternators for No. 1 engine rigidly connected, also the shafts of the alternators for No. 3 engine rigidly connected. The machines on No. 1 engine are run in parallel, as well as the two on No. 3 engine. This arrangement practically makes 600-kilowatt units on both of these engines, at the same time having the many advantages of being able to subdivide these units and have four independent alternators.

Due to the crowded condition of the station prior to reconstruction, the installing of the new machines and construction of the new switchboard, at the same time maintaining continuous service, introduced many conditions and difficulties not encountered in the erection of a new station. All of the available space being occupied by old equipment, it was not possible to first install new apparatus to replace that which was to be removed. It was therefore necessary before beginning the station reconstruction to await such time as the capacity of one of the engines could be dispensed with, with the least danger of running short of capacity in case of accident to one of the other engines. To have at all times sufficient capacity to meet the requirements and at the same time to have spare capacity for emergencies was, of course, the difficult part of the reconstruction.

Work was begun in the station by the removal of the old equipment connected to No. 2 engine and replacing it by one 300-kilowatt S. K. C. generator. The apparatus connected to No. 3 engine was next replaced by two 300-kilowatt S. K. C. generators. No. 4 engine was then reconnected to part of the line shafting on the upper flat which had previously been run from No. 3 engine. By this time the fall load was near at hand, with the new machines yet to be installed on No. 1 engine. This was an unpleasant fact confronting us at this time, and it was a great temptation to allow the old equipment to remain on No. 1 engine until spring, but the saving sure to follow the installation of new generators on this engine made it advisable to complete the reconstruction.

The load had increased to such an extent that it was not safe to be without, at least, part of the capacity of No. 1 engine at all times. To provide for this there was installed, to be run temporarily from No. 1 engine, one 300-kilowatt generator and later, owing to a heavy increase in load, one 180-kilowatt generator, both belted directly to the engine and running with very short centers to allow of the new generators, intended to be run regularly from this same engine, being placed in their proper positions, in line with the generators connected to No. 2 and No. 3 engines.

THE SWITCHBOARD.

During the time of installing the new generators there was also being constructed the new switchboard. From the diagrams it will be seen that the location of the new board brought it directly over several of the old generators, and the close quarters in which the work was done in the station will be appreciated from the statement that the iron framework, supporting the floor of the board cleared the eye bolts on top of these old machines, still operating, by only six inches.

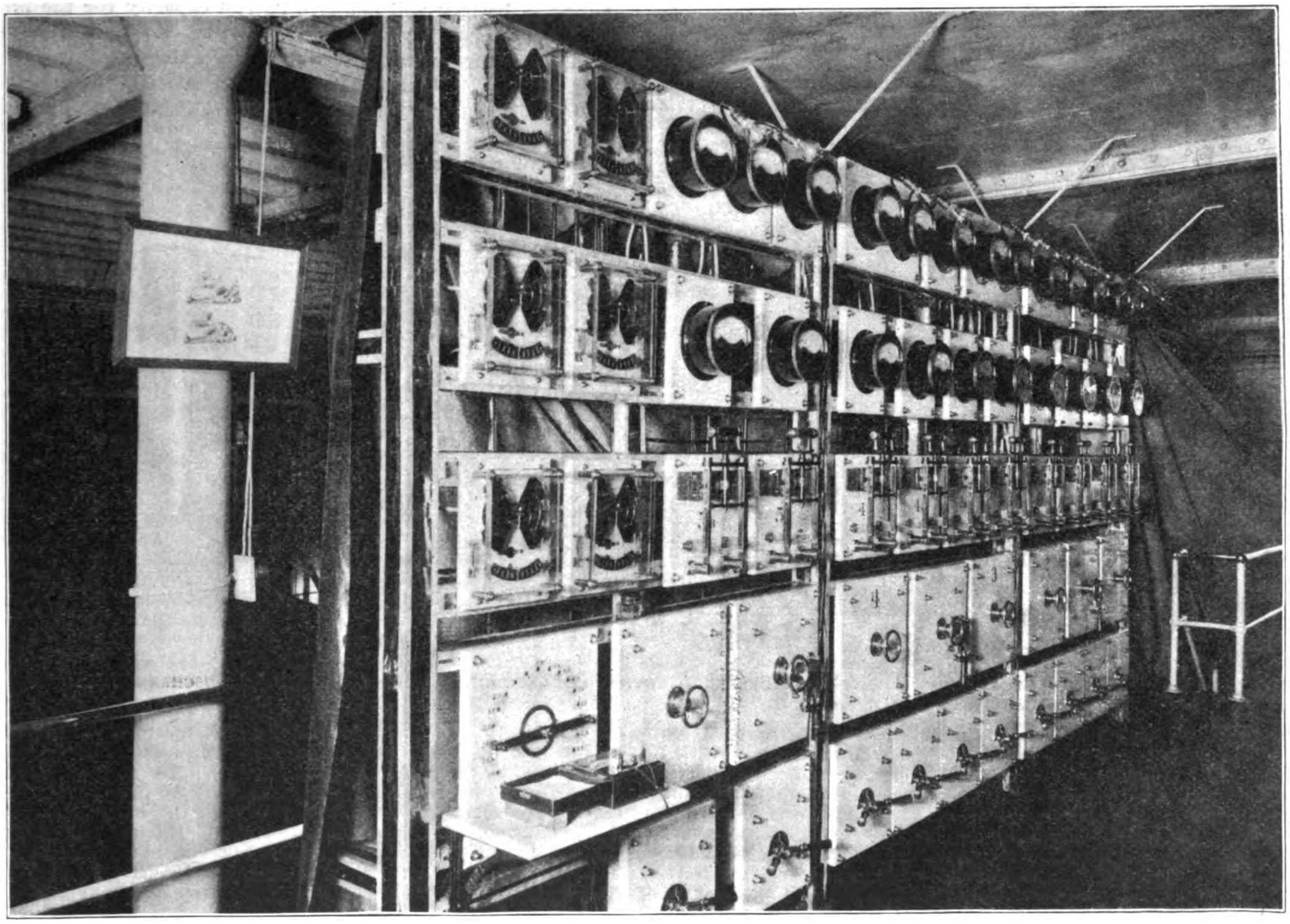


FIG. 8.—DYNAMO SWITCHBOARD, ROYAL ELECTRIC CO., MONTREAL.

The installation of the five 300-kilowatt generators was completed by the middle of October just at the beginning of the heavy winter load and the new 2-phase board was completed at about the same time.

The transferring of the service from the old to the new switchboard transformed the entire alternating system from a single to a 2-phase system. The operation of transferring the circuits from the old to the new board was of course made with all circuits alive, and while this transfer would not have been a particularly difficult operation with the service 'dead,' the transferring without any interruption to the service was a rather ticklish undertaking. It was made in the daytime within a period of ten hours without any interruption to the service or inconvenience to the customers; in fact, they were not aware at any time of the changes taking place in the station.

Fig. 8 represents the generator board and Fig. 6 the circuit board and the terminal board of the new switchboard. The board has been designed on the "universal combination" plan, by means of which there is a universal interchangeability of circuits, dynamo and exciter connections, enabling any circuit to be operated from any generator and any generator to be excited from any exciter.

Fig. 4 shows the arrangement of switches, rheostats and instruments on the generator board. The instruments on the top row, excepting the three mounted on single bases, are voltmeters, there being one for each phase of each generator; the single instruments are ammeters in the excited circuits. Below these are the generator ammeters and switches, there being one for each phase of each generator. The two lower rows show the rheostats and exciter switches.

The circuit board consists of two rows of 4-pole switches, two switches being required for each circuit. These switches are so connected that by a single throw of one switch a circuit can be connected to any generator. Above the rows of switches are mounted ammeters, one ammeter for each phase of each circuit, and above the ammeters are fuse blocks.

In the rear of the circuit board is the terminal board, on which is mounted a single row of 4-pole switches, one switch for each circuit, and an auxiliary set of bus bars, and below these a row of recording meters. By means of these auxiliary switches and bus bars any circuit panel or panels on the main circuit board can be cut "dead" and the circuit or circuits transferred to the terminal board. As the bus bars on the latter can be connected to any alternator, the terminal board duplicates to a great extent the circuit board and generator board. During the day the entire output can, if necessary, be handled from the terminal board.

Fig. 5 gives a floor plan of the switchboard and detail of iron frame work supporting the slate floor. The location of the switchboard, shown in Fig. 3, directly in front of the driving belts of the engines, is of course not desirable, but it was the only available space. There have been erected, as will be noted in the cut, Fig. 7, heavy wrought iron bars immediately in front of the belts for protecting the board in the event of a driving belt breaking.

The framework of the switchboard consists of seasoned white oak, over which is a layer of asbestos, and over this are two layers of mica, the edges of this framework being protected for mechanical purposes by fiber angles. This character of frame work for switchboards was first used in the construction of the switchboard of the United Electric Light and Power Company in New York City, and after that Company had made extensive experiments with iron and frame switchboard construction. It is practically fireproof, as well as being a good insulator, and from the severe tests during the past four years which it has withstood, there are reasons to believe that it is a very superior and satisfactory framework for switchboards.

The switches, fuses, blocks, etc., are of the standard S. K. C. type; they are independently mounted on the switchboard which permits of great interchangeability of all parts of the board.

THE RESULTS OBTAINED.

From the preceding account it will be noted that every part of the alternating system of the Royal Electric Company has been rearranged and redesigned. The lines and circuits were rearranged to overcome objectionable inductive effects and to transform them from single to double phase circuits; 1,161 old transformers were replaced by 628 new transformers with a reduction in leakage load of 245 amperes; eighteen old-style, single-phase generators with their revolving wire on the armatures, collector brushes and rings, their numerous belts, pulleys and line shaftings were replaced by five S. K. C. generators of the inductor 2-phase type, the latter being belted directly to the engines and the old wooden single-phase board was replaced by a new fireproof 2-phase board designed to distribute current for light and power from the same circuit.

All of this reconstruction has been designed and carried out on plans which adapt the system to be served either from its existing steam plant or from the Chambly water power plant. Upon the delivery of power from Chambly the five 300-kilowatt generators recently installed will be used as synchronous motors, from which will be operated the direct current arc machines.

The system affected by the above described changes operating for five months under the old conditions from October 1, 1894, to March 1, 1895, consumed 2,931 tons of coal more than was consumed in the five months from October 1, 1896, to March 1, 1897. The number of incandescent lights being 10,200 more during the latter than during the former period.

In the winter of 1894-5, it was necessary to keep in operation four engines, two each of 500 horse power, and two each of 1,000 horse power rated capacity in order to supply the demand on the station at time of heavy load. During the winter of 1896-7, one of the 500-horse-power engines was never operated and the other 500-horse-power engine was only kept turning over, doing little or no work.

Corresponding economies have been effected in the number of station employés, and oil and waste. In station maintenance—that is, of dynamos and switchboards—there has been no expense since October last, and in maintenance of transformers, nothing; whereas previously, under the old system, the maintenance account for incandescent dynamos and switchboards was several thousand dollars a year and on transformers nearly as much.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—V.

BY JOSEPH APPLETON.

[Copyright, 1897.]

INSTALLATION, CARE AND MAINTENANCE.

(Continued.)

A NEW battery will not give its full capacity for the first twenty or thirty discharges, as it takes a little time to get all the active material into proper working condition. To get a battery into first-class condition a small overcharge should be given every time for the first month; while overcharging in this manner about 25 per cent. more current should be put into the battery than has been taken out, this is done by extending the time of charge, and not by increasing the rate. In ordinary work a charge of about 10 per cent. in excess of the discharge is required to keep the battery in normal condition. In many cases, probably the majority, it is impossible to tell exactly how much current, in ampere hours, has been taken out of a battery during a discharge, therefore this cannot always be used as a guide to tell how much charge should be given.

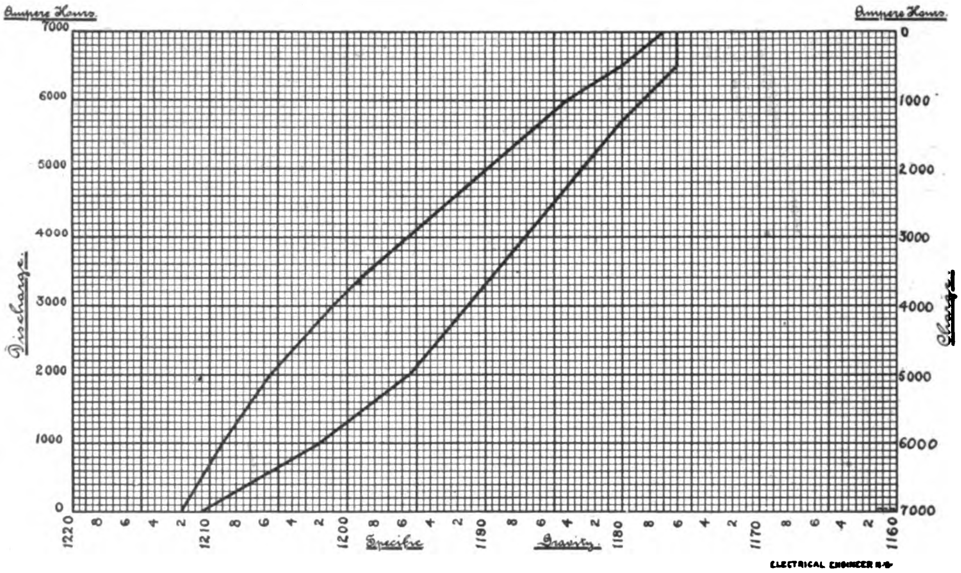


FIG. 18.—CURVE SHOWING VARIATION OF SPECIFIC GRAVITY OF ELECTROLYTE DURING CHARGE AND DISCHARGE.

In charging a battery the following points should be watched: The rate of charge is preferably kept at normal, or under, except under special conditions, or in case of emergency. Where records of discharge are kept the amount of charge required can be readily ascertained, 10 per cent. in excess of the amount taken out during discharge being sufficient. Where accurate records of the discharge are not available, it is necessary to determine the condition of a cell under charge by means of the voltage and specific gravity.

When the voltage of a cell, while charging at normal rates, reads 2.5 volts it may be considered practically, fully charged; the voltage will rise higher than this, but it is unnecessary to carry the charge further except when an occasional overcharge is given.

The specific gravity of the electrolyte is an excellent indication of the condition of a battery, but care must be taken to keep the density uniform throughout the cell. It will be found that the electrolyte at the bottom of a cell becomes denser than that at the top; this is due to the fact that during charge, when the sulphur is being returned to the electrolyte from the active material on the plates, it gravitates to the bottom of the cell, being heavier than the electrolyte.

In order to prevent this concentration of acid at the bottom of a cell, the electrolyte should be kept stirred up by means of a pump or siphon. In many plants a permanent arrangement is provided for maintaining a proper circulation of the electrolyte by means of air forced into the cell through a system of tubing connected with a small blower driven by an electric motor.

Evaporation will cause the electrolyte to fall below the level of the plates; this is detrimental and must be compensated for by the addition of water, as it is only the water which evaporates, the acid remaining in the solution. When adding water to a cell to make up for this evaporation, it should be put into the cell through a hose or funnel reaching to the bottom, otherwise the water being lighter than the acid will remain in a layer on the top.

The hydrometer measures the density of the electrolyte in the upper portion of the cell, and will give false results unless these precautions are taken, of course, the error is more noticeable in larger cells where the depth is greater. Fig. 18 shows a curve which illustrates how closely the specific gravity of the electrolyte indicates the condition of charge in a cell. This curve was taken by the writer from a large battery in one of the Edison stations, in this country.

There is certainly no better guide to the condition of a cell than the specific gravity of the electrolyte. It is possible for a cell to appear by its voltage and gassing, apparently fully charged, while in reality this is not the case, as a high internal resistance will cause a cell to give an abnormal voltage while charging, and a cell may gas freely when not fully charged, if the plates have been allowed to get into a very bad condition.

There is no action which will give a fictitious reading with the hydrometer, the density of the electrolyte being dependent on the amount of sulphur it contains, and, as previously described, it is only when the active material is fully formed or charged, that the sulphur is returned to the electrolyte; at other times it being in the plates in the form of sulphate of lead. The voltage of a cell and the specific gravity are somewhat dependent on each other, a low density electrolyte giving a lower voltage.

The best efficiency and durability is obtained from a battery when it is charged at slow rates, never exceeding the normal: this is not always the most economical method when considered from an operating point of view, especially in central stations, where often in order to meet the conditions and give the maximum efficiency to the generating plant, the battery has to be charged in four or five hours. With a modern storage battery this is quite possible, but the question of the advisability must be determined by the conditions which exist in each case, namely, whether the loss in efficiency and durability is more than made up by the economy which accrues from this plan of operation.

Occasionally during the charging of a battery, say, once in every week, the cells should be tested individually with a low reading voltmeter and hydrometer, to ascertain whether they are all of uniform voltage and specific gravity. Sometimes a cell may be found which is a little below the others in voltage. This will be more noticeable towards the end of a charge when the voltage should begin to rise rapidly, also by the low specific gravity of the electrolyte and the lack of gas given off from the plates. When a cell reads low in this way, it should be carefully overhauled and examined to see if any foreign substance has been introduced which would short-circuit the element. The color of the plates is also a good indication of the condition of a cell; the positives should be a dark brown color, free from any scale and deposit, the negatives being of a clean, gray color.

Whenever the time is available it is the best practice to reduce the charging rate towards the end of charge, when the plates commence to gas freely. Energy is being wasted when much gas is given off, and by reducing the rate until the gassing is moderated the cells can be charged nearly as quickly and with less loss of energy.

The cause of the gassing is as follows: The active material on the plates is able to absorb and utilize only a certain amount of the gas produced by the passage of the current through the electrolyte; the charging rate of a cell is fixed accordingly, so that when a cell is in a discharged condition, the active material can take up all the gas set free. As the active material becomes charged the quantity of gas it can absorb is less, consequently a portion of it is given off in bubbles.

A battery should never be discharged in ordinary work below 1.8 volts per cell when the rate is normal At high rates a lower voltage is reached before the cell is discharged to the same limit, on account of the greater fall of potential due to internal resistance; this follows the usual C^2R law.

SHOULD THE MANUFACTURE OF SCIENTIFIC APPARATUS IN THIS COUNTRY BE PROTECTED AND ENCOURAGED BY A TARIFF?

BY A. A. ZIEGLER, PRESIDENT ZIEGLER ELECTRIC CO.

THIS question may be regarded from three points of view, that of the extreme protectionist, that of the free trader, and that of the moderate or intermediate observer, who oscillates between a position favoring such a tariff as will provide sufficient revenue for the expenses of government, and one supporting duties which will afford such a measure of protection to American industry as will enable manufacturers here to compete on an even footing with importers of the foreign-made goods.

To the free trader no argument can be addressed which would be likely to change his opinion on the subject; his attitude, consistent, even if mistaken, is in favor of purchasing in the cheapest market, wherever that may be, regardless of the effect on home manufacture.

To the protectionist, on the other hand, no argument need be addressed in favor of protection as a general principle, the only matters upon which he is solicitous being, Is the industry a desirable one? does it need protection? and how much? and what, if any, exceptions should be made from the payment of duty?

The following remarks must therefore be addressed to the protectionist and the moderate man: In the first place, it may be noted that the exceptions to the rule in this connection are the most important element in the problem. The market for scientific apparatus is largely, if not almost exclusively, among colleges, schools and educational institutions of various kinds, who are entitled to import duty free under the law as it now stands, Sec. 585 of the Act of 1894, being as follows: "Philosophical and scientific apparatus, utensils, instruments and preparations, including bottles and boxes containing the same, statuary, casts of marble, bronze, alabaster or plaster of Paris; paintings, drawings and etchings, specially imported in good faith for the use of any society or institution incorporated or established for religious, philosophical, educational, scientific, or literary purposes, or for encouragement of the fine arts, and not intended for sale."

This being so, the market for apparatus of this nature would be practically restricted to those persons purchasing apparatus for their personal use, were it not for the fact that even now much apparatus can be furnished better, quicker and more cheaply by our own manufacturers than it can be obtained by importation. This condition, however, for the most part obtains in the case of the cheaper and less delicate apparatus, and where finely adjusted and expensive apparatus is required there has been an impression (not altogether unwarranted) that it was not possible to obtain such apparatus in this country, or only at a prohibitive price. Admitting this fact to be true, and with certain modifications it does approximate the truth, what is the reason for such a condition? This reason, it appears to the writer, is not far to seek, and possesses what may be considered as a reciprocating nature, in this respect—that apparatus of this class is purchased abroad for the reason that it has not been made here (or at least at as low a price), and per contra it has not been made here for the reason that it has not, with the existing demand and with the existing prices of labor, rents, taxes and other expenses, been possible to compete with the price for which such material could be imported duty free, although it might and very probably would be possible to compete with such prices, were a tariff, of say some 35 per cent ad valorem imposed on all such importations.

The remedy, therefore, suggests itself, and that is to place a specific duty by name on the various classes of apparatus falling under the general class of material now under consideration, and allow no exceptions.

This suggestion we are aware will undoubtedly be met with the usual outcry that institutions of learning should be favored in this respect by being permitted to import duty free simply because they are institutions of learning, and therefore, as such, entitled to exceptional privileges.

This argument, of the ad captandum order, is plausible and specious, but not, it is submitted, founded on principles of justice. There is no reason, it would appear, if scientific apparatus is to be deprived of the protection of the tariff, why all other materials employed in educational purposes should not be admitted duty free. The tariff on the coal used for heating the buildings, the iron and steel used in construction, and the plate glass in the windows should be relieved of the duty on their importation.

At this point we shall possibly be met with the reply that the material quoted is not such as cannot equally well be provided from our own native resources, whereas high grade scientific apparatus can only be obtained from abroad. It may not be stated quite so baldly, but that is the trend of the argument.

Now, admitting for the moment that such apparatus can at present be imported more cheaply than it can be purchased from home manufacturers, the mere raising of price should be no adverse argument in the eyes of the strict protectionist, for to him the maintenance of high prices is a consummation devoutly to be wished. To the man of more moderate views the building up of an industry which will employ skilled labor at high wages and which in course of time may have the swaddling clothes of protection removed from it (as has been practically the case with some of its elder brethren) should appeal forcibly.

It may well be that with such an infant industry as with some of our adolescent if not adult industries it will before many years be the case that we shall ask no odds from any one, and that our superior machinery, intelligence and methods will enable us to compete with the old world in price as well as in quality.

Admit, however, if you please, that this cannot be carried out in the course of a year or two, is not such a condition of affairs worth waiting for, even at the cost of some temporary augmentation of prices?

Mr. Edward Atkinson, who can hardly be considered as a protectionist, said, in an address to the New England Free Trade League, "There are many other articles still remaining on the free list which in the course of time might be fully established within the limits of our own country if the representatives should secure the same benefit which the iron masters did in the manner described for nearly a generation, ending in their complete success in establishing an American industry to the exclusion of all foreign products of like kind, at a cost to consumers already stated," etc.

And again, "Southern members rightly claim that if protection with incidental revenue is to be the policy of the country it should cover the whole country and be applied to all arts and products."

The logic of this position can hardly be disputed, but it may be urged on the other hand, as it has been with regard to the question of books, that the purpose for which they are imported should relieve them from duty. If this is a correct point of view, as before stated, to be consistent, any dutiable material whatever if used for any purpose coming under the category of "educational" should be exempted from the application of the tariff.

Books, it may be admitted, occupy a different position from apparatus; a book is not a manufactured article or raw material either. In its essential character, a book does not consist merely of the paper and binding but of the brains put into it. It is sui generis, and a particular foreign book cannot be manufactured in this country without committing either a breach of copyright law or a moral theft. At the present date any person in the United States is at liberty to write a book and print and sell it without competition from abroad on that book. Every book is different from every other book, but this is not the case with apparatus, where the essential differences are much less.

The eleemosynary attitude with regard to public education is, we think, a weak one. Education is a good thing, so is the protection of the growing industries of the country, or the affording of temporary assistance to industries of value which have a capacity of growth within them, and the protection of American industries is now the policy of the country and one to which the administration is fully committed.

This particular industry, moreover, is not one to invite the immigration of hordes of wretched Huns, Poles, Armenians and Italians to receive from 50 to 75 cents a day, but involves skill and intelligence, and tends in every way to raise the standard of American industry, and as a necessary consequence the standard of wages also.

The solicitude displayed by our legislators in the past for the interests of labor and high wages would seem, if we may judge by the localities where labor is concentrated, to have fallen short of its ostensible purpose of raising the condition of the American workingman to some fancied height of poetic refinement and exaltation. A stroll through the districts inhabited by the working people of New York, Boston, Lowell, Fall River, Chicago, Pittsburg, Cleveland, or the mining towns of Pennsylvania, makes us wonder whither the profits of protection have vanished.

Now, here, however, is an industry which cannot be carried on by the offscourings of less fortunate countries, but which will call for the highest efforts of American skill and ingenuity. Fine mechanical work and intelligence will be essentials and these will command good pay, and furnish increased material for taxation.

It is probable that protection such as here indicated will not result in more than a temporary increase of price, but that in the course of a few years better apparatus can be produced in this country at no higher prices than those for which imported goods can be obtained. Without some such protection, however, the industry will not and cannot advance, so large a proportion of the available market being exempt, by the provisions now proposed, from any tariff.

At the risk of repetition, it may be asked why an industry such as that of the manufacture of scientific and electrical instruments should be singled out for destruction. If free trade should prevail that industry would have to take its chances in the general debacle, but so long as agriculture is no longer recognized as the main stay of the country and manufactures assume its place, and so long as the declared and preferred policy of the administration is "protection" as distinguished from "tariff for revenue"—only or mainly—it is difficult to perceive the ground for the exemption, except on the plea that the public institutions of learning are charities to be partially supported at the expense of a particular trade.

That we are not stating the position of the protectionist too strongly is, we think, shown by the following words of Congressman Walker, of Massachusetts: "We must take care of our own country and our own workingmen, and shut off by protective duties whatever might come in here that would deprive any of our people of the opportunity of supplying the needs of their own countrymen. * * * Every member from New England takes this view when he wants to get elected and when he wants to get a schedule into a tariff bill for any industry in his own district. Such a man makes a mistake when he denounces a rate that is necessary for the constituents of some other Congressman. If we are not willing to make this protective policy universal * * * we shall be forced to abandon the entire system and substitute for it the vicious free trade policy of Great Britain."

Whether or no the policy of protection is a good one is a large question, not to be discussed here, but since the elections of last year, is not open to revision for at least four years. We do not say "Protect us at the expense of all other industries," but we do say, "Protect all industries," and do not select us as the one industry to be left "naked to its enemies."

ELECTRIC HEATERS IN THE GREAT NIAGARA POWER HOUSE.

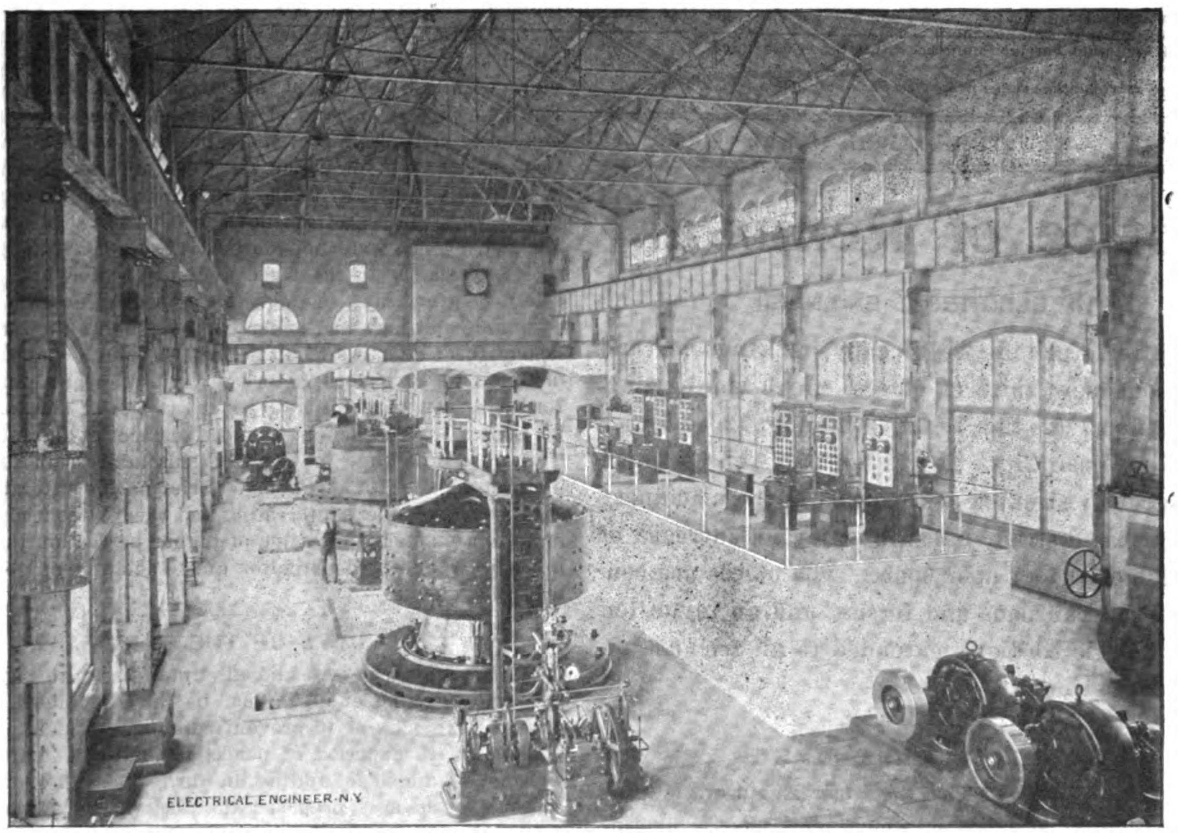
BY ORRIN E. DUNLAP.

THE central power station of the Niagara Falls Power Company at Niagara Falls is probably the largest building in the United States, if not in the world, that is heated entirely by electricity. Despite the large proportions of this structure, no heat other than electricity is employed to make it comfortable during the cold winter months. The present dimensions of the power house are, length, 195 feet; width, 60 feet, and height about 50 feet. It is of the Moorish style of architecture, and built of Queenston, Ont., limestone. The wheel-pit of the power company is being enlarged, and the power house is to be extended to cover it, but when these costly improvements are completed, electricity will still be employed to heat the building. However, the facts as given below relate to the building as it exists to-day.

The fact that the power house is divided into the dynamo room and the office quarters makes necessary the use of two kinds of heaters, one style being used in the office portion of the building, and the other in the dynamo room. All the heaters in the office portion of the building are on a secondary 100-volt circuit, which circuit is fed through converters which reduce the voltage from 2,000 to 100. The use of a high potential circuit through the offices would necessarily entail danger, and it is for this reason the low voltage was adopted. The office section is two stories in height, and in it there is about 175 horse power in heaters. These heaters are of the "American" pattern, but they are seldom all in service at the same time. Quite naturally, it depends largely upon the weather conditions as to the amount of heat necessary to make the rooms comfortable. The current devoted to heating the offices is taken from the primary of the circuit which feeds the street railways about the city of Niagara Falls. In the office occupied by Paul M. Lincoln, who is the electrical superintendent of the Niagara Falls Power Company, there are two 7-horse-power heaters, or a total of 14 horse power in this one room, which is about 20 by 15, by 9 or 10 feet high. In very cold weather it requires the service of both heaters to make the room comfortable.

In the dynamo room, which is quite spacious, the heaters employed are of an entirely different pattern than those in use in the office portion of the building. They were designed by Mr. Paul M. Lincoln and made by Dobbie, Stuart & Co., of Niagara Falls. Instead of being placed on the floor, they are fastened on the wall of the room about 15 feet above the floor. This method of placing them was adopted, partly because of the additional safety and also because it serves nicely in distributing the heat from them. In all there are 15 of these heaters in the dynamo room, placed in circuits of five each, and each circuit is capable of taking up about 200 horse-power, but it never yet has been found necessary to put all three circuits in service, two of them answering every purpose in the very coldest weather. The current used for heating purposes in the dynamo room is taken from the bus bars, and carried on No. 4 rubber covered wire. As this current is taken direct from the 2,200 volt circuit, and as each heater takes up about 40 horse power, it is apparent that to install converters to convert this power down to 100 volts, the voltage used in the office portion of the building, would be quite expensive.

All the heaters in the dynamo room are of very simple construction. They are made of two circular rolled iron plates which are about an eighth of an inch thick and 24 inches in diameter. Bolts hold these plates about four feet apart, one above the other. In each plate there are 28 holes, the diameter of each hole being about half an inch. Each of these holes contains a porcelain insulator having a large head, and through these insulators No. 6 wire is strung. In all there are 38 coils, and each coil is about an inch and a half in diameter, the distance between convolutions being about twice the diameter of the wire. The latter is such that the resistance of the heaters will take about 65 amperes at 440 volts, so that each five heaters in series will consume 65 amperes at 2,200 volts.



Electric Heaters in the Great Power House at Niagara Falls.—Heaters Suspended Around the Walls.

In heating the dynamo room and the office portion of the power house, the maximum amount of power used is about 420 or 430 horse power. It must be taken into consideration, however, that this is not taking into account the heat from the dynamos, which is an important factor so far as the dynamo room is concerned. Three dynamos, each of 5,000 horse power capacity, are now in use in the dynamo room, but, as a general thing, only two of the machines are operated at the same time. If each of the dynamos were run so as to generate 4,000 horse power instead of at its full capacity, and 3 per cent. of this power was lost in heat, which is a fair estimate, each of the two dynamos would contribute 120 horse power toward heating the dynamo room, or from the two machines 240 horse power in heat would be the result. By adding this 240 horse-power to the amount of power consumed by the heaters, it will be seen that nearly 700 horse power is consumed in heat in the building.

The Niagara Falls Power Company have found their electric heating service very comfortable, but this does not denote that electricity will yet come into general use for heating purposes. The company are fortunate in having a large amount of cheap power, but despite this fact the electrical heating of their power house is quite a luxury, and one which few people can afford.

HE LOOKED AT EMMA.

In the suit of Clara Pfeffer, by her guardian, ad litem, Leopold Pfeffer, against the Nassau Electric Railroad Company, to recover $10,000 for the loss of two toes, the jury found a verdict for the defendant. According to Mr. S. S. Whitehouse, counsel for the plaintiff, the motorman, Christian Doertem, was paying attentions to Emma Steckler, who on the day the plaintiff was injured, was visiting her aunt, Mrs. Antoinette Froelich, at No. 107 Johnson avenue, in front of which the accident happened. Counsel said that the motorman was turning to look at Emma, who was at her aunt's window, when Clara ran across the street, and that he was consequently not able to stop the car before it hurt the child. Mrs. Froelich testified that the motorman did turn his head, but Emma testified that he did not.—Brooklyn "Citizen."

FEATHER BED NO PROTECTION.

The belief that lightning will not strike a feather bed was shown to be mistaken by an incident of the electric storm of Saturday. A bolt struck a chimney on the house of Charles Steates, who lives on the Deerfield road. Part of it jumped to the house of Bernard Huss and tore off the conductor pipe. The other part went down the chimney, ripped the plaster and paper from a bedroom, and then struck a feather bed. The bed was torn and the feathers scattered about the room.—Utica (N. Y.) "Herald."

"CONCISENESS."—A reader in the South says: "I am personally a great admirer of The Electrical Engineer, and have always considered it an admirable publication. It has been a great assistance to me in my professional work. What strikes me most is its conciseness."

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
120 Liberty Street, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - - 1564 Monadnock Block, Chicago, Ill
Philadelphia Office - - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - -	per year.	$3.00
Four or more Copies in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

Vol. XXIII. NEW YORK, APRIL 14, 1897. No. 467.

Notice of Removal.

THE ELECTRICAL ENGINEER

on and after April 14 will occupy its handsome and commodious new suite of offices, entire south wing, eleventh floor, of the Beard Building, 120 Liberty street, New York City. It will not only thus be most advantageously situated at the heart of the machinery and electrical district, but will enjoy an increase of several hundred feet floor space. The offices are convenient to all railroads and ferries, and an invitation to visit them is cordially extended to all friends and patrons of the journal.

RECONSTRUCTING OLD PLANTS.

IN last week's issue of The Electrical Engineer, in commenting on the situation in which many electric lighting companies found themselves to-day it was pointed out that entire rebuilding, or extensive improvements in machinery and auxiliary apparatus, could alone bring them up to date and place them in a position to meet the present demands of the public both as regards quality of service and as to rates. To reconstruct an old station is evidently more difficult than to start in afresh from the foundations up; but in nine cases out of ten, financial considerations make it the only feasible method of attaining the desired end. How to carry out such a plan without interrupting the service is usually a serious problem and requires much finesse. Probably as representative a piece of work of this kind as has been carried out in recent years is the reconstruction of the Royal Electric Company's alternating current plant at Montreal, so well described elsewhere in this issue by the company's electrical engineer, Mr. P. G. Gossler. While the actual methods employed in this delicate engineering operation are of great value in themselves, the results in dollars and cents will perhaps appeal still more strongly to those having in charge the financial management of central stations. To put over 10,000 lights additional on the circuits and shut down 1,000 horse power in engines at the same time is an achievement which is deserving of more than passing notice; and when to this is added a considerable reduction in the cost of dynamo and transformer maintenance, dynamo attendance, oil, etc., the benefits due to the change make a superb showing. We congratulate Mr. W. H. Browne, the able general manager of the Royal Electric Company, and his technical staff on their brilliant feat, and believe that their work will not fail to have due influence on similarly situated companies this side of the border.

MR. TESLA ON ROENTGEN RAYS.

LAST week Mr. Tesla gave some of the results of his experiments in the domain of Röntgen rays, before the New York Academy of Sciences, and showed some of his latest types of high frequency generators. Mr. Tesla still adheres to his original view that the Röntgen effects are due to the action of molecules projected from the tube at high velocities, but we must confess our inability to reconcile this view with the results of his experiments in deflecting the Röntgen rays by means of a magnet, unless we assume the molecules charged and at the same time endowed with a vortical motion, a point which Mr. Tesla did not elaborate on. It is so rarely that Mr. Tesla appears on the lecture platform that it is to be regretted that the conditions surrounding his last appearance were not more favorable. It was hardly fair to Mr. Tesla, or to the large audience which had assembled solely to greet him, to delay his appearance until two other estimable speakers had taken up the time of the audience for nearly three-quarters of an hour. The result was that it was close on to 10 o'clock before Mr. Tesla began, and he was forced to conclude his address in its initial stages. It is to be hoped, for the benefit of the science at large that Mr. Tesla will find time to write out his address in full for the Transactions of the Academy. Brief as his utterances were, they were extremely interesting and they evidenced a mellowing and a mastery indicative of higher perfection than ever of his powers as an investigator and elucidator of obscure natural phenomena.

VIEWS OF THE TARIFF.

THIS country at any and all times ought to pay its way, and revenue enough must be raised to meet legitimate national expenses or to prevent running into debt. For some years past, in a period of peace, the national debt has been enormously added to, and as the tariff was a low one in some respects, it is now proposed to raise the tariff, achieving a double purpose, namely, obtaining an adequate income and insuring a degree of protection to various industries. We publish this week two views of the situation, and a third has been brought to our attention, namely, that of the leather men, headed by a Republican, ex-Mayor Schieren, of Brooklyn, who want hides to come in free as a large and growing export trade depends upon that condition. Our central station friend buys his imported carbons because he cannot get their equal here. Mr. Ziegler believes that scientific apparatus should be protected so that its production may be encouraged, and the foreign goods kept out. Thus it goes, all along the line, but there are obviously one or two facts to which all the others must be brought into harmony. The first is the necessity of sufficient national revenue, and its raising by tariffs and excises. The next is the possibility that a tariff may be so high as to be prohibitory and thus cut the revenue down. The third is that export trade has had great expansion and is based on ability to manufacture cheaply with raw material at low prices. If from these considerations, we drew the inference that a moderate tariff is in reality the need of the hour, we might not be very far in the wrong. But probably some of our readers may regard that as a personal view of the matter, and would remind us of Gen. Hancock's remark that the tariff was a local issue.

LETTERS TO THE EDITOR

ARC CARBONS AND THE NEW TARIFF.

I BEG leave to call the attention of your readers to that part of the Dingley tariff bill which provides for a change of duty on imported carbons and would thank you to give this letter publicity in your valuable paper.

Under the McKinley bill the rate of imported carbons was 20 per cent., under the Wilson bill the rate was increased to 30 per cent. The Dingley bill, now under consideration, provides for a still further increase of 20 per cent., thus bringing up the rate to 50 per cent.

While I am strongly in favor of a protective tariff, I cannot but see a gross injustice to the users of imported carbons in imposing such a ridiculously high tariff on goods that I am pretty well convinced cannot be made in this country.

The question naturally arises, who will be the gainer and who the loser by this proceeding? Will the American carbon manufacturers profit by it? No, they will not. The quality of carbons manufactured in this country is not sufficiently good to take the place of an imported carbon, and this fact is not due to the lack of proficiency in the art of manufacturing them, but to the lack of certain materials which form part of imported carbons, and which cannot be gotten in this country. It is immaterial to the European manufacturers what rate of duty they have to pay. If the new tariff goes into effect they will simply raise their prices, as some have already announced, and will, by no means, be the loser in doing so. It is the electrical fraternity that will have to suffer for this. The users of imported carbons cannot do without them, and consequently, will have to pay the increased prices. Do you think any one would willingly pay about $15 for a certain size of imported carbons, while he can get the same size of domestic carbons at $5, if he could use the latter?

The above figures prove sufficiently that American manufacturers do not need more protection than they have at present, and the importer cannot get anywhere near their prices to provide revenue for the government. I think it hardly necessary to tax thus severely a whole industry, which, in my opinion, should unite to oppose this measure.

A CENTRAL STATION MAN.

New York City, April 7, 1897.

PROF. ANTHONY'S METHOD OF MOTOR REGULATION.

IN your issue of March 31, I see that Mr. Blood returns to the attack of my method of motor speed control with the following statement, referring to my communication appearing in your issue of Feb. 10: "These remarks show that the description given in the original article was somewhat misleading. In that article (in The Electrical Engineer of Dec. 16, 1896), reference is made to the machine as a multipolar machine. This is absolutely a misnomer, since Prof. Anthony's scheme, as he now explains it, requires a bipolar machine."

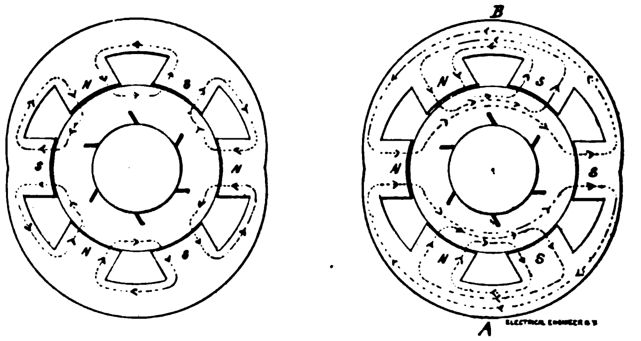
Mr. Blood is "absolutely" in error. In my communication I said: "Mine requires a multipolar armature winding of the two-path or "series" type. Any one familiar with the construction of multipolar generators or motors ought to know what kind that means, and that it is not a winding adapted to a bipolar machine. Furthermore, none but a genuine multipolar machine could work as I stated in that communication mine works.

But to be more explicit, the original experiments were performed upon a regular six-pole machine, having a drum armature whose coils embraced one-sixth of the circumference, and were connected, as is well understood, for a two path, six-pole winding. Six sets of brushes were used at intervals of 60 degs. around the commutator. These were connected three in multiple as is usual in six-pole machines. Two brushes 180 degs. apart might have been used alone on either of the three diameters of commutation. Or two brushes 60 degs. apart might have been used at either of the six pairs of commutation points. Or four brushes might have been used, omitting the two most inconvenient of access. All these arrangements were actually tried. In any case, whatever the arrangement, no change was made in the brushes used or in their connections, when the field was manipulated for changing the speed.

Fig. 1 represents the field excited as in the normal multipolar working of the machine, the pole pieces being alternately north and south. When so excited the motor made about 500 r. p. m. Fig. 2 represents the magnetization with the poles on the horizontal diameter reversed, giving three north poles on one side, and three south poles on the other side of the vertical diameter. Excited in this way the motor made 1,600 revolutions. That it made more than 1,500 was due to the fact that the field casting used was designed for a regular six-pole machine and had not sufficient sectional area to carry the magnetic flux necessary for the full field strength.

From an inspection of Fig. 2 it is plain that in a machine designed especially for this method of speed control the yoke should be considerably thickened in the regions A and B. The draughtsman has essayed to show this construction in these figures. It is plain also that the armature core should have a greater cross-section than for a regular six-pole machine.

Mr. Blood may say that Fig. 2 is a bipolar machine, but he must remember that the armature is a multipolar armature, and if he will give the matter a little thought he will see that for a bipolar machine Fig. 2 would give the slow speed and Fig. 1 the high speed, while with my method, the opposite is true, as I stated in my communication which he criticises. I consider that my method possesses great advantages over the other, but I do not care to go into that here, neither do I feel warranted in further encroaching upon your space for the discussion of the originality of my invention. Since Mr. Blood has called this in queston I will add here that none of the patents he has cited describe my method of speed control.



FIGS. 1 AND 2. PROF. ANTHONY'S METHOD OF MOTOR REGULATION.

WM. A. ANTHONY.

New York City, April 10, 1897.

AN EARLY SPRAGUE ELECTRIC RAILWAY COACH.

The description of the experiments made with a motor car pulling four standard coaches at the works of the General Electric Company recently, which appeared in your last issue, omits a somewhat important point of historical interest.

The car used was one made for the Sprague Electric Railway and Motor Company in 1887, about a year before the Richmond trolley road was put into operation. It was built by the Gilbert Car Manufacturing Company at Green Island, near Troy, was a full-sized car body, and was provided with compartments at each end so that it could be used by smokers, which is the practice on the motor cars of the Metropolitan Railroad in Chicago to-day. It was designed as an experimental motor car to pull a full-sized elevated train. It had two trucks, with 42-inch Krupp steel wheels, and each axle was to be driven by a duplex motor of 75 horse-power capacity with single gear reduction, thus making an aggregate capacity of 300 horse power.

The motors were partly constructed in the old works of the Sprague Electric Railway and Motor Company on West Thirtieth street, New York, but they were never completed, the Richmond road and the active development of the trolley system proving of more immediate importance.

The car lay in the works of the Gilbert Manufacturing Company for a number of years, and now, equipped with the heavier type of railway motors, curious to note four in number, with single gear reduction, and of almost identically the same capacity as originally projected, is put to service in experimental work on identically the same projected loads, ten years after it was built. CHAS. M. SPRAGUE.

New York City, April 9, 1897.

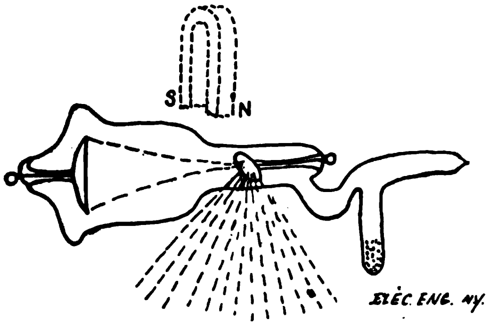
ROENTGEN RAY BURNS.

BY PROF. ELIHU THOMSON.

THE cause of the injury to the skin which follows an exposure to a source of Röntgen rays is still a subject for discussion. It is known that a comparatively short exposure at sufficiently small distances from the source will produce the effect. It has been claimed by some that Röntgen rays do not produce the mischief, but that the effect is essentially electro-static. Others have expressed the opinion that ozone and other substances present in the neighborhood of the excited tube are the real causes of the injury.

It has seemed desirable to set at rest, by experiment, these doubtful theories. The very peculiar nature of the injury itself, its course of development, the accidental circumstances under which it has occurred, have all tended to negative any theory except that which regards rays from the tube as the true cause. These rays might be either Röntgen rays, or rays so closely analogous as to be with difficulty distinguished therefrom.

The first effect after exposure is a slight reddening of the skin which is made more easily discernible by a little friction over the spot affected. This lasts two, three or more days and tends to fade. In the writer's experience, at the end of a week there has been an almost complete absence of any noticeable effect on the skin. On the ninth day, however, the affected part was found to redden, and this increased for a few days until blistering and sloughing took place with slow and tedious healing. These effects were noted in the case of the exposure of the little finger of the left hand and are at present writing in progress upon a portion of the third finger of the same hand, in consequence of an exposure for only twelve minutes to the rays from a special tube. This tube was made for the purpose of obtaining strong effects by lessening the working distance from the bombarded spot on the platinum, which is the source of the rays.



PROF. THOMSON'S X-RAY TUBE FOR POWERFUL EFFECTS.

The accompanying sketch shows the general form of the tube. It is narrowed around the platinum anode and the glass is also made thin around the same. It is thus possible to get the finger, the fluorescent screen, or the photographic film, very close to the bombarded spot on the platinum anode. The distance need be not over one-half an inch as a minimum. By the use of a magnet the spot on the platinum could be shifted so as to be very close to the glass and upon the edge of the platinum sheet. The intensity of the radiation per unit of surface was increased thereby, according to the law of inverse squares, which seems to hold in this case. This use of the magnet is indicated in dotted lines and is very convenient for directing the cathode rays upon any part of the platinum anode; which anode might in fact be faced with a variety of different substances, or have its surface differently formed, or curved at places while the cathode beam could be directed first to one part and then to another and the effects noted. If a platinum anode has been perforated by the beam at one point the tube is still useful, for a slight effect of the magnet puts the beam upon a new surface. Many a good tube may thus be made to do service even after several holes have been melted through the platinum sheet.

With such a source of rays as the tube shown it was easy to try an experiment the result of which seems to the writer to leave no doubt of the fact that Röntgen rays, or rays of the same general characteristics, do actually cause the burns and injury which may follow prolonged exposures to the Röntgen radiation. The left hand was covered with a lead sheet of over 1-16 inch in thickness and an oblong hole of about three-fourths of an inch long and about five-sixteenths inch wide, cut through it at the part just over the third finger between the first and second joint. This limited the passage of rays to the part of the finger under the opening.

But around the finger and under the middle of the opening was placed a strip of heavy tinfoil about 3-16 inch wide. This divided the exposed area into two parts. One of these parts in turn was covered with two layers of thin aluminum leaf gummed to the finger. Thus there were, in fact, three spots on the finger within the opening, one covered with aluminum foil or leaf, another with heavy tinfoil, and the third left entirely bare. The opening in the lead sheet was brought close to the platinum anode, so that the finger was about ⅝ inch distant from the bombarded spot.

The exposure was for a period of twelve minutes, which it was thought would be sufficient. The result at first was two faintly reddened spots, one having the outline of the part under the opening in the lead shield covered by the aluminum foil, and corresponding thereto, and the other corresponding to the bare spot. Under the tinfoil strip there was no action. These reddened spots, though scarcely visible, could be developed by slight friction, but gradually faded until, at the end of a week, from the time of exposure, they were with great difficulty distinguishable from the rest of the skin, even after the spot was rubbed. On the ninth day, however, they returned and the spots became painful and a little swollen. This has continued to increase and will probably end in blistering, sloughing and final healing. The part covered by the tinfoil is sharply marked from the others in being entirely unaffected. The effect produced through the aluminum leaf is about the same as on the bare spot, showing that thin aluminum does not stop the rays which produce harm.

It is needless to say that the effect is proved by the experiment to be neither electro-static, nor ozonic, but merely a result of certain rays reaching the skin surface, and such rays are probably those of the Röntgen rays not readily absorbed. According to the law of inverse squares an exposure of 12 minutes at ⅝ inch distance would require, at 10 inches distance, for equal effects, about 50 hours, or over two days. There is, then, no occasion for any alarm at the effects of Röntgen rays, as exposures of sufficient duration to produce harm are rarely if ever necessary.

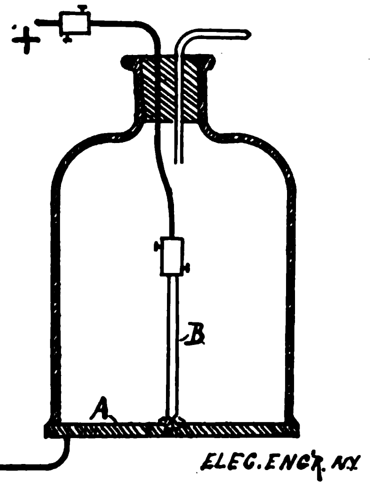
In regard to the claim which has been made that injury only follows exposures made by induction coils, while static machines do not produce the effect, it may be said that in the writer's former experiment, of which the little finger was made the subject, a large capacity static machine was used, and the result was severe enough. The present experiment was made with an induction coil as the source of electric discharges, and as yet there is no difference in the results. The effect is now, of course, limited to two small spots a little distance apart.

MR. TESLA BEFORE THE NEW YORK ACADEMY OF SCIENCES.

ON April 6, Mr. Nikola Tesla delivered before the New York Academy of Sciences an address "On the Streams of Lenard and Röntgen, with Novel Apparatus for Their Production." The lecturer began by stating that in 1894, in experimenting to determine the actinic action of phosphorescent light emanating from vacuum tubes, he had found that the actinic power of Crookes tubes varied greatly, and in the most anomalous manner. Thus some tubes emitting a strong light had very little action on photographic plates, while some showing a feeble light acted very strongly on such plates. A large number of these plates, made by Tonnele for the Century Magazine, were stored in Mr. Tesla's laboratory when it was destroyed by fire, and thus he was unable now to examine them for the Röntgen effects. He believed that he had just missed the discovery which made Röntgen famous and though he was thoroughly familiar with Lenard's work, he did not see far enough.

Mr. Tesla then reviewed his work in the direction of obtaining a reliable apparatus for generating high frequency currents, which he recognized as the keynote to the production of vacuum tube lighting. He told how he had met with difficulties at every point; how a small bubble of air would destroy the value of the coil, or how one-quarter of an inch of wire too much or too little would throw a coil out of balance; how one day a coil would run cold and on another day hot, etc. By finally calling to his aid the condenser, Mr. Tesla stated, he had succeeded in obtaining the desired action and now nothing stood in the way of securing millions of vibrations from ordinary circuits. The lecturer then briefly explained the principle of the condenser discharge as applied to high frequency currents, and pointed to various types of apparatus on the lecture table designed to utilize the principle.

In order to demonstrate the action of the high frequency currents Mr. Tesla attached a circular loop of heavy copper wire to the terminals of a high frequency generator and brought to brilliant incandescence a small lamp connected diametrically across the heavy loop; the illumination of the lamp could be varied by connecting it to various points on the diameter of the loop. Mr. Tesla also lit the lamp by the current induced in a second loop brought in proximity to the first. He explained that the coil accomplishing this work had a resistance of 600 ohms and an inductance of 6 henrys; the coil was connected to the circuit one-half the time and took from the primary circuit only 5 watts.



Tesla's Arc X-Ray Generator.

Mr. Tesla next showed a vacuum tube lit from the terminals of another high frequency machine. He also showed a coil consisting of a single turn of heavy wire which formed the core, as it were, of a small coil of a few turns wound on a paper cylinder surrounding the heavy wire. When connected to a high frequency generator, this apparatus gave a 4-inch spark with an expenditure of energy equal to that taken by one lamp. Mr. Tesla stated that his high frequency generators were so constructed that they could be connected to any existing circuits, direct or alternating.

Returning to the Röntgen rays, the lecturer stated that he had succeeded in discovering a new source of these rays, far more powerful than any heretofore available, though the difficulty of maintaining it was very great. This new source is the electric arc; not the ordinary arc, however. The arc required for the purpose is that maintained between a platinum terminal and an aluminum plate, as illustrated in the accompanying diagram, where A represents the aluminum plate and B the platinum, enclosed in a glass jar.

Mr. Tesla stated that he had also succeeded in deflecting the Röntgen rays by a magnet. He had proved this by deflecting the rays into a condenser placed a long distance from the source of the rays, and which in 5 seconds was charged sufficiently to throw a galvanometer needle off the scale.

ONE of the longest electrical patents ever issued has been granted to Mr. Thaddeus Cahill, of New York. It includes 175 claims for the electrical production and distribution of musical sounds. The apparatus is wholly electrical and bears little if any likeness either in structure on in mode of operation to a piano or organ, though the music produced is said to be similar to that of either. The principle involved is the translation of electrical vibrations into harmonious tones and chords. Mr. Cahill's ability as a maker of claims should render him valuable at election times.

ELECTRIC TRANSPORTATION

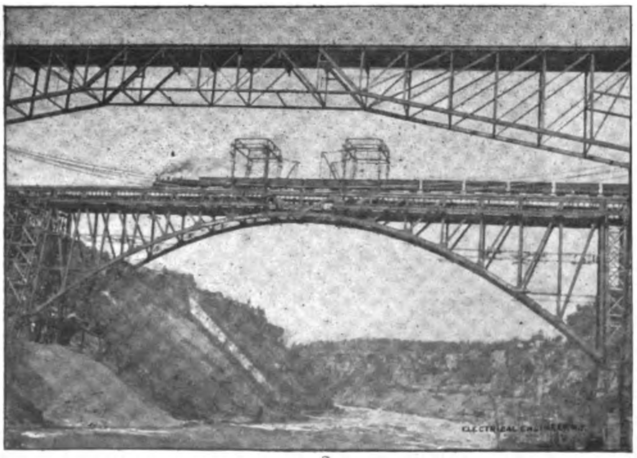
NEW STEEL ARCH TROLLEY BRIDGE AT NIAGARA.

BY ORRIN E. DUNLAP.

IN The Electrical Engineer of Dec. 2, there appeared some account of the new steel arch trolley bridge that is being constructed across the gorge at Niagara Falls. The work on this all-metal structure has progressed rapidly throughout the winter months and it is pleasing to record that, despite the dangerous nature of the work and the dangerous locality, not a single life has been lost, nor has a serious accident happened on the job. The large stone abutments for this bridge are located midway between the water's edge and the top of the high bank on the débris slope. Preparatory to the erection of the steel superstructure, great structures of scaffolding were erected between these abutments and the cliffs, and on these scaffolds the end spans and first panels were built. From this point on, panel after panel, was built in, the work progressing from both sides of the river simultaneously, and gradually the two sections approached one another at a point high over midstream.

It was on Sunday, March 28, that the last panel was placed, and this left the ends of the two great steel sections about two inches apart. To adjust this and allow the end plates of the sections to touch and come together required careful work, and Chief Engineer L. L. Buck was present in person to direct the task. This was commenced on the morning of Monday, March 29, when the men on the work took their stations and the work of adjustment commenced. From the center of the old railway suspension bridge to the great screws at either side of the steel arch at both the Canadian and New York State ends a line was formed, and at a given signal, which was passed along the line, the gangs of men on the screw levers began to turn. This allowed the great steel sections, weighing thousands of tons, to come together. First one corner was lowered and then another, until at last the four screws were operated simultaneously, and the sections met so exactly that the bolt holes in the plates of the two sections matched perfectly, the drift bolts being easily placed. This was indeed the climax of the work, and well displayed the engineering skill that made such an accurate meeting possible. It clearly told what extreme accuracy had been shown in making every member of the arch, and greatly pleased the Pennsylvania Steel Company, makers of the great structure.

It is expected that the arch will be completed in June. It will have a span of 550 feet, which will be connected at the ends to the cliffs by trusses 115 feet long. These dimensions afford excellent opportunity to compare the new arch with other all-metal arches in this country and Europe, the dimensions of which are as shown in the table below.



New Niagara Trolley Bridge.

All who are familiar with the railway suspension bridge, which the new arch will replace, will understand the immensity of the task of constructing this great arch, for it is being built beneath and about the suspension bridge, and this without interrupting the travel of trains or carriages. The illustration presented herewith shows the arch built about the suspension bridge, which it is intended to remove, and which will be a task of no small magnitude.

With the removal of this suspension bridge will disappear one of the most famous structures of its kind in the United States. It was one of the earliest, if not the very first, great suspension bridges ever erected in America. In its original shape the superstructure was of wood, which was renewed in steel in 1880. In 1886 the original stone towers were replaced by towers of steel. It was owing to the construction of the railway suspension bridge that the village of Bellevue changed its name to "Suspension Bridge," a name which is still retained on all railway time tables despite the fact that the village of Suspension Bridge became a part of the city of Niagara Falls in 1892.

	Span.	Rise.
Louis I., Oporto, Portugal	566 feet.	146 feet.
Garabit, France	543 "	170 "
Pia Maria, Portugal	525 "	121 "
Eads' St. Louis bridge	520 "	47 "
Washington bridge, New York	510 "	91.7 "
Paderno, Italy	492 "	123 "
Rochester (N. Y.) park bridge	428 "	67 "

EXPLOSION OF RETURN TUBULAR BOILERS AT THE ELMIRA, N. Y. RAILWAY POWER HOUSE.

BY M. C. D.

On March 29, two of the large horizontal boilers in the power house of the West Side Railroad Company, of Elmira, N. Y., exploded, killing the fireman and injuring the engines, besides completely demolishing the power house.

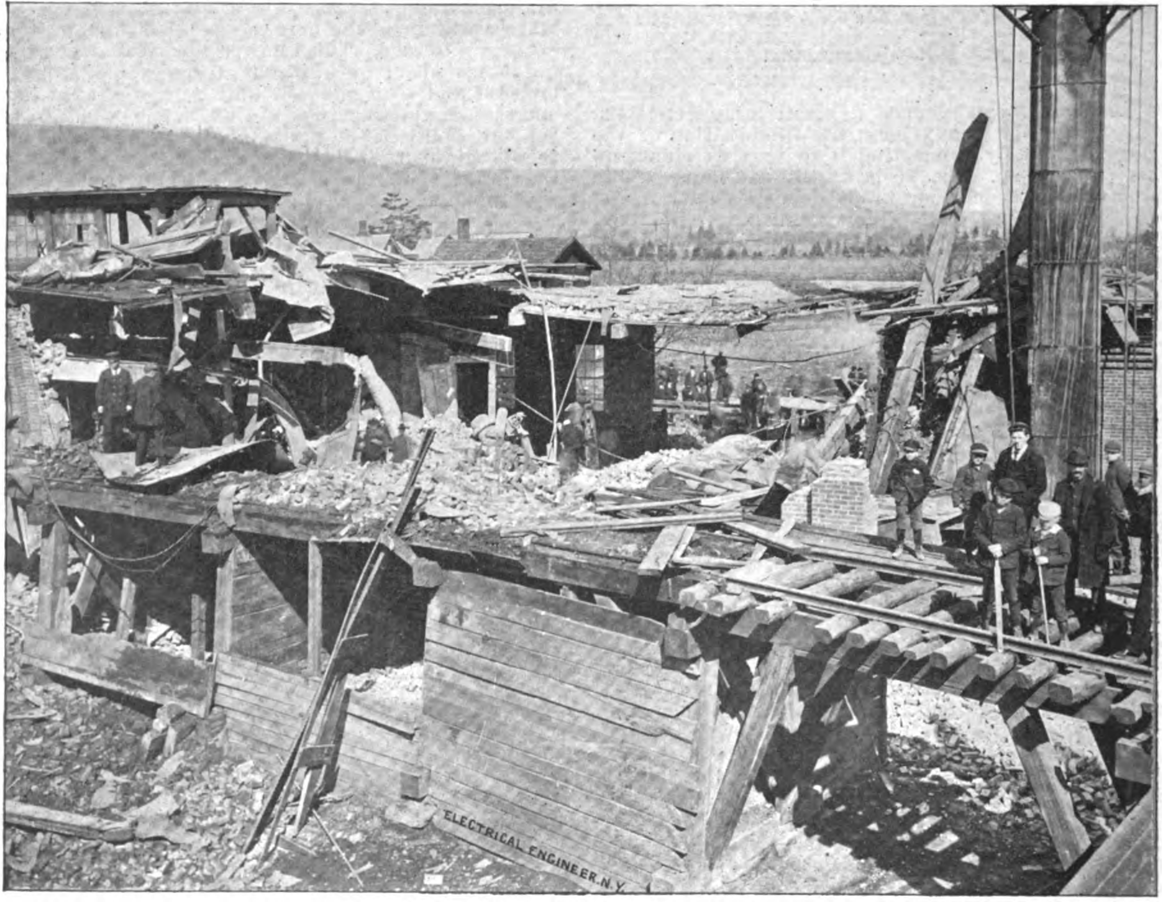
The above is a record that in these modern days of improved steam engineering, is by far too often staring us in the face in large letters in our morning papers. It is read by the public, but soon passes out of mind. While the above item of news applies to Elmira, N. Y., all the difference in preceding items of like news is the name of the town, but the boiler is the same type everywhere. It is persistently used by stubborn, unprogressive engineers or soulless corporations, who want the cheapest they can get.

And a most astonishing thing is that there are insurance companies whose representatives and themselves indorse and recommend such a type of boiler as is here reported. They cannot, no matter how much they try, make a fire tube boiler safe; that is, so that it will not destroy life and property. Then why the modern engineer should stoop to recommend such a magazine of destruction when, if he is up to date, he knows there are safe boilers in the market, with which such accidents cannot possibly happen, is more than the writer can comprehend.

A water tube boiler fills the bill; there is no question about that; the proofs are overwhelming. These Elmira boilers were running at a moderate pressure, being arranged to carry a working pressure of 80 pounds, and all the conditions so far as such a type of boiler was concerned were complete, and the appointments were alike thorough.

The boilers themselves were arranged as is usually done in power houses of this type in batteries of two boilers; the boilers themselves were of the most approved of their type, and according to the modern specification of our steam boiler insurance companies, braced as required by them. The boilers were 16 feet long and 72 inches diameter, with about 70 4-inch tubes arranged tube over tube, not staggered. The boilers were connected to an independent iron stack. The station was in the vicinity of a number of dwelling houses, and it is a miracle that more lives were not lost; but the direction of the explosion may account for that.

As has frequently happened in previous explosions, it was the boiler next the nearest engine that first exploded. The writer's opinion, which is based on many years' close observations, is that this accident, like many others, was caused by the opening of a valve, in a hurry, thus making a sudden draught on the boilers. The nearest boiler, getting the heaviest draught, thus caused the water to suddenly lift up to the steam outlet, uncovering the surface of the shell nearest and over the hot fire in the furnace, causing the surrounding water to immediately flash into steam, at a pressure that no such boiler could withstand; hence the explosion and the devastation and loss of life.



Wreck Caused by Boiler Explosion at Elmira, N. Y., Railway Power House.

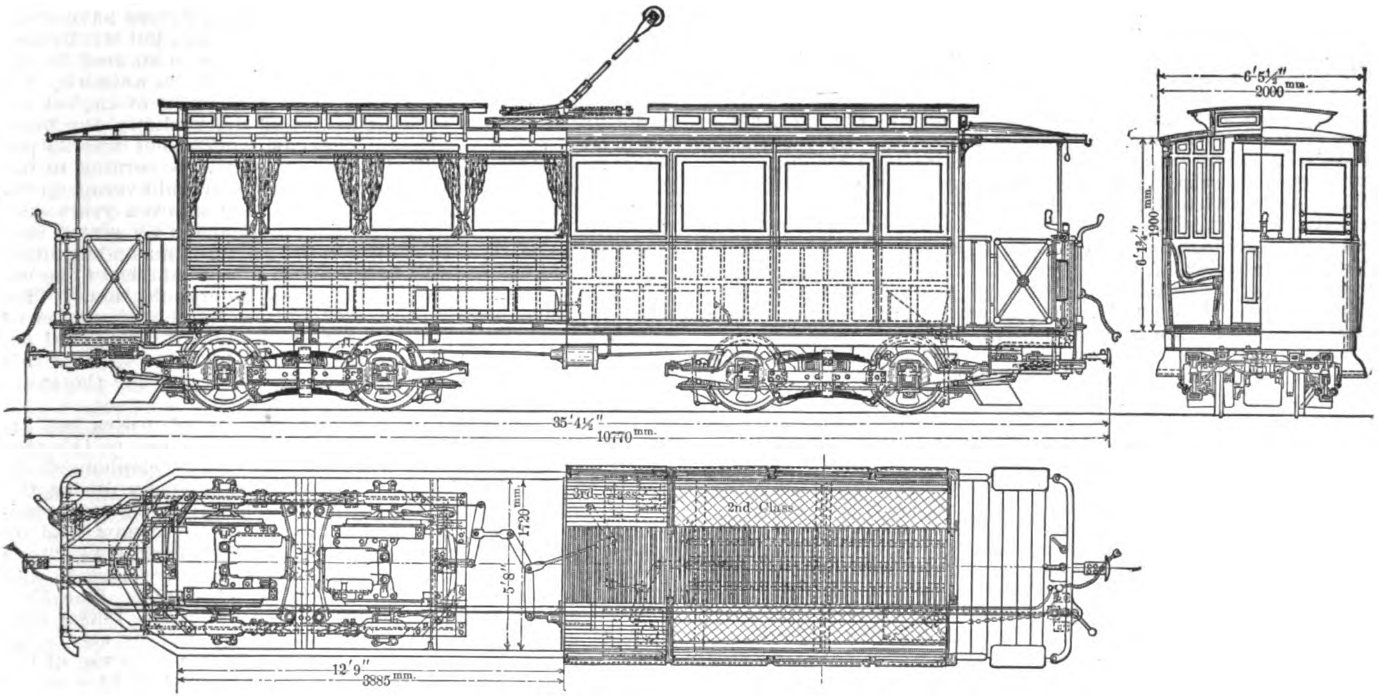
The boiler that exploded first parted on the girth seam, carrying the rivets and part of the outer lap on the rear half of the boiler. The boiler was built in two courses, hence there was only one girth seam riveted. The under side of the shell at the rivet seam in the center of the boiler was split about seven-eighths of the circumference. The top was split central on the rivet centers; one-half of the boiler was driven through the brick wall of the boiler room and for about 1,000 feet into the field, and was driven end on into the earth. At the center line of the rivets on the girth seam the tubes are broken or cracked; all are bent and twisted in every conceivable shape. The braces are broken through the center of the first rivet hole in palm of brace. The tubes in the back head are to some extent driven through. The tubes in this boiler on both ends are all beaded over, an old fashioned practice.

The front half of this boiler shows the force of the explosion. It was driven through cars and landed in a demolished wall a distorted, shapeless mass. In fact, everywhere around this plant the evidences of destruction are seen. I thought while viewing the destruction visible, of how valuable an agent the camera could be made in the hands of an engineer committee, who could have got subject matter of great importance to engineers in general, and proof of the modern needs in the boiler room, and more particularly the ability to convince the doubting that the only safe remedy against such possibilities was to put in a modern improved sectional water tube boiler.

GERMAN INTERURBAN ELECTRIC CAR.

GERMANY is rapidly converting her horse roads into electric, and statistics show it to be far ahead of any other European country in the number of electric roads. The success of the latter has even stimulated the adoption of electricity for interurban traffic, and at the present time a steam road, the Oberschlesische Dampfstrassenbahn, in Prussia, is actually being changed over to electricity.

The accompanying engravings show side and end elevations and a section of one of the cars, of which thirty will be equipped with motors and fifty will be trailers. As will be noticed, there are compartments for both second and third class passengers. The "Standard" air brake, of the Standard Air Brake Company, New York, was specified for the entire installation in view of the satisfactory results which had attended the use of this brake on the Grosse Leipziger Strassenbahn in Leipzig, Germany. On the latter road over 300 Standard brake equipments are in use. Full details of the motor to be used on this car were published in the January issue.



MOTOR CAR WITH AIR BRAKE ON OBERSCHLESISCHE DAMPFSTRASSENBAHN, GERMANY.

The Oberschlesische is a road of extremely narrow gauge, the track having a width of but 30 inches. In order to furnish adequate power, motors will be placed on each axle, that is, four to a car, these motors being of a specially narrow type. There was no room therefore on the axles or the car for the axle type compressor. On this account the gearless motor driven compressor will be used.

The hand brake staff is retained in addition to the air brake, and will operate in conjunction therewith if required. The brake rigging however is arranged to secure uniform pressure alike on all the wheels, and the train when filled will weigh over 50 tons. The steepest grade along the road is 5 per cent. and cars will maintain an average speed of 16 miles per hour. The motor compressor furnished in this installation occupies a space of 16 in. x 24 in. x 18 in.

FINANCIAL PRACTICE AND ENGINEERING METHODS OF AMERICAN STREET RAILWAYS.[1]—I.

BY E. E. HIGGINS.

I THINK it is a good plan in any discussion of this kind to glance at the field of investigation for a moment. There are some things here which have surprised me and possibly may surprise you. Referring to the map, in this very small section of the country covering New England, the Middle States, Ohio, Virginia and West Virginia, there are 64 per cent. of the cities of the United States of over 15,000 inhabitants, there being 215 in all in the Eastern and Central sections of the country, North of Mason & Dixon's line, covering perhaps one-fourth of the area of the United States, there are not less than 83 per cent. of the cities of the United States having over 15,000 inhabitants; south of Mason & Dixon's line, including Texas, there are but 11 per cent., or 24 cities in all; while in the great West, covering an immense area, there are but 6 per cent.

That means that primarily the street railway section of the country is necessarily in the East, because the population is there; and you cannot have street railways without population to support them. That that is true is seen from one or two other statistics. I do not propose to deal very much with statistics to-night, but there are two or three things which may possibly be brought out better in that way than any other.

In the eastern section 44 per cent. of the street railway mileage of the country is concentrated; and in a larger section still, the East and Central East, 76 per cent. is concentrated; while in the South there is but 8 per cent. and in the great West but 16 per cent. The capitalization also is divided in much the same way, 86 per cent. being in the East and Central East, 4 per cent. in the Southern States, and 10 per cent. in the Western States. Now there is another rather interesting feature in connection with this field of street railway operation. It follows from the fact that this immense number of cities is concentrated in this small area, that they must be close together; in other words, we have a network of cities, and the opportunities for suburban and interurban roads are of course very great. In Massachusetts, for example, the whole eastern part of the State is as much of a network in street railroads as in steam railroads, and that is saying a good deal. In New York State it is not quite so much at present, but indications are, if the present rate of growth in mileage is continued, there will be in that State a very large traffic earning power in the fields which have formerly been given over to steam railroads.

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[1] Delivered before the New York Electrical Society at Columbia University, April 7, 1897.

Now, in the West, it is a matter of fact, and remotely follows from these figures, that the population centers are more or less isolated and the street railways have to rely very largely upon the purely urban traffic. There are of course, in a few of the cities, suburban sections not very far away. Denver, for example, contains numerous health resorts which go far to make up its lack of purely residential suburbs. San Francisco has resorts in much the same general way. But when you consider that there are in the great West but two cities having a population of over 100,000 inhabitants, that there is only one city between 50,000 and 100,000, six between 25,000 and 50,000, and four between 15,000 and 25,000, you can see that the chance for anything more than a merely urban traffic is small.

The same thing in a general way is true of the South. In that section there is only one large city of 100,000 inhabitants, four from 50,000 to 100,000, ten from 25,000 to 50,000, and nine from 15,000 to 25,000. From these figures it follows that we should not expect to find in the West, with one or two conspicuous exceptions, great street railway prosperity, and I shall speak in a moment or two of some of the special reasons why we do not, as a matter of fact, find very large prosperity.

Now just a little bit of history. History is always dry, and I shall not go into it at very great length. I do not know and do not care very much what was the first street railway to be built in the world. It is sufficient to know that between 1850 and 1870, or, limiting it a little more, between 1860 and 1870, was a period of very rapid growth of street railways, all built to be operated by horses.

In 1872 the first cable road was put in operation in San Francisco, and from that time until along in the '80's, cable railroading was a fad with the larger roads. Between 1880 and 1883 there was a great deal of uneasiness among street railway companies. Every one conceded the desirability of doing away with horses and adopting an improved motive power. The question as to what motive power was the real one. The cable was too expensive for most roads. Only a few of the cities of greatest traffic density could think for a moment of putting in a construction costing anywhere from $75,000 to $300,000 a mile. At the same time the municipalities were urging the improvement; the newspapers were calling upon the street railway companies to give better service into the suburbs; real estate syndicates which had property to sell were bringing the question up in every way possible, and the difficulties of the street railway manager could hardly be exaggerated. Compressed air motors, gas motors, ammonia motors, and perhaps more than all, the storage battery system were considered among the most hoped for possibilities.

At that time no one believed it possible that the roads could put in the overhead electric system, even if the overhead system could be proven to be successful, on account of the opposition to it on the part of municipalities. In 1888, the Richmond Road was first operated. The history of that road in its early fight of electric traction versus horse traction is interesting. I suppose that Mr. Sprague spent the greater part of six months on his back under the cars at Richmond trying to get his motors to work, and the fact that he succeeded was the result of one of the most indomitable and plucky fights that has ever been made in any department of industrial development. The original Sprague motors were single reduction, very light indeed, poorly constructed, easy to burn out, over-loaded under the usual conditions of traffic, particularly at Richmond. Later motors brought about a double reduction through the use of internal gearing.

The Thomson-Houston Company entered into the fight with its accustomed energy and during the next three or four years, there was one of the most remarkable "booms"—it is hard to find a word which expresses so much as this word—in electric railroading that could possibly be imagined. It would not have been believed possible in 1888 that so much mileage of the overhead system could be put in in three or four years.

In 1892 electric traction was practically determined upon by all street railroad managers. The cable system was no longer considered, and from 1892 until the present time, cable mileage has actually been cut down, not because cars cannot be operated more cheaply than by electricity, for as a matter of fact, in many cases where the traffic is very dense, the cable system is still more economical per car mile, but because the electric cars were more popular, insured smoother riding, better lighting, and, as a rule, between the two motive powers, electricity had so many points of advantage, so far as the public were concerned—the poles and wires being in—that the cable companies in some cases were forced to adopt electricity or go to the wall.

The result is that to-day out of 15,000 miles of street railroads in the United States, 85 per cent. are in operation by electricity as against 8 per cent. by horses (only 1,200 miles), 4 per cent. by the cable system, and 4 per cent. by miscellaneous motive power, chiefly steam dummy lines. So much for the history of electricity as a motive power for street railways.

TELEPHONY AND TELEGRAPHY

DISCUSSION AT ALBANY OF THE NEW YORK TELEPHONE RATES.—MR U. N. BETHELL'S ARGUMENT.

At the hearing, at Albany, on Thursday last, April 8, on the Brush bill to regulate telephone charges, the telephone side of the case was presented by Mr. U. N. Bethell, the general manager of the New York Telephone Company. In answering the arguments of the supporters of the bill he took up the statement made at a recent hearing that the Ainsworth committee report showed that in 1885 the Metropolitan Telephone Company made a profit of 116 per cent., in 1886 of 147 per cent., and in 1887 of 145 per cent. Such figures have often been quoted before in support of telephone bills, but Mr. Bethell showed by a full citation of the statistics contained in the Ainsworth report that there was absolutely no authority for them. By disregarding various important items of capital expenditure necessary to the conduct of the business, the highest percentage of profit that could be worked out was 33 per cent., and even this was a fictitious figure. According to the figures given in the Ainsworth report, the actual average profit of the Metropolitan (N. Y.) Company for the seven years ending with 1887 was 9.66 per cent. The report itself stated that "The evidence shows that the substitution of an underground for an aerial system will entail a loss of three-fifths of the entire net earnings of the company since its organization." This statement had always been disregarded by the advocates of telephone rate bills, and they had manipulated the capital account of the company to suit themselves; but even with all this there was absolutely no authority in the report for the exaggerated profits cited before the committee.

The present bill had been drawn, and its advocates had argued for it, said Mr. Bethell, with sole reference to the rate of $240 a year, as if that were the New York Telephone Company's only rate. The work done by the company during the past three years in modifying and reducing its rates was wholly ignored. As a matter of fact the $240 rate is now paid by a comparatively small proportion of New York subscribers and is paid by them because they use the telephone largely, and it is to their advantage to have unlimited service. The New York Telephone Company has at present some 18,000 subscribers, of whom about 4,300, or less than 25 per cent., pay the $240 rate. Of these 4,300, there are 2,500 whose use of the service is such that they can get all they require at a lower rate by contracting on the message rate plan at the schedule now in force. This leaves only 1,800 subscribers, or just 10 per cent. of the total number in the system, whose demand on the service is such that it is an advantage to them to take the unlimited service and to pay the $240 a year, which is the present price of it.

Consequently the proposed bill is aimed to relieve a class of large users of the telephone service, large firms and corporations doing an extensive business, at the expense of the large majority of the subscribers whose use of the service is limited, but necessary to their affairs or their comfort. This larger proportion of the subscribers contract on the message rate basis, and their actual average rate is considerably less than the uniform flat rate laid down by the bill.

The flat rate system of charging for telephone service was the plan naturally adopted in the early days of the telephone exchange, when the exchanges were small the service restrictd and the call on the service and on the plant about the same in the case of every subscriber to the exchanges. As the exchanges grew in size and spread out over large cities increasing the cost and complication of the plant, and as the demands of the subscribers on the service began to vary in natural proportion to the wide variance in their business activity and importance, the disadvantage of the flat rate began to be apparent. The steadily increasing cost of the plant and growth in the general use of the service could only be met by a corresponding increase in the general rate, an increase easily met by large concerns to whom almost any price for telephone service would be an insignificant item of their general expenses, but which bore heavily on the moderate customer who is the mainstay of every business. The cure for this situation was found by striking at the heart of the problem. Instead of taking the subscriber's line and station as the unit of value in the supply of telephone service, which has been generally done since the beginning of exchange telephony, the telephone message or connection was taken as the unit and a new system of rates for New York City was studied out on this basis.

A very short consideration of the subject would convince any investigator that the message rate system is the proper solution of the telephone rate problem in a large city like New York, even were there not the remarkable success of the system during the three years it has been in existence to point to as proof of its correctness.

In the early days of the telephone exchange a single exchange served each system and the amount of plant used for each subscriber and operating labor required for each subscriber was approximately the same. A uniform rate was naturally found satisfactory by all concerned and as time went on this rate was naturally considered to be for the hire of a telephone instrument and line, and the actual service performed was lost sight of. But as the telephone systems grew in number of subscribers and extent of area covered, it began to be apparent that the service and not the line and instrument was the main point. With larger areas to serve, numerous exchanges had to be established, and these exchanges had all to be interconnected by trunk lines to carry calls from one district to another. Hence in New York, although a subscriber's line to the exchange may be only half a mile or even a few hundred feet long, he often uses trunk lines five, ten or even fifteen miles long to reach his correspondent in another part of the city. This transfer of calls from one district to another, and in New York the great majority of calls are so transferred, greatly increases the cost and complication of the operating as compared with that of a self-contained single exchange system. The subscriber, however, never appreciated how it made any difference to the company whether he sent few or many messages. He was accustomed to think that he paid for the hire of a telephone—the telephone was there and might as well be used. The messages, however, were what really counted and a subscriber's line was profitable or the reverse to operate according as it gave origin to few or many messages—as it made a light or heavy demand on the operating labor and on the trunk line system joining the various central offices.

Working on this principle the Metropolitan Telephone Company evolved a schedule of rates based on the amount of service supplied. The message rate principle had been adopted years previously in Buffalo and had been heartily indorsed by the Ainsworth committee in its report. In dealing with this subject the report said: "With a fair minimum rate as an equivalent for the possession and right to use the telephone, and a reasonable scale of prices for connections, if used, the toll system seems to have for both customer and company marked advantage over the flat rate."

In adopting the message system the company was conservative and proceeded cautiously, after an extended study of the subject and a careful examination of the working of the system in Buffalo. The plan was offered to customers as an alternative to the flat rate and was in no way obligatory on old or new customers. The first schedule was adopted in June, 1894, with a minimum rate of $150, the style of equipment and grade of service being exactly the same as those supplied at the flat rate of $240. After a little experience in the working of the system a reduction of the minimum rate to $120 was made in November, 1894. In the light of still further experience with the new scheme of rates, which found immediate favor among both old and new subscribers, a revised schedule was put in force in May 1895, under which the minimum annual rate was $75 for a line shared with another subscriber and $90 for a direct and exclusive line. These rates include the right to send 600 outward local messages and to publication of the subscriber's name, telephone number and address in the company's quarterly directory. The charge for additional messages decreases as the number contracted for increases, ranging from 10 cents down to 5 cents per message. If the subscriber to secure the lowest price for messages contracts and pays in advance for more messages than he subsequently used, the unearneu portion of the advance payment is refunded. An adjustment is made at the end of each contract year so that the subscriber pays in exact accordance with his use of the service. When the subscriber guarantees to use a fixed number above 1,500 messages, liberal discounts are made. For payment of the yearly rate in advance, the number of messages covered by a given rate is increased by 10 per cent.

It should be borne clearly in mind that at these rates with their various attractive features to businesslike customers the highest grade of telephone service known to the world is supplied; and the $75 or $90 customer gets exactly the same style of line and instrument, switchboard facilities and the same command over the vast trunking system as his $240 neighbor. The only difference is that he doesn't use them so much. He also gets the same advantage from the technical improvements constantly introduced into the system and from the increase in the area and scope of the system. The only difference between one customer and another is in their respective use of the service.

Another feature of the liberal policy of the company in adopting this method of charging for telephone service—the practical result of which has been a large reduction of rates—is that the method was not aimed solely at acquiring new business, but the new rates were at once made available to all old subscribers paying the flat rate and new contracts were made with all those who found that they could make a reduction in their telephone expenses by coming under the message rate schedule and chose to adopt that schedule.

The message rates had been persistently advertised for the past three years in the daily and weekly press, in street cars and other public places and by means of numerous special circulars sent broadcast over New York. The message rates have been adopted by or are available to, at an economy, all but about 10 per cent. of the company's subscribers and under the message rates a majority of the company's subscribers pay an average rate considerably less than the rate named in the Brush bill.' Yet the advocates of the bill ignore all this, have heard nothing of any reduction in rates and persistently speak of the $240 rate as if that were the only price at which telephone service could be had in the city of New York.

The introduction of the message rates and the hearty support given them, as evidenced by an increase of 6,165 subscribers in the two years ending Dec. 31, 1896, brought the advantages of telephone service home to many who had been unable to consider its use when the flat rate was the only rate available. At the same time the company was enabled to accelerate the transformation of its system to complete metallic circuit working, for whereas in May, 1893, there were more than 5,000 subscribers or nearly half the system still using single wire grounded circuits with old style instruments, at the close of 1896 all this old-fashioned material had disappeared and all subscribers experienced the benefit of complete metallic circuit working. This extensive reconstruction of the plant has been accompanied by a marked improvement in the organization and discipline of the staff, the general result being a grade of service that is unapproached anywhere. Even the supporters of the bill testify to this and say they have no complaint to make of the service.

To put what has been explained above into figures, the following statement was offered. The New York Company operates about 1,500 public stations for the convenience of the non-subscriber and occasional user. At these stations charges are made by the message, but they are not included under the regular message rate subscriber stations. There are also about 1,500 stations at low flat rates averaging less than the rate fixed in the bill. This leaves in round numbers 10,700 stations receiving service at message rates. The average rate paid for service at these stations is less than $109 a year. This sum, the average rate of over 10,000 subscribers, is considerably less than the uniform rate named in the bill—$125—and this fact alone should be enough to show conclusively that it would be ill-advised and improper. If the bill were made a law it would benefit some 1,800 subscribers who already get more than they really pay for, while it would raise the average rate of 10,700 others by at least $16 a year.

The class of large users who hold to the $240 flat rate is not an increasing class. On the contrary, it is constantly diminishing. And those who are deserting it, strange to say, are the largest users who are taking up the message rate system in order to get improved facilities and a more elastic arrangement of their telephone facilities. A line that is used very largely is frequently reported "busy" to important incoming calls. Many lines in New York City are reported "busy" fifty times a day and some as often as 250 times. The only cure for this evil is additional lines, as its existence shows that the telephone facilities to a given point are insufficient for the traffic. Under the message rate plan extra lines may be had at the most economical rate and large users are adopting the plan and fitting up their premises with veritable miniature telephone exchanges on the message rate plan in place of the one or two flat rate lines they formerly had. A switchboard is placed in the subscriber's place of business and from this radiate lines connected to telephones placed at the different desks or in the different departments of the establishment. The switchboard is connected to the nearest central office by means of several, sometimes ten or a dozen, trunk lines. This makes a most flexible system for handling a large amount of telephone traffic and the charges are based on wholesale principles. The facility of using the service is much improved. There is no running to the telephone, no "holding the line" for each user has a telephone at his right hand. No waiting in turn, for there are enough trunk lines to the main system to avoid crowding. And above all, there are no "busy" reports to those calling for connection from without. These telephones—all long-distance instruments of the most improved type—are charged for at $24 a year each; the lines to the central office at $36 a year, the switchboard and 4,000 local messages at $160 a year, and additional messages at 3 cents each—cheaper than postage. Large concerns of all sorts are now taking advantage of this plan to provide themselves with adequate telephone facilities at a fair price. Under the same plan tenants in large apartment houses secure telephone service at a rate of $2 a month and a small toll on each message. All this, Mr. Bethell pointed out, had become possible under the message rate plan, which the Brush bill seeks to set aside.

A NEW AUTOMATIC ELECTRIC BURGLAR ALARM SYSTEM.

MUCH ingenuity has been displayed in contriving means for frustrating the efforts of burglars, and these efforts have yielded a variety of devices in which electricity plays a prominent part. The most recent work in this field is that now being brought out by the Bankers' Electric Protective Company, of Chicago. The system is entirely "local," and dependence is placed upon the integrity of circuits within the building containing the property to be safeguarded.

The engraving, Fig. 1, shows the cabinet which is used to surround the safe or other object to be protected. Where the safe is kept in a vault the vault serves the purposes of a cabinet. In either case an electric lining is used, consisting of strips of metal mounted in connection with thin metal sheets, so arranged that even a pin thrust through the cabinet and penetrating the lining will sound the alarm. The door cannot be opened, or curtain raised, until the time-lock has disconnected it from the alarm system.

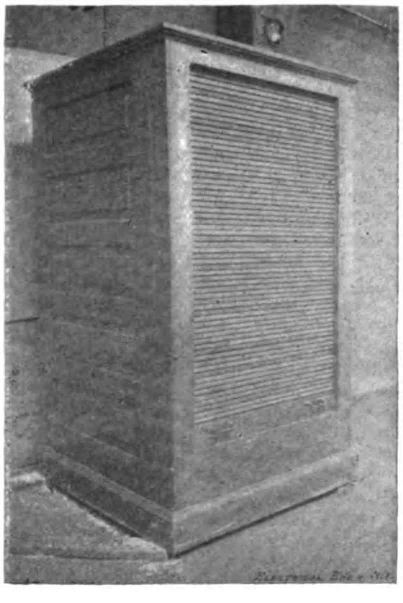


FIG. 1.—CABINET SURROUNDING SAFE.

Fig. 2 shows the current indicator which is used to guide in the opening and closing of the system and also to show the condition of the current during the day, at which time the needle should normally stand at number 5, and for the purpose of keeping a record of the system customers are furnished with addressed postals, one of which must be regularly mailed at stated intervals. After closing the curtain, the needle stands at the red mark or middle position. After pushing the button located on the outside of the cabinet, it will go to the "Shut" position, showing that the alarm has been switched onto the curtain, at which position it will remain until the chronometric switch throws the current off of the curtain, when it will again stand at red mark, showing that the curtain is in a condition to be opened without causing an alarm, and will again come to the open side after the curtain is raised.

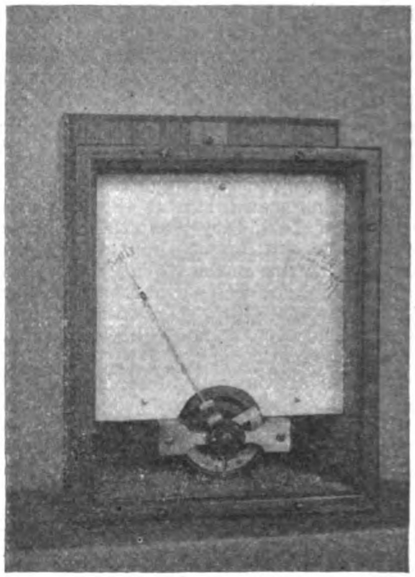


FIG. 2.—CURRENT INDICATOR.

The timer and controlling instrument, Fig. 3, of steel, is located inside of the vault or cabinet in a convenient and accessible place and contains chronometric switch, push buttons, galvanometer, resistance coils and terminal board. In the closing of the system, the chronometric switch is first wound for the number of hours the alarm is desired to be on, then the push marked "On" is operated, when the galvanometer needle will be deflected and prove that all switch instruments in the alarm box are on, then after closing the curtain the indicator on the outside of the cabinet shows that the proper contact is established on contacts and also that the alarm is on after pushing the button under it.

Fig. 5 shows the alarm box as it appears from the outside, provided with storm hood. It is made of steel; the front and back are constructed of heavy double angle gratings to provide for acoustic qualities for an 18-inch gong. The whole is lined in a similar manner to that of a cabinet, so that any attempt at tampering will cause an alarm to be sounded the same as would be the case if the cabinet were molested. The door is held closed by numerous heavy lag bolts, the partial removal of any one of which will cause an alarm, and in order for the door to be opened it necessitates the removal of all of them, which requires a considerable length of time.

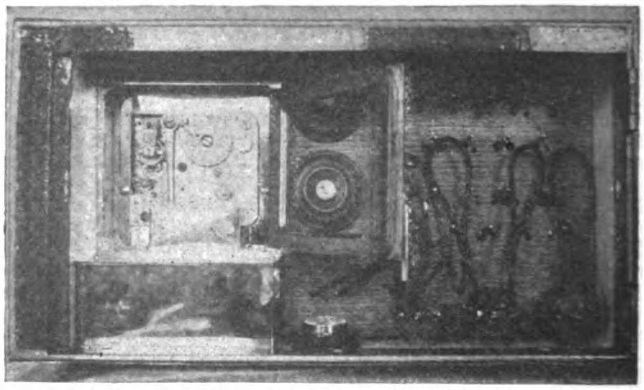


FIG. 3.—TIMER AND CONTROLLING INSTRUMENT.

The relay instrument, Fig. 4, is located in the alarm box, the batteries for operating and controlling it being inside of the cabinet or vault, and is so made and adjusted, combined with the strength of batteries and proportions of resistance coil, that just sufficient current flows through it to maintain its pointer or contact arm balanced between two local contact points, so that any disturbance in the way of an increase or decrease of this normal amount of current will cause the pointer to contact with one of the screws on either side of it and so close the local circuit and cause an alarm.

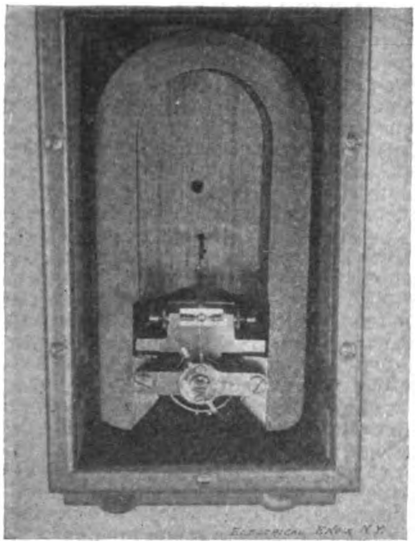


FIG. 4.—THE RELAY INSTRUMENT.

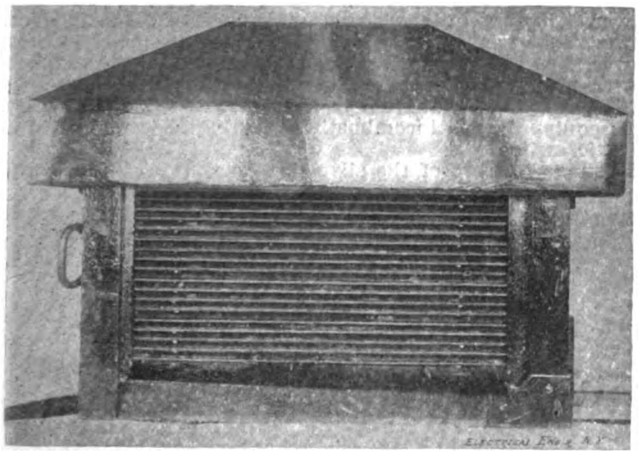


FIG. 5.—THE ALARM BOX.

OBITUARY

DR. HEINRICH VON STEPHAN.

Dr. Heinrich von Stephan, who died in Berlin on April 7, was for more than a quarter of a century the German Imperial Postmaster-General. He was born in 1830. Beginning in 1849, he devoted himself to the postal service, and his promotion from grade to grade, after entering in 1856 the general office in Berlin, was steady and rapid. He was identified with the establishment of the Universal Postal Union, which now includes in its benefits almost every nation. He introduced the telephone system into the German postal service and established the pneumatic system of postal transmission wherever possible. He was honored repeatedly by decorations and otherwise, as a result of his administration of his department.

MR. E. T. COGHILL.

Mr. E. T. Coghill, a former resident of Richmond and manager of the Southern Bell Telephone Exchange at Wilmington, N. C., died in that city on March 29, of a congestive chill very suddenly. Mr. Coghill was a son of the late William T. and Mrs. Hardinia Coghill. His age was about thirty-five years. He resided in Norfolk, Va., up to about eight years ago, when he went to Wilmington for the telephone company. He was a man faithful to every trust and held in the highest esteem by his many friends.

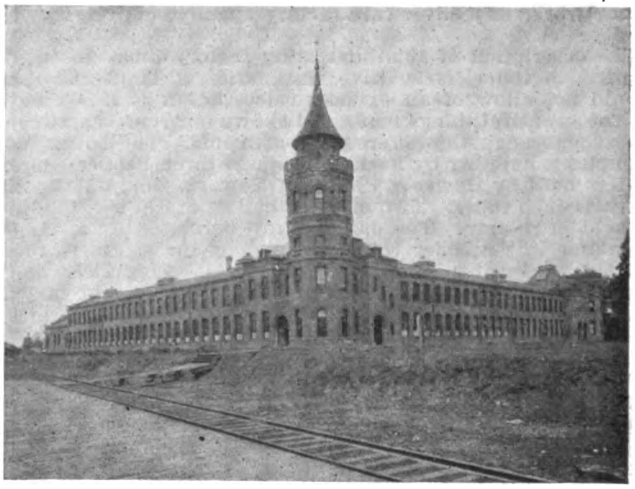
MR. G. LA F. MORRIS, president of the Birmingham (Ala.) Consolidated Electric Light Company, and a large shareholder in the Birmingham Railway and Electric Company has died, aged 48. He arrived in the city a poor man, but amassed a handsome fortune.

MR. H. E. JENNISON, superintendent of construction for Western Union Telegraph Company, was asphyxiated by coal gas on March 26 in the Burk railroad tunnel at Leadville, Colo., while directing some repairs to a cable. He was 60 years of age and a resident of Omaha.

POWER TRANSMISSION

MAKING TIFFANY SILVERWARE BY ELECTRIC POWER.

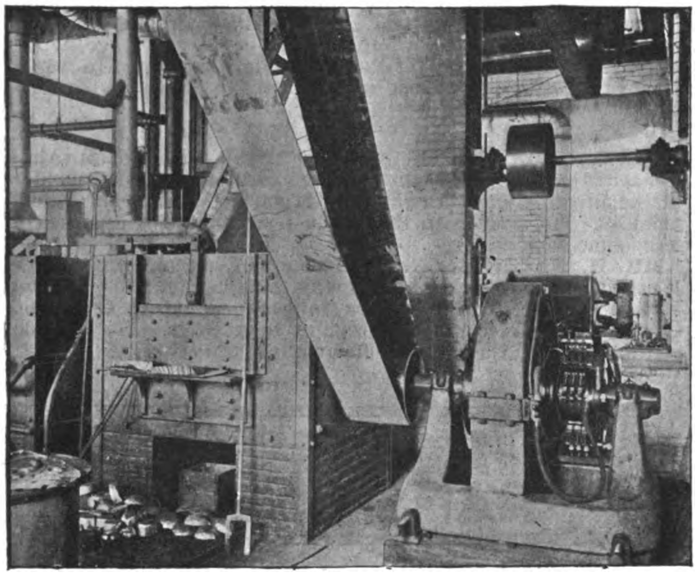
THE famous silverware factory of Tiffany & Co., so long located in the heart of New York, has been removed to Forest Hill, near Newark, N. J., where a new and spacious modern building has been prepared to receive this department of that great business, from which has come metal work of such a highly artistic character as to recall the glorious days of Benvenuto Cellini and the great artisans of the Cinque Cento. Here deft workers will handle the pale metal under better physical conditions, until it assumes manifold forms of ornamentation from the simple impression of the decorative silver spoon to the intricate colored silver and enameled work which vies with and rises superior to the creations of the best English and French silversmiths. This striking supremacy was acknowledged by the industrial and art papers of England and France during the last two great French exhibitions, when Tiffany & Co. secured the medal of honor—the highest award. Tiffany & Co. is an American institution and in no way is this more forcibly demonstrated than in the practice adopted in that part of it now located at Forest Hill.



TIFFANY & CO'S FACTORY AT FOREST HILL, N. J.

In this factory, everything with but few exceptions is modern—the building, the machinery, and, last, and most up to date, the method of driving it. The entire steam engine plant is confined to one room, the power is distributed by electricity over a two-wire 250-volt direct current system carefully laid out and as carefully executed. The entire electrical apparatus is of General Electric Company make, installed by the New York office, and is of the most recent manufacture.

The factory consists of a main front looking southeast and three wings extending northwest, built of brick and stone, two stories high with a spired tower on the south corner. It is 350 feet long by 300 feet wide and is divided into fifteen fireproof compartments. The first wing running along the side of the Erie Railroad, and part of the front was constructed some two years ago. To this building was removed the plated ware department, the motive power for which was furnished by a 50-horse-power engine. On the adoption of electric drive this was superseded by a 4-pole 50-horse-power 850-revolution motor.


50 H. P. Motor in Plated Ware Department.

The other two wings of the factory have been built during the past year and run parallel with the first, but are closed at the northwest end by the engine room, forming a large two-story building around a spacious central court yard. In this building the entire silverware manufacture of Tiffany & Co. is now carried on, under the superintendency of Mr. Parsell, to whose kindly courtesy we are indebted for data and facilities. This factory is the first instance, so far as we are aware, in the world of a silverware factory operated entirely by electricity.

The description of this interesting factory must, for us, be limited to the electric drive installation. Time and space would not allow of an extensive description at this time of all the beautiful things made and shown our representative on his trip through the different departments. The boiler room occupies a building by itself. It houses three 100-horse-power boilers built by Hewes & Philips of Newark, 66in. x 16ft., with 96 three-inch tubes. Two of these boilers are in use, the third is held in reserve. The dampers are regulated by a damper regulator in the boiler room operated by the steam pressure. All the feed water is filtered through a Blessing filter, and a special meter is provided for any boiler trials that may be necessary. The boiler room also contains a Worthington fire pump of 1,000 gallons capacity, connected to fifteen fire stations, one to each of the fireproof compartments. The steam piping is in duplicate, and is covered with Johns asbestos packing.

A covered passage leads from the boiler room to a handsome engine room which is a model of its kind. The main engine is a 250-horse-power 490-revolution Corliss, also built by Hewes & Philips of Newark. It is belted by a 28-inch belt to a countershaft running the entire width of the room, to which is also belted as an auxiliary the horizontal Ball & Wood engine of 50 horse power. This engine formerly drove the machinery in the plating department, but since this department was included in the electric drive scheme, the engine has been removed to the engine room proper. It will be used as an auxiliary in cases of light load when the factory is running overtime.

All the bearings are of the Hyatt roller type. Standing beside the main engine is a Phole air lift drawing the water from the artesian well, and a steam pump forcing it up into the tank on the corner tower.

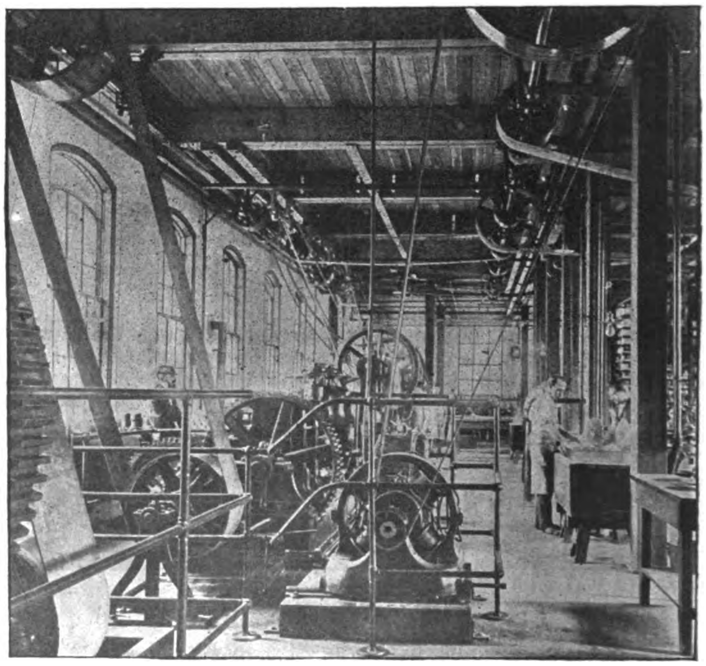
The countershaft is equipped with Worrall cut-off couplings by means of which either or both of the generators may be driven. To it are belted two General Electric moderate speed multipolar generators, each four pole, 100-kilowatt 750-revolution machines, delivering current at 250 volts. These generators are of a type which has recently come into extended use. The frames and pole pieces are of special soft steel. The armatures provided with air ducts are thoroughly ventilated, and the coils of copper wire made on forms before being placed on the core are bound down solidly at both ends on cylindrical flange extensions of the spider. The bending of the armature coils is thus avoided and they can be removed and replaced easily and speedily. The insulation used is similar to that employed in the G. E. railway motors, and is both tough and impervious to moisture. The brushes are of carbon set in specially constructed holders to give proper contact on the commutator.

The blue Vermont marble switchboard is composed of five panels. The center panel carries a voltmeter and voltmeter switch, and twelve knife switches, six for the lighting feeders and six for the power feeders. The two panels on each side are generator panels and each is equipped with ammeter, main switch, field switch, rheostat, pilot lamp and a G. E. automatic magnetic blow-out circuit breaker. The two outside panels carry four switches; on the right panel two for lighting and two for power in the case factory; on the left panel two for lighting and two for power in the plating department. All the switches are of the G. E. quick break single pole pattern.

The leads from the generators are carried to the switchboard beneath the floor. From the switchboard the feeder circuits rise to the ceiling of the engine room, and, carried on porcelain insulators, in lines as straight as possible, pass to the various points of utilization in this interesting factory. In all passage ways on the floor of the engine room corrugated rubber is laid down, and all the machinery, both steam and electrical, is surrounded by polished brass railings.

The motor equipment consists of three I. B. motors, 2-pole, 3 horse power, 1,800 revolutions; two I. B. motors, 2-pole, 5 horse power, 1,700 revolutions; one M. P. motor, 4-pole, 8 horse power, 1,600 revolutions: four M. P. motors, 4-pole, 10 horse power, 1,350 revolutions; three M. P. motors, 4-pole, 15 horse power, 1,200 revolutions; one M. P. motor, 4-pole, 20 horse power, 1,050 revolutions; two M. P. motors, 4-pole, 30 horse power, 975 revolutions; one M. P. motor, 4-pole, 50 horse power, 850 revolutions, allotted to the different departments, and each equipped with incombustible starting rheostats with automatic switch.

The manufacture of the silverware may be said to start in a room on the first floor of the central wing, separated from the engine room by a driveway, and known as the smelting and refining room. This contains a cupola and cupel in which the refuse of the factory is treated. All the dust and refuse from the benches, floors and polishing tables is collected either by a powerful exhaust fan in a huge receiver or is carefully swept up, and moulded into cakes, is introduced into the


20 H. P. Motor in Spoon Making Room.

cupola and melted down. The hand washings are all collected into huge tanks and filtered to collect the metal dust. Nothing is wasted. Every scrap of the precious metal is recovered and turned back into the factory.

Next to this room is the moulding room, containing melting furnaces, casting machines, sand mills and boxes, etc. Here the casting is effected. This room contains a 4-pole 15-horse-power 1,200-revolution motor, belted to overhead shafting operating blast blower, moulding machinery, etc. In the next room, known as the stamping and rolling room, it drives a series of drop presses under which the silverware is stamped into the beautiful designs, which are associated with the mere mention of the name of Tiffany. This room also contains a large rolling mill, where sheets of silver one yard long and more, by two feet wide are rolled down to required thickness, toggle press and a hydraulic press of 1,000 tons capacity with its pump, all driven by a 4-pole 30-horse-power 975-revolution motor, also belted to ceiling countershafting.

The next room occupies the remainder of the length of the wing and is known as the spoon-making room. Here the plain sheets of silver pass through the various processes to emerge in the shape of spoons of all patterns ready for the polisher's table. The heavy machinery in this room consists of two large rolling mills; the light, of five presses, four spoon mills, four filing lathes, four drop presses, one shears, one saw lathe, one reversible mill and one burr lathe. All this is driven by a 4-pole 20-horse-power 1,050-revolution motor also set upon the floor and surrounded by a brass railing. The only device not driven by electricity in this room is the steam hammer.

Mounting a spiral staircase in the corner of this room we emerge upon the second floor, and find ourselves in a large L-shaped room occupying almost the entire front and the southeast corner of the new building. This is devoted to the silversmith's small work, mounting, etc., and is driven by two motors both mounted on small platforms. That in the long leg of the L is a 2-pole 3-horse-power 1,800 revolution motor; that in the short L is a 2-pole 5-horse-power 1,700-revolution machine. As its name indicates, the work done here is of a small character, and from this room come the delicately worked articles such as boxes, buckles, brushes, mirrors and other articles for the boudoir, writing desk, etc. The greater part of the work in this room is bench work. The machinery driven by the smaller motor consists of emery wheels, burr lathes, drills, etc. That driven by the larger motor comprises one circular saw, one jig saw, one burr lathe and one turning lathe, one shears, one rolling mill and a grindstone.

The next room is the stock room, in which blanks are cut and wire drawn. This is equipped with a 2-pole 5-horse-power 1,700-revolution motor mounted upon a stand, driving a wire draw bench and five mills in which silver borders for teapots, coffee pots, cups, etc., etc., are rolled.

Adjoining this is the spinning room, in which are eleven spinning lathes, three turning lathes, a large and a small circular saw, an emery wheel and a grindstone. All this is driven by a 4-pole 8-horse-power 1,600-revolution motor, set upon a low table and belted to ceiling shafting. The remaining length of the second floor on this wing is devoted to silversmith's work. In this room, as in that given up to the silversmith's smaller work, a great part of the work is done at benches. The machinery is small and consists of two swedges, one saw and drill and one burr lathe. The motive power is a 2-pole 3-horse-power 1,800-revolution motor, mounted upon a raised platform.

Following this room is the gilding room, in which the machinery consisting of the three plating dynamos and two scratch brushes is driven by a 4-pole 10-horse-power 1,350-revolution motor. One of the plating dynamos is a Wilde machine imported many years ago, but still active. From this room entrance is gained to the etching, enamelling and fancy finish room. This room contains a series of polishing wheels, scratch brushes and drills all driven by a 4-pole 10-horse-power 1,350-revolution motor. Here the exquisite enamelling and niello work is done.

The next room is the chasing department in which as the work is done by hand no motor is required, and adjoining this is the engraving and die sinking department, in which light machinery is driven by a 2-pole 3-horse-power 1,800-revolution motor. The remainder of the second floor in that wing is the designing room.

Descending to the first floor, and passing through a door behind the engine room countershafting brings us to the machine shop, in which all machinery repairs are made. The machinery in this room consists of lathes, planers, shears, shapers, milling machines, cutters, etc., all driven by a 4-pole 10-horse-power 1,350-revolution motor, mounted on a stand and belted to ceiling countershafting. A second motor set on the floor is a 4-pole 15-horse-power 1,200-revolution machine belted to a shaft running through the wall into the brushing and bobbing room. This room contains another 4-pole 15-horse-power 1,200-revolution motor, also belted to ceiling countershafting. From the ceiling countershafting two belts are brought down to shafting running beneath the brushing and bobbing benches. To the uninitiated "bobbing" is smoothing off irregularities on the silverware by means of a walrus hide disc; "brushing" is the polishing operation, after the silverware has been "bobbed."

At the side of the brushing and bobbing rom is a small room containing a Sturtevant exhaust fan and an exhaust tank, a McKenzie blower and a large Root blower driven by a 4-pole 30-horse-power 975-revolution motor. The exhaust fan draws all the dust from the brushing and bobbing tables into the tank, where it is collected for reduction in the smelting and refining room.

The polishing in the brushing room is the preliminary polishing of the silverware. From this room it passes to the finishing and polishing room, when the final polish is given to it. The rouge lathes are enclosed in a glass chamber and an exhaust opening faces each wheel. This department has a 4-pole 10-horse-power 1,350-revolution motor for its machinery, which in addition to the rouge lathes consists of a burnishing lathe, a grindstone and a scratch brush.

The last work room of the factory is the repairing department, where all repairs to costly silverware, in many instances impossible to duplicate, are made. This is equipped with a 2-pole 5-horse-power 1,700-revolution motor driving monitor and turning lathes, drills, saws, and presses, emery wheels, etc. Through a window in the side of this room all the finished work is passed into the office whence it is shipped to the store in New York.

The new building is lighted by 1,190 250-volt 16-candle-power lamps, the old building or plating department by 199 250-volt 16-candle-power lamps, all furnished from the generators which supply the current for the motors.

SOCIETY & CLUB NOTES

CINCINNATI ELECTRICAL CLUB DINNER.

The Cincinnati Electrical Club spent Friday evening, April 2, at dinner and a social meeting at the Gibson House. The addresses of the evening were delivered by Mr. T. J. Creaghead, Mr. Bert Baldwin, Mr. C. E. Jones and Prof. Thos. French, Jr. Mr. Jones' history of the beginnings of electricity in Cincinnati, and Mr. Baldwin's recountal of the developments of electricity in street railway work were full of value to men of the electrical fraternity and elicited an animated discussion.

Among the gentlemen present were: Messrs. Wm. M. Venable, Hugo Diemer, G. J. Smith, Alfred Knight, David Hall, L. E. Bogen, Wm. B. Hubbell, E. M. Lawton, P. H. Trout, Geo. Hafer, Jr., E. A. Sarran, W. G. Reuter.

ELECTRICITY AT THE NEW YORK ACADEMY OF SCIENCES.

THE fourth annual exhibition of the New York Academy of Sciences was held on April 5 and 6 at the American Museum of Natural History. The Department of Electricity, in charge of Mr. G. F. Sever, contained a number of interesting exhibits. Mr. M. K. Eyre, of the Edison Lamp Works, exhibited a historical collection of incandescent lamps, showing the development of the lamp and its component parts, from the first crude forms to the present 220-volt, high-frequency lamp.

Mr. W. H. Meadowcroft exhibited a complete X-ray outfit in operation, as well as a variety of Röntgen ray tubes and fluoroscopes made by the General Electric Company. The Thomson inductorium employed gave a 14-inch spark, and was provided with the new hammer break.

Among other X-ray apparatus shown was a 20-inch spark coil and tubes, by Mr. M. O'Connor, who also showed a number of excellent X-ray photographs. Dr. Pupin showed an induction coil and circuit breaker, and Mr. M. Osterberg some German X-ray tubes and an electrical igniter for gas engines. Prof. R. O. Doremus exhibited one of the two original Henry induction coils. The Electric Arc Light Company showed one of their enclosed arc lamps in operation and various parts of the regulating mechanism. Among the battery exhibits was a small model of a Jacques carbon battery and the carbon cell used by Mr. W. E. Case in his lecture experiments before the New York Electrical Society. Both these were exhibited by the Electrical Engineering Department of Columbia University.

Messrs. C. M. Clark and C. W. MacMillen, senior students at Columbia University, exhibited in operation an apparatus devised by them for obtaining the maximum value of a direct current in any circuit and the time elapsing between the make and break of the circuit. They employ for this purpose a circuit breaker and the timing is done by a disc saturated with an iron solution and speeded at a known rate upon which the current leaves a trace. The Cutter circuit breaker employed, set at 40 amperes, broke the current in one-fiftieth of a second, the maximum current recorded on short circuit being 225 amperes.

There was also shown a 1-horse-power Fort Wayne self-starting synchronous motor, the construction of which is familiar to our readers. One of the insulators of the 10,000-volt Niagara-Buffalo transmission line was also on view.

In the Chemical Section there was quite an array of electric furnaces at work during the exhibition. Dr. R. O. Doremus, of the Department of Chemistry of the College of the City of New York, exhibited the electric furnace used by Prof. Moissan in his lecture before the Academy last fall. Another furnace was shown in operation by Messrs. Pellew, Tucker and Van Gelder, the quartz fused being condensed on a glass tube inserted in the top of the furnace. Mr. C. F. McKenna exhibited a "double arc" electric furnace. In this three carbons are used, placed at right angles, the two outer being connected to the positive and negative sides of a three-wire system, and the central carbon to the neutral conductor. Prof. Charles A. Doremus exhibited in operation an electric furnace arranged for lantern projection after a model of Roberts-Austen.

In the Physics Section Prof. O. N. Rood showed a set of photographs demonstrating the regular reflection of the X-rays, and Prof. C. C. Trowbridge two X-ray detectors or fluoroscopes of new form especially adapted to research. Prof. Wm. Hallock showed a hydraulic illustration of the Wheatstone bridge and a variable graphite-asbestos resistance, operating by pressure. Mr. H. C. Parker exhibited a set of graphite high resistances and a set of low resistance shunts. Mention must also be made of the electrical gyroscope of Prof. A. G. Compton which showed in an admirable manner the phenomenon of precession and other actions of the heavenly bodies.

INTERNATIONAL ITALIAN ELECTRICAL EXHIBITION OF 1898, AT TURIN.

On the occasion of the Italian National Exhibition, which will be held from April to October, 1898, to celebrate the Fiftieth Anniversary of the Proclamation of the Italian Constitution, exhibitors from all countries will be admitted to the special department of electricity.

The electrical exhibition will be divided into the following classes: 1. Equipment of electric and magnetic apparatus for schools. 2. Materials and fittings for electric wiring and distributing systems. 3. Electrical and magnetic testing apparatus. 4. Telegraphs and telephones. 5. Railway signalling and block apparatus; application of electricity to train lighting and heating. 6. Dynamo-electric machines and electric motors. 7. Mechanical applications of electricity—electric traction. 8. Electric lighting. 9. Electro-chemistry and electro metallurgy. 10. Miscellaneous applications of electricity. 11. Historical apparatus.

In issuing a general invitation to the electrical firms of all countries to participate in the Turin exhibition of 1898, the promoters are moved by the desire of presenting to visitors a complete display of exhibits from the best-known Italian and foreign manufacturers, including all the latest and most interesting inventions and improvements. The promoters are convinced that so far as electricity is concerned nothing but an exhibition where manufacturers and specialists of all countries are represented will prove efficient in assuring progress both in science and industry. Italy, where unemployed hydraulic power is still abundant, affords a large field to the enterprising spirit of electrical engineers. The success which crowned the International Electrical Exhibition held in Turin in 1884, where, besides many other practical results, the advantages of transformers were first brought into notice, justifies the hopes of the promoters that foreign electrical engineering firms will accept the invitation and take part in the exhibition of 1898, thus contributing with their specialties to make it a display worthy of this branch of industry.

The executive committee of the exhibition has appointed a representative of each nation to act as a member of the organization committee. Mr. J. W. Lieb, Jr., general manager of the Edison Electric Illuminating Company, of New York, has been appointed to represent the United States, and full information can be obtained from him.

LITERATURE

UNSERE KENNTNISSE IN DER ELEKTROLYSE UND ELEKTROSYNTHESE ORGANISCHER VERBINDUNGEN. (Our Knowledge of the Electrolysis and Electrosynthesis of Organic Compounds.) By Dr. Walter Loeb. Halle a. S., W. Knapp. 42 pp., 8 vo. Paper. Price, $1.50.

This work gives some interesting information on the progress of electro-chemical investigation in organic chemistry and describes a number of successfully executed electro-syntheses of organic compounds.

KALENDER FUR ELECTROCHEMIKER FUR 1897. With supplement. By Dr. A. Neuburger. Berlin, M. Krayn. 682 pp. Pocket size. Flexible covers. Price, $2.

This compact reference book gives besides the great mass of useful information, tables, formulas, etc., generally contained in such works, a great amount of specific information for the electro-chemist, which is not to be found in any larger work in so compact a form.

Besides the tabulated figures of the resistance and conductivity of solid, liquid or molten bodies, it furnishes calculations for the efficiency of electric central stations, directions for quantitative electro-chemical analysis, and a general treatise on secondary batteries. In connection with the latter it gives a tabulated review of nearly 70 pages of the capacity etc., of the secondary batteries in general use in Germany.

The supplement of 320 pages furnishes complete information as to the suitable arrangement of an electro-chemical laboratory, and a review of the patent laws, of most countries, laws and ordinances regulating the installation of boilers and electric power plants, insurance underwriters' rules, etc.

POCKET HANDBOOK OF USEFUL INFORMATION, PRICE LISTS, ETC.—By Joseph W. Marsh. Pittsburg, 1897. The Standard Underground Cable Co. 182 pp. Pocket size, with flap.

The long expected handbook of the Standard Underground Cable Company is now ready for distribution, and a careful investigation of the material contained between its covers will be time well spent.

The present edition contains 182 pages and is an amplification of the handbook published in 1890 with necessary additions to bring its contents up to date in every respect. From a perusal of the volume it is apparent that the purpose kept in mind in preparing this revised edition has been to give all useful information relating to electric wires and cables, and the installation of the latter, in as brief a form as possible consistent with a proper understanding of the subject discussed, and also to provide convenient rules, tables, etc., for ready reference and for use by practical men.

The first 110 pages contain the price lists of all material sold by the company, with complete descriptions of all such articles in detail, and a handy telegraph code for the use of customers.

The question of electrolysis is thoroughly discussed in an article by the company's electrician, giving the results of actual tests made in the laboratory and in actual commercial practice.

Complete instructions are given for installing all classes of cables and accessories, including conduit laying, cable laying and jointing, application of protective devices, etc. Methods of testing cables, locating faults, etc., are carefully discussed and explained with diagrammatic figures, and will prove valuable to those having such work to do.

The remainder of the book contains many tables of general and electrical information, among them complete data as to the diameter, weight and resistance of solid and stranded copper wire. These are especially accurate, and very complete.

The information on the "Effects of Alternating Currents," and "Changes of Electrical Properties with Change of Temperature," are of particular value at this time.

The general appearance of the book is very satisfactory by reason of the neat binding and the high grade of the typographical work. The volume will make a valuable addition to any technical library and its compact size renders it especially convenient for a pocket handbook.

PERSONAL

MR. N. W. PERRY has a careful historical and critical review of electric railway work in the April Cassier's Magazine, with many illustrations.

MR. G. H. STOCKBRIDGE begins in the April Engineering Magazine a series of articles on epoch making events in electricity. The first is on Volta and the electricity of tension succeeded by that of motion.

MR. A. A. CARY contributes to the Engineering Magazine another installment of his excellent article on boiler water and its purification. We are glad to note that Van Nostrand & Co. announce the appearance of these later in book form, from their house.

MR. ASHLEY W. COLE, recently appointed a member of the New York State Railroad Commission, has now been elected its chairman.

DR. S. S. WHEELER, president of the Crocker-Wheeler Electric Company, has returned from his March trip to Bermuda, fully restored in health.

MR. C. W. PRICE, editor of the Electrical Review, who went recently to the West Indies to shake off lingering traces of the grip, has returned home looking as though he had accomplished his purpose very successfully.

MR. MARTIN INSULL, of Sargent & Lundy, Chicago, has been in the East on professional work.

MR. G. F. NOXON, representing the Mayrhofer Electric Stage Lighting Company, has sailed for England, to put in the electrical effects for the play, "Shaft No. 2," which is to be produced at the Imperial Theatre, Newcastle.

MR. H. B. SWEET, lately of the Memphis (Tenn.) Electric Light and Power Company for some three years, has been appointed electrician for the Utica Electric Light Company, of Utica, N. Y.

MR. W. F. HAM has been appointed secretary of the Nassau Electric Railroad Company, of Brooklyn, N. Y.

COUNT ALEXANDER HADIK DE FUTAK, a gentleman hitherto unknown to fame, will, it is announced by the New York Press, "return to this city in June and go into business with Dr. Tesla."

MR. GARDINER C. SIMS, who has been staying at Lakewood, N. J., was in New York last week looking much better in health. He is still lame, however, from his accident.

LEGAL NOTES

INCANDESCENT LAMP LITIGATION.

The Westinghouse Company informs us that it has brought the following suits under its incandescent electric lamp patents against parties who have refused to take licenses: The Beacon Lamp Company, under the Stanley & Thompson patent, for process of manufacturing silk filaments; the Globe Electric Lamp Company, under the Weston tamadine or cellulose filament patent; the Warren Electric Specialty Company, under the Weston tamadine or cellulose filament patent; also under the Packard pump patent, and the Maxim patent for automatic cut-out used in the treating apparatus. The suit which was brought against the Davis Electrical Works is to be discontinued, as that company has now taken license.

MINNESOTA LICENSE LAW FOR ELECTRICIANS.

The substitute for H. F. 731, introduced by the committee on municipal legislation of the Minnesota Legislature, reads as follows:

Section 1. It shall be unlawful for any company, firm, corporation or individual, in a city of this State having a population of over 50,000 to install or repair any electrical wire or device for the transmission of electrical currents for arc or incandescent lighting, house annunciators, burglar alarms, telephone or telegraph systems, messenger call services, lighting fixtures, or other electrical apparatus, unless first licensed so to do by the city council of such city.

Sec. 2. The city councils of all such cities are hereby authorized and empowered to grant such licenses, and to require bonds from the licensees for the faithful performance of their duties.

Sec. 3. Any company, firm, corporation or individual who shall violate any of the provisions of this act shall be deemed guilty of a misdemeanor and, upon conviction thereof, shall be punished by a fine of not more than $500 or by imprisonment not more than six months in the discretion of the court.

SERVITUDE OF STREET RAILWAYS—A CONNECTICUT DECISION IN THEIR FAVOR.

THE Connecticut Supreme Court, after several months of deliberation, has decided the case of the Canastota Knife Company against the Newington Tramway Company, involving the question of the additional servitude of the trolley roads on highways as entitling the abutting landowner to damages. Two of the judges, Chief Justice Andrews and Judge Hamersly, hold unqualifiedly that the trolley road is an additional servitude. Three of the judges, Baldwin, Fenn, and Torrance, held in effect that the trolley road is not in itself an additional servitude but may become such by abuse. The effect of the decision, apparently, is to compel the landowner to prove such exceptional abuse before obtaining damages; and practically the decision seems a victory for the trolley companies, though the result is somewhat indecisive, and the main question was not squarely met by the court.

It is stated that the principle on which the court divided was the question of the priority of private rights on the Connecticut highways, the two judges who favored the trolley servitude, holding to the antecedent and fundamental character of such private rights, while the three other judges held that public and private rights are equal.

The question of the additional servitude has a number of times been raised during the last few years before the Supreme Court of Connecticut, but each time the decision has been evaded. The only previous decisions date back for about a third of a century. They are two in number. In the first the Supreme Court held that a steam road was an additional servitude on the highway, and in the second case a Supreme Court judge, sitting in a lower tribunal, denied the additional servitude of a horse railway. Up to the decision just rendered the Supreme Court of Connecticut has not passed, as a body, on the question of servitude in connection with a street railway.

THE ROOSEVELT TELEPHONE SWITCH PATENT DEFEATED.

Judge Grosscup, in the U. S. Circuit Court at Chicago, on April 5, decided against the Roosevelt patent, in the suit between the Western Telephone Construction Co. and the Western Electric Co., dismissing the bill of the latter company for want of equity. This patent, No. 215,837, was granted to H. L. Roosevelt May 27, 1879, and covered broadly the gravity switch telephone patents, viz., those in which the relations and conditions of the circuits are changed through the action of the weight of the receiver, when on its support, against a spring. The circuit is in one condition, open or closed, as the case may be, when the telephone has been taken off its hook, and in another condition when it has been hung up again. The patent had eight strong claims. The normal expiration of this patent is understood to have been May 27, 1896, but there are many others subsidiary to it.

WESTERN UNION TELEPHONE ROYALTIES IN THE U. S. SUPREME COURT.

At Washington, on April 12, the Supreme Court of the United States denied the petition for a writ of certiorari in the case of the American Bell Telephone Company vs. the Western Union Telegraph Company, to compel the Circuit Court of Appeals for the first circuit to certify the case to the Supreme Court. The case involves the question of royalties claimed from the Bell Company by the Western Union Company and was originally brought in the Circuit Court for the district of Massachusetts, to secure an account of these royalties. It is alleged that about $5,000,000 is involved, though that seems an extreme amount.

After instituting the suit the Western Union sought to have it dismissed, and after it was dismissed the Bell Company appealed to the Circuit Court of Appeals, when the decision of the Circuit Court was reversed.

The Western Union Company sought to have the case reviewed by the Supreme Court, but the opinion rendered denies this petition. This has the effect of taking the case back to the Circuit Court for further proceedings in accordance with the decision of the Circuit Court of Appeals.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 30, 1897.

Alarms and Signals:—

ELECTRICALLY CONTROLLED RAILWAY SIGNAL. F. McBrien, Newark, N. J., 579,929. Filed Sept. 3, 1896.

The signals are controlled by track circuits alone.

SIGNALING. J. G. Schreuder, Edgewood Park, and J. P. Coleman, Swissvale, Pa., 579,933. Filed Aug. 26, 1896.

Means whereby signals may be operated by operator or automatically by train movements.

Batteries, Primary:—

ELECTRICAL GENERATOR. S. V. Essick, Yonkers, N. Y., 579,707. Filed May 14, 1896.

For description see last issue.

BATTERY COVER. H. J. Brewer, New York, 579,916. Filed Oct. 2, 1896.

Means for removing the cover from the jar, and also for taking out a battery element which is supported by the cover.

Batteries, Secondary:

MOLD FOR MANUFACTURING SECONDARY BATTERY PLATES. F. King, London, England, 579,877. Filed April 10, 1896.

Details of construction.

Conductors, Conduits and Insulators:—

INSULATOR AND HOLDER FOR ELECTRIC RAILWAYS. W. C. Keithly, San Francisco, Cal., 579,725. Filed Nov. 27, 1896.

Means for securing the insulator within a protecting cap and removably locking it thereto, and suspending the whole device from the posts.

SUBWAY JUNCTION BOX. G. C. Deake and G. N. Moore, New York, 579,864. Filed June 30, 1896.

A subway box having an inner lower water-tight cover, loose top cover, and a duplex gas-relief valve in the lower cover, the valve adapted to first open a vent into a valve chamber, and later open the vent from the chamber.

Distribution:—

MULTIPLE SERIES SYSTEM OF ELECTRICAL DISTRIBUTION. —F. B. Badt, Chicago, Ill., 579,556. Filed Jan. 25, 1897.

Comprises a generator from which the main conductors only are led, and electromagnetic means adapted to respond upon'a variation in potential between a compensating and a main conductor to reduce the electromotive force of the generator.

Electro-Metallurgy:—

APPARATUS FOR HEATING BLOOMS OR OTHER ARTICLES OF METAL. A. J. Moxham, Johnstown, Pa., 579,597. Filed Nov. 4, 1890.

Consists in directly surrounding the article to be treated by a conductor adapted to carry the electric current.

PROCESS OF TREATING AURIFEROUS AND ARGENTIFEROUS ORES. J. H. Haycraft, Adelaide, South Australia, 579,872. Filed Sept. 29, 1894.

Process of extracting gold and silver from finely divided auriferous and argentiferous ores.

Measurement:

ELECTRIC METER. G. Hookham, Birmingham, England, 579,582. Filed Sept. 18, 1896.

For continuous currents.

Miscellaneous:—

METHOD OF OVERCOMING ELECTRIC PHENOMENA IN GOODS, ETC. B. W. Child, Boston, Mass., 579,738. Filed July 26, 1893.

Means for rendering normal the electric condition of paper, consisting in directing upon it a current of atmospheric air and bringing into close proximity with the surface of the material, electric conductors.

ELECTRICAL GOVERNOR FOR MARINE ENGINES. G. A. Tower, Richmond, Va., 579,780. Filed March 18, 1896.

Details of construction.

MOTOR PROPELLED VEHICLE. H. G. Morris and P. G. Salom, Philadelphia, Pa., 579,890. Filed June 20, 1896.

Employs two electric motors so mounted side by side on the axle that the two driving wheels are independently driven.

ELECTRIC HEATER. W. R. Smith, Manchester, N. H., 579,611. Filed June 11, 1896.

Employs an electrical resistance composed of a single jointless piece disposed in two helices of opposite pitch.

REFLECTOR FOR FOCUSING CATHODE RAYS. R. M. Russell, Birmingham, Ala., 579,808. Filed Sept. 15, 1896.

Consists of the outer concavo-convex shell of lead and an inner shell of tin.

Railways and Appliances:—

TROLLEY WHEEL FRAME FOR TROLLEY CARS. W. Grunow, Jr., Bridgeport, Conn., 579,576. Filed May 8, 1896.

A tangential trolley wheel frame adapted to be connected with the trucks of a car.

TROLLEY SYSTEM. W. H. Walker, Pittsburg, Pa., 579,728. Filed June 26, 1896.

Details of construction.

ELECTRIC RAILWAY. F. Mansfield, New York, 579,759. Filed Aug. 4, 1893.

Comprises a car having double trucks, a contact device suspended therefrom, consisting of a short conducting bar supported horizontally beneath and between the axles of each truck, and an intermediate conducting bar hinged between the short bars.

ELECTRIC RAILWAY. F. Mansfield, Philadelphia, Pa., 579,760. Filed Aug. 13, 1895.

Contact device for third-rail system.

Switches, Cut-Outs, Etc.:—

SWITCH BOX FOR FLUSH SWITCHES. J. W. Poole, Chelsea, Mass., 579,894. Filed Dec. 28, 1895.

Details of construction.

Telegraphs:—

TELEGRAPH TRANSMITTER. C. L. Buckingham, New York, and J. Gardam, Brooklyn, N. Y., 579,633. Filed Sept. 2, 1896.

Comprises a motor, a train of gear, circuit controlling apparatus for directing suitable signals to line, a phonic governor, consisting of a toothed wheel connected to and driven by the train of gear, and a tuning fork spring, whose vibration is maintained by the teeth of the wheel.

PRINTING TELEGRAPH. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 579,634. Filed Aug. 28, 1896.

Comprises a stationary support having circumferential grooves, inclined grooves, gear wheel, feed wheel, an escapement wheel and a train of gearing for positively connecting the wheels togther.

PRINTING TELEGRAPH. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 579,635. Filed Sept. 3, 1896.

Similar to above.

PRINTING TELEGRAPH. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 579,635. Filed Sept. 3, 1896.

Similar to above.

PRINTING TELEGRAPH. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 579,636. Filed Jan. 5, 1897.

Similar to above.

STOCK PRINTER. F. A. Graham, New York, 579,676. Filed March 11, 1896.

Comprises a single belt provided with printing characters, a series of paper strips, and electromagnetic mechanism for causing an impression to be made upon any one of the series of strips.

Telephones:—

MICROPHONE. A. W. S. Davis, Lowell, Mass., 579,699. Filed April 30, 1896.

Consists of a casing having a central aperture and a transverse groove, and a diaphragm, a button, an adusting screw for the button and a covered flat spring lying in the groove, for supporting tthe button.

MOUTHPIECE FOR TELEPHONES. C. L. Cohn, Boston, Mass., and M. Martin, Malden, Mass., 579,790. Filed Dec. 11, 1896.

Embodies a frusto-conical mouthpiece lining, comprising a liquid-proof external section, and an absorbent inner section secured to the interior of the outer section.

THE STOCK MARKET

LITTLE ADVANCE IN THE BUSINESS SITUATION.

Plague in Asia, war in Europe and floods in America present a trinity of adverse conditions, and the need of a Mark Tapley spirit is much manifest in these days. Still, things in trade and industry do hold their own with remarkable firmness. Business failures remain at the lower level already noted, bank clearings show a gain of 20 per cent. over the corresponding week in 1896, and gross railway earnings are larger for the first time since July last year. Seeing that tariff uncertainty ties up many wheels, this is an obviously good retrun.

Western Union on sales of 19,025 shares rose from 79¾ to 81½; and General Electric on sales of only 2,100 hovered around 31 and 32. American Bell Telephone declined from 222 to 218½.

REPORTS OF COMPANIES

GENERAL ELECTRIC BALANCE SHEET.

The General Electric Company has filed this abridged balance sheet as of Jan. 31, 1897:

ASSETS.	
Buildings	$444,437
Cash and debts receivable	10,176,755
Merchandise, etc.	3,988,757
Patent rights	8,000,000
Debenture in treasury	512,132
Miscellaneous	11,787,681
Profit and loss deficit	12,697,685
Total	$47,607,448
LIABILITIES.	
Capital stock	$34,712,000
Debts and reserve	12,895,448
Total	$47,607,448

The General Electric's profit and loss deficit of $12,697,685 compares with $13,917,071 Jan. 31, 1896; $14,794,716 in 1895, and $12,454,967 in 1894.

TRADE NOTES & NOVELTIES

THE NEW POWER WHEEL—THE CAZIN WATER AND STEAM WHEEL.

THE subject of the utilization of water power, which is becoming of such importance, and which might be said to be still in its infancy, so far as this country is concerned, has received additional matter in the shape of a pamphlet just distributed among civil, mechanical, and electrical engineers, generally throughout the United States, by the American Impulse-Wheel Company of New York.

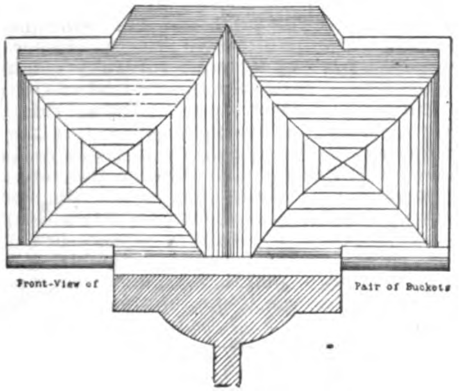


FIG. 1.

The invention described in the publication referred to, is a wheel of the free jet or percussion type (operated by either steam or water) which is claimed to go beyond anything of the sort hitherto known to the mechanical world, in developing maximum efficiency of the motive power.

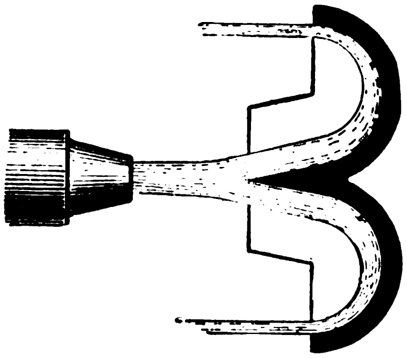


FIG. 2.

It is an established fact in hydraulics that the jet of water must be completely inverted by the vane or bucket of a wheel, traveling at half the velocity of the jet, in order to obtain the best results in transmitting the inherent power of the jet. It is unnecessary to quote authorities in support of this theorem, but it is of interest to note the claims of this new wheel company in complying therewith. The accompanying engravings indicate more clearly than verbal explanations the basis for the assertion, that the wheel actually performs the work theoretically required.

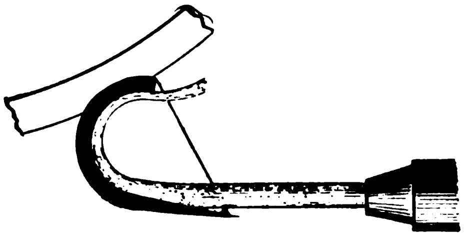


FIG. 3.

Fig. 1 shows a front view of a pair of buckets in which the curves of the receiving lip and vanes are indicated by the shaded lines.

Figs. 2, 3 and 4 show sections of the vanes showing not only the true curves but also the course of the jet in contact therewith.

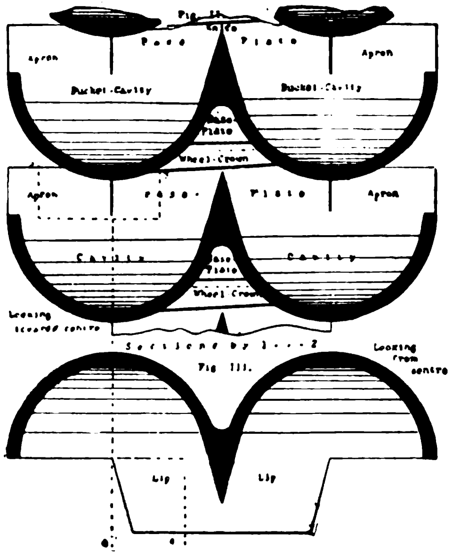


FIG. 4.

Fig. 5 finally shows the positions of the vanes on the wheel crown and also the diagonal nozzle tip intended to provide against loss of power between the time the jet leaves the nozzle and contact with the buckets.

These diagrams show the pertinent facts of the merits of the device, and it is claimed and demonstrated, in the pamphlet referred to, that the jet is not only inverted while the bucket is in its best positon relative to the jet, but also completely and permanently in all positions taken by the bucket while receiving the jet impact—a necessary condition to highest efficiency frequently overlooked by wheel manufacturers. In addition to these brief items, the book contains considerable information relating to power calculations, hydraulics, water rights and other matters, part of which has appeared in the Journal of the Franklin Institute and various engineering publications. The invention is covered by patent rights issued to F. M. F. Cazin, inventor, and is offered for sale by the American Impulse-Wheel Company, 120-122 Liberty street, New York, who will furnish copies of the book upon application.

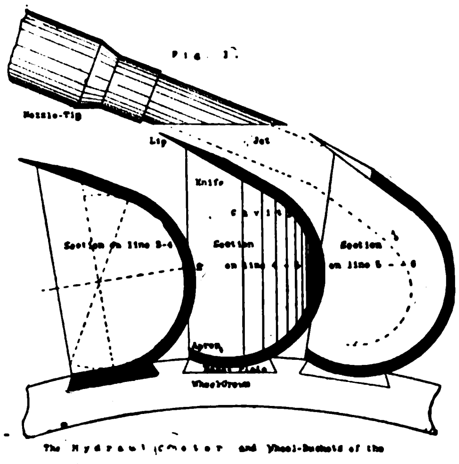


FIG. 5.

A CORRECTION.—An error was made in our notice of a pole sale made by S. C. Strock, New York, to the American Telephone and Telegraph Company. Instead of 3,000 poles, Mr. Strock informs us that the sale comprised no fewer than 8,000 poles, and that the lengths were from 25 to 55 feet. This in itself makes the transaction a decided record breaker in manufactured yellow pine poles. If a larger order has been given lately, we would like to note it.

THE NEW YORK DYNAMO AND MOTOR CO.

This active young concern, under the management of the enterprising Mr. A. Farina, has secured the New York agency of Messrs. Roth Bros. & Company, of Chicago, who manufacture a complete line of motors, dynamos and fan outfits. The fan motors are well designed, mechanically and electrically. The fields are of wrought iron and all parts of the field and armature coils are readily accessible. The bearings are self-oiling and do not "throw" or drip oil.

The company make a specialty of designing isolated plants for private installations for city or country use. The offices of the New York Dynamo and Motor Company are at 257 Broadway.

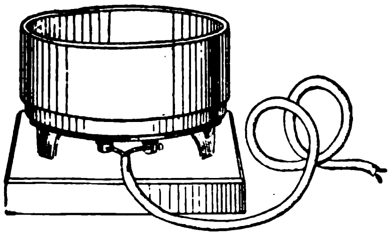
COLUMBIA INCANDESCENT LAMPS.

IT gives us pleasure to announce that Mr. R. B. Corey has recently taken charge of the sale of the Columbia incandescent lamp in the eastern territory, in addition to his other electrical lines, with offices in the Havermeyer Building, New York. Mr. Oscar Hoppe, New York manager of the Columbia Company during the past year, is associated with Mr. Corey.

The Columbia Company have just issued a circular describing their different styles of street railway lamps. A feature of their new railway lamp is the double coil filament without an anchor. Practice has shown that the filament in this lamp does not droop and come in contact with the glass, and that the lamps give very satisfactory service and a beautiful light.

The company also manufacture a round bulb lamp which is now in extensive use on street railways, for head lights. This lamp consumes the same amount of energy as the lamps in the cars, so that it can be used in series with them. This lamp is also admirably adapted for decorative illumination in cars used by trolley parties. It is furnished either plain, frosted, or colored. The bulb of this lamp is round and a trifle over two inches in diameter, setting directly into the base, without a neck. This construction gives it great strength and compactness.

ELECTRIC SOLDERING POTS.



The American Electric Heating Corporation, of Boston, announce as ready for market electric solder pots in two sizes, one to hold four pounds using 1¾ amperes at 110 volts; a larger size holds ten pounds. They are easily portable and are by far the best device for this work ever offered. It is clear that neither gas nor gasoline heated pots can compare with them for cleanliness, convenience or close regulation of temperature. These pots are especially useful in electrical repair shops for tinning wire and similar uses. They are fully guaranteed.

FERRACUTE DIES AND PRESSES FOR ASIA,

A remarkable example of the promptness with which many branches of American industry are capable of responding to the new developments in export trade is afforded in the factory of the Ferracute Machine Company, of Bridgeton, N. J. A few days ago, a number of the officials of the Philadelphia mint, and other engineering experts, were invited by Mr. Oberlin Smith, the president and engineer of the company, to inspect a notable consignment of presses, dies and other apparatus which have been ordered by an Asiatic government. This machinery is intended to supersede European appliances, which have hitherto been the only ones virtually available. The foreign trade of which this order is a noteworthy evidence, has sprung up within the last twelve months, during which the Ferracute Company has received commissions from many distant corporations, mostly in Europe. The specialty of this company is cutting, stamping, embossing and coining presses. It is now doing a great deal of electrical work. Among its recent orders were a number of presses for stamping armature plates, for the General Electric Company. Similar presses have been sent to Berlin and Buda-Pesth. Some of these presses weigh 15,000 or 16,000 pounds. The larger sizes are capable of stamping armature plates of five and six feet diameter. All these machines have been designed by Mr. Oberlin Smith, whose name, for many years, has been a household word in engineering circles. Bridgeton, where the works of the Ferracute Machine Company are located, is a lively manufacturing city of some 13,000 inhabitants, in the "wilds" of New Jersey, 38 miles south of Philadelphia.

FOSTORIA INCANDESCENT LAMP CO.

The announcement was made recently of the formation of the Fostoria, O., Incandescent Lamp Company. The capital is $50,000, all of which is paid in by the subscribers. The directors are: J. B. Crouse, Rosswell Crocker, H. A. Tremaine, B. G. Tremainé, and Ira Cadwallader, each of whom subscribed for $10,000 of stock. The officers are: J. B. Crouse, president; Rosswell Crocker, vice-president; H. A. Tremaine, secretary and treasurer. It will be noted that the men prominent in the enterprise are those so well known in connection with the Crouse-Tremaine Carbon Company, the manufacturers of electric light and other carbons at Fostoria.

THE PAINT FOR 1897.

Prof. Spennhath, Director of the Technical School of Aix-la-Chapelle, lately won the $2,000 prize offered by the Society for the Advancement of the Industrial Arts for the best essay on Protective Paints. The prize was not won simply by theoretical demonstrations, although the professor furnished scientific reasons also, but by most carefully conducted practical experiments with various pigments and oils, covering several years' time. The results demonstrated that a properly made paint of graphite and boiled linseed oil is the most suitable for protecting structural iron work, roofs, etc., exposed to the destructive agencies of heat, cold, storms, etc.

Running parallel with these results are the facts demonstrated by those who have used Dixon's Silica Graphite Paint during the past 30 years. Roofs and iron work properly painted with Dixon's paint have not required repainting in 15 to 20 years. As the season for painting is now close at hand it may pay those interested to write to the Joseph Dixon Crucible Company, Jersey City, N. J., for circulars.

ENCLOSED ARCS IN FRANCE.

The United States has always held a high place in the world's record of practical inventions, and the success of the enclosed arc lamp here, followed by its adoption in France after the lecture of Prof. Louis B. Marks, before the Société Internationale des Electriciens in Paris, on January 20, 1897, is another feather in the eagle's wing of ingenuity and progress. We understand that whilst at first the new system was viewed with incredulity and indifference, a total change came over th French scientific world after the explanations and demonsrations of the lecture above referred to, which has appeared in full in our columns. We congratulate Mr. Marks on his phenomenal success.

CASTINGS FOR THE BERLIN, CONN., POWER PLANT.

The Sessions Foundry Company, Bristol, Conn., have recently made nearly all the castings for two large engines for the Berlin power house for running cars by electricity on the steam railroad track from New Britain to Hartford and other points; and among the other castings were two heavy balance wheels weighing complete and finished 50 tons each. The Sessions Company cast each wheel in two sections, making each casting about 26 tons each; and they have facilities for making even larger castings than that.

NEW RAILS FOR THE B. & O.

The recent purchase of 58,000 tons of 80 lb. steel rails by the receivers of the Baltimore and Ohio Railroad Co. at a cost of about $1,000,000 is another evidence that Messrs. Cowen and Murray intend placing the B. & O. in first-class physical condition. It is understood that these rails will be placed in the track as soon as possible, and that by fall the tracks between Baltimore and the Ohio River will practically be entirely relaid with new steel and new oak ties. As fast as the old rail is taken up it will be relaid on the less important branches, or used in extending much needed side tracks.

LALLY'S ELECTRIC LIGHTER FOR FIRE ENGINES.

John T. Lally, of Wilmington, Del., has invented an electric lighter which has been placed in the engine house of the Reliance Fire Company. The lighter is fastened to the floor about 18 inches in front of the engine and as the engine strikes the lever the electric spark lights the gas which throws a flame to the height of 14 inches and about 4 inches in width, so as to light the kindling in the engine. There is no waste of gas. The arrangement is very complete. The lighter and the box that contains the springs which open and close the valves controlling the supply of gas are handsomely nickel-plated.

THE BANGOR ELECTRIC CLOCK COMPANY is being organized at Bangor, Me., with Gen. Joseph S. Smith as general manager. One of its clocks is the invention of W. J Dudley and is said to run three years without attention.

NEW YORK NOTES.

AMERICAN WAX AND PAPER COMPANY, 199 Franklin street, New York, have recently received two carloads of pure ozokerite which they are now offering to the electrical trade at reasonable figures.

BAYSHORE, L. I., is to have an entirely new electric lighting plant. Messrs. Osterberg & Sutton, who are the consulting engineers for the company, have sent out plans and specifications. The 2,000 volt single phase system will be used, and the streets of Bay Shore will be lighted up by about May 15 for the first time in several years.

MR. T. E. HUGHES will hereafter represent in New York the wire department of the Standard Underground Cable Co., as distinguished from its cable business, the growth of its trade necessitating bifurcation. Mr. G. L. Wiley informs us that April 20 the company will move to Rooms 506-8-10, in the Telephone Building, 18 Cortlandt street.

THE STANDARD OIL COMPANY are about to erect at Bayonne, N. J., a boiler shop 300 feet long and 105 feet wide. The main portion of the shop is divided into three bays. The central bay, about 50 feet wide, is served with a 15-ton electric crane supported on heavy girders about 40 feet above the floor. On either side of this main portion is a wing about 30 feet wide. The walls of the building are brick and the supporting frame work is steel. The roofs are to be covered with corrugated iron. The main columns of the shop are 25 feet apart and all arranged so that jib cranes of suitable size and capacity can be attached at any point, which, together with the traveling crane in the center, will enable them to cover the entire floor surface of the building. One end of the building for a distance of about 75 feet in length is supported by clear span trusses which gives a clear floor space over this entire area. The steel work was designed and will be erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

THE CONDUIT WIRING CO., 12 West Twenty-ninth street, has gone out of business and has transferred its operations to Davis & Brussel.

ELECTRIC CARRIAGE AND WAGON COMPANY is now licensed to operate twelve storage cabs and hansoms, and now has six in service. Its stables are in West Thirty-ninth street, off Broadway.

THE IMPERIAL ELECTRIC COMPANY, 140 Washington street, and the M. & M. Co., of same address, have combined their interests. The business will be continued under the firm name of the Imperial Electric Company.

J. W. FERGUSON, 253 Broadway, general contractor, is building the new plant of the Edison Electric Illuminating Company, of Brooklyn. The foundation is already started and, it is expected, will be completed by him about August 1. This plant is to be the main station of the company on Long Island. Mr. Ferguson has been identified for a number of years in the electrical trade as a general contractor for the building of power plants, factories, mills, shops, etc. A few of the plants built by him are the Edison Electric Illuminating Company, Paterson, N. J.; the Bergen County Traction Company, Fort Lee, N. J.; the Steinway Railway Company, Astoria, L. I.

JAMES L. ROBERTSON & SONS, 204 Fulton street, New York, have brought out a new edition of their excellent catalogue as to their Robertson-Thompson indicators, and other instruments. It also includes descriptions illustrated and in detail as to their Hine eliminator, Robertson pump governor, live steam separator, exhaust oil extractor, shaking and dumping grate bars, exhaust pipe head, waste oil filter, Kellam's steam damper regulator, safety water columns, and other necessary apparatus for central stations and isolated plants. It is a very useful catalogue for all steam users to have around the house.

CLIMAX BOILERS.—The Clonbrock Steam Boiler Company, Brooklyn, N. Y., have issued an admirable catalogue in regard to their boiler. It is in effect a handsome book and a manual of steam data, full of useful information, and contains in addition a number of views and other details illustrative of the numerous electrical and other plants in which their celebrated vertical boilers have been installed. A copy will be sent to any address on application.

ELMER P. MORRIS has removed his office to the Smith building, 15 Cortlandt street, New York, where he will be pleased to see his friends. Mr. Morris is manufacturers' agent for several well-known concerns and is in excellent shape to furnish at short notice anything in the line of arc lamps, measuring instruments, railway specialties, and general electric supplies.

WESTERN NOTES

THE ELECTRIC APPLIANCE COMPANY report that they are rapidly closing agency arrangements in different parts of the country for their 1897 line of fan motors and ceiling fans. They are offering a full line of direct and alternating fan motors, and also a full line of direct and alternating current ceiling fans, and are prepared to offer attractive arrangements to good live agents.

THE CENTRAL ELECTRIC COMPANY is carrying in its Chicago stock a complete line of snap, flush and push switches of the following makes: Hart, Perkins, Xntric, Stevens and C. S., and is prepared to furnish these goods made up in gangs with any particular finish, to match special hardware. This company is publishing a four-page folder price list of the Stevens push button switches, which it states will be gladly mailed to any one in the business, upon receipt of a communication requesting the same.

WEBSTER CHEMICAL COMPANY, 400 Sibley street, St. Paul, Minn., are selling a crystal chemical coloring for incandescent lamps, which costs but little and of which the users speak in the highest terms. One pint will color 300 lamps and give them a brilliant, durable, clear color. They will be glad to hear from those who need colors of any hue.

J. H. SIEGRIST, JR. COMPANY, 13 Laclede Building, St. Louis, who have placed 197 of the "Ideal" automatic engines in St. Louis, have now taken the agency for the new "National" electric apparatus, both alternating and direct current, direct connected and belted to handle in connection with the above engines. As a "starter," they have sold a 50-kilowatt "National" direct connected generator and 13-in. x 12-in. "Ideal" engine to the Koken Iron Works, St. Louis, to be used for running motors on the machine tools to be installed in their new shops. The above company have been in the engine business since 1886, and are well and favorably known among the prominent steam users of the West.

THE METROPOLITAN ELECTRIC COMPANY are sending out to the trade a comprehensive catalogue covering electrical and combination fixtures which they manufacture. This catalogue is complete in every detail, and a great many of the fixtures are now shown to the public for the first time.

THE WESTERN ELECTRIC COMPANY have just issued an illustrated booklet of their various types of 1897 fan motors. The matter is very descriptive; full details of the different styles of fans which they manufacture, are given as well as the prices. This little book is gotten up in a most tasteful manner with a green paper cover on which is shown a cut of one of their newest desk fans printed in gold relief. The interior is also a very creditable specimen of the printer's art, the reading matter being set up in red and black type; and the handsome half-tone cuts which are also shown serve to add to the attractive appearance, and usefulness of the publication.

AMERICAN ELECTRIC TELEPHONE COMPANY, hitherto of Kokomo, Ind., should now be addressed at 171-173 South Canal street, Chicago, where they have now established their office and factory with increased facilities and first-class modern appointments.

KINLOCH TELEPHONE COMPANY, St. Louis, Mo., claims to have 4,000 prospective subscribers under contract and is now busily engaged laying its conduits.

CHAS. E. GREGORY COMPANY, Chicago, announce that owing to the constant increase of work in their repair department, they found it necessary to have larger space, and have secured commodious quarters at 47-53 South Jefferson street, beside their old stand, where they have an equipment suitable for turning out work promptly. The additional space which has been acquired will supply a long-needed want of room for suitably displaying and handling their large stock of machinery, apparatus and general electrical goods.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Iowa, report that business has begun picking up with springlike activity and sales for the first three months of this year are over double those of last year. Orders are coming in from all parts of the United States, as well as from foreign countries. Many of the largest street railways and central stations, have adopted Garton arresters and will use no other. The company consider prospects as brighter than ever before, and very encouraging for a steady good trade.

THE DEARBORN ELECTRIC COMPANY, Chicago, have removed from their old quarters at 19 Quincy street, to 330 Dearborn street, where they have fitted up a very nice office and store. Since the reorganization of this company a few months ago, and the infusion of new blood into the concern in the persons of Messrs. Charles Messer and A. W. Dee, the business of the concern has shown quite a healthy increase, and its energetic managers are very hopeful of being able to secure a good share of the electrical supply trade in the near future. They report that they have had some very nice orders for Dearborn long-distance telephones, in addition to regular electical supplies. This company has also got the agency for New England switches, which are meeting with considerable favor in the Western territory.

PHILADELPHIA NOTES

A. W. FRANCE, Tacony, Pa., reports having received an order from Sayre & Fisher Co., Sayreville, N. J., for a large alternating and 500-volt direct current switchboard, to be equipped with his patent non-arcing switches; also one from the Suburban Electric Company of Tacony, Philadelphia, for an 8-circuit board for the 2,200-volt alternators to be equipped with non-arcing switches. The Suburban Company made a very thorough test with these switches before placing their order, shifting very heavy loads from one machine to another, without a sign of an arc. They have pulled the switches on dead short circuits without a spark. He is also very busy filling orders for fuse boxes and grease cups, the demand being so great that the factory is kept running day and night.

PHOSPHOR-BRONZE SMELTING COMPANY, LTD., 2200 Washington avenue, Philadelphia, have issued a new brochure with regard to their excellent Delta metal, an alloy of copper, made in various relations of combined qualities in adjustment to the demands of different characters of work. There are many uses for it in the electrical field.

THE SAWYER ELECTRIC COMPANY, Lippincott building, Philadelphia, have taken the agency for Eastern Pennsylvania of the Royal alternator, built by the Royal Electric Company of Peoria, Ill.

CUTTER ELECTRIC AND MFG. CO., of Philadelphia, have appointed Mr. A. D. Chandler, of 1114 the Marquette Building, Chicago, Western agent for their well-known make of switches and circuit breakers. Mr. H. B. Cutter, president of the company, made quite a prolonged visit to Chicago while completing the new arrangements for conducting the Western agency of his company, and at the same time had an opportunity of meeting some of his many friends who reside in that city.

KEYSTONE ELECTRIC INSULATION COMPANY, of Philadelphia, find that they are enjoying a large increase of business in New York City and need better facilities in that region. They have therefore secured a suite of offices in the Smith Building, 15 Cortlandt street, where they will be glad to see friends and show samples. Their interests at that place will be represented by the ever energetic Elmer P. Morris.

NEW ENGLAND NOTES

THE BOSTON ELECTRODUCT COMPANY is, it is stated, building a new factory at Versailles, near Pittsburg. The main building will be 122 by 43 feet.

NATIONAL RUBBER COMPANY, Bristol, R. I., request that in future all communications in regard to general office business be addressed to W. De F. Brown, secretary, Bristol, R. I.

ADVERTISERS' HINTS

THE WARD LEONARD ELECTRIC COMPANY, Hoboken, N. J., offer to send on trial (they paying expressage both ways) one of their new type motor-starting rheostats to those requesting it before May 1.

A. L. BOGART, 22 Union Square, New York, advertises frictional machines and a full line of gas lighting supplies.

THE STANLEY ELECTRIC MANUFACTURING COMPANY have removed their Chicago office from 305 Dearborn street, to 1506 Marquette Building, where they will be glad to take care of the Western trade as of old.

THE BURT MANUFACTURING COMPANY, Akron, O., agree to send any prospective buyer one of the Cross oil filters for thirty days' trial in order that it may prove it saves 50 per cent. And if it does not prove it, it may be returned at the company's expense.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., have experienced such a demand for their apparatus as to necessitate running their works day and night.

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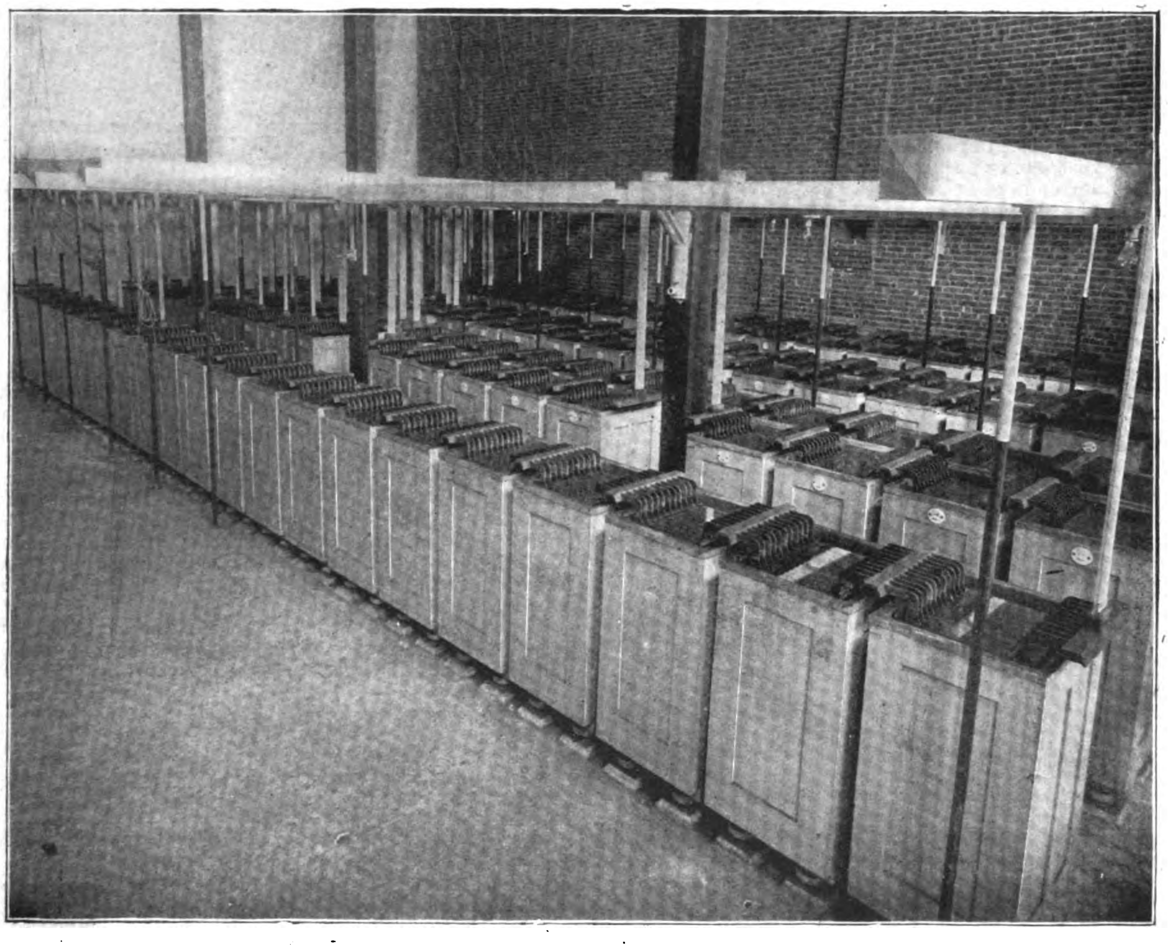
ELECTRIC LIGHTING

THE SCOTIA STREET STORAGE BATTERY STATION OF THE BOSTON EDISON CO.

THE Edison Illuminating Company, of Boston, were one of the very first companies in the United States to install storage batteries as auxiliaries to their generating plant; and to their two battery plants which have been operating for the past few years they have now added a third plant. This latter, known as the Fourth or Scotia street station, is distinguished from its predecessors in that it is purely a battery station and has no generators.



Battery Room in Scotia Street Storage Battery Station, Edison Electric Illuminating Co., Boston, Mass.

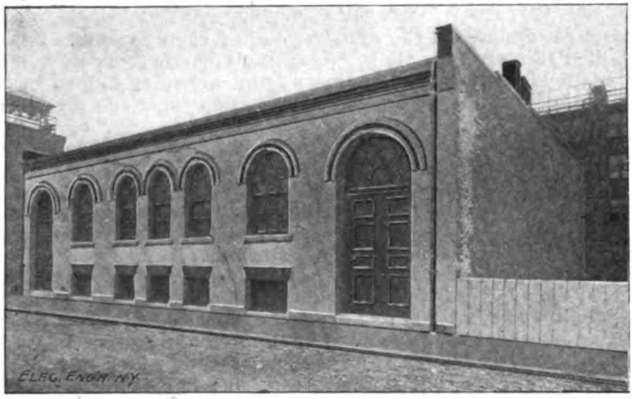
The problem which presented itself was that of supplying light and power two miles from the nearest generating plant. The district supplied by the Fourth station is the Back Bay or fashionable residence district of Boston. It was, of course, impracticable to put in a steam plant in such a district, to say nothing of the poor economy which such a plant would give. The company had been refusing to supply power in the district for several years, because of the variation which it caused in the lights, being so far from the generating station. They also had the problem of extending their system in order to take in customers who were constantly applying for light. The district seemed too far from the generating plant to run new feeders, so that it was finally decided that a storage battery plant would solve the problem in the most satisfactory way, as this would enable the company to take light and power customers on the extreme end of their system. It also enabled them to take their generating current from their most economical station on the water front and also helped to improve the economy of that station by increasing the night load on it.

After deciding upon the battery plant, and foreseeing that this would be the probable future means of extending the system, it was determined to put up a battery plant thoroughly equipped to give the best possible results, but to be put up at a reasonable expense, with a view of determining what would be the cost of constructing such stations.

The station is located a little to one side of the Back Bay district and is 7,000 feet from the First or Head Place station, which, in turn, is 3,800 feet from the Third or Atlantic avenue station on the water front. The Fourth station is, therefore, a trifle over two miles from the generators which charge the battery. The current is sent from the Third station to the First and from there to the Fourth, being generated at a high potential, the same generator charging the First station battery as well as the Fourth and the current being boosted to make up for the drop in potential between the First and the Fourth stations.

The building is of brick, quite plain, covering an area of 60 by 65 feet, the roof being about 25 feet above the floor. The walls are 20 inches thick, so that the building can be run up to any height desired in case a use should develop for upper stories in the shape of apartments or a store house. The roof is placed at such a height that iron work for two more floors can be put in under it. As the battery only takes up half of the space it is possible, by putting in an extra floor, to install a battery of four times the present capacity.

The front of the building is divided off into a room about 12 feet wide and the full width of the building, which is used as a regulating room, the battery occupying the other portion of the building. There are three monitors in the roof for ventilation and there are also three ventilating ducts in each of the side walls. The floor is composed of 12 inches of concrete, with a regular cement finish, it being the company's experience that it is unnecessary to make a battery room floor so that it can be flooded with acid or water, it being a very simple matter to keep acid off the floor.

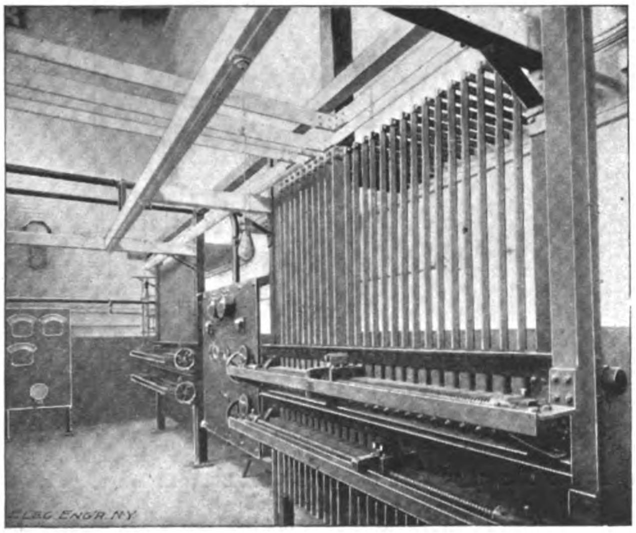


THE SCOTIA STREET STORAGE BATTERY STATION, BOSTON, MASS.

Each cell sets on four petticoat insulators, resting on tiles 6 x 6 inches, bedded in cement on the floor. The battery consists of 140 cells, each consisting of a hard pine tank, 18 x 22 x 38¾ inches, inside measurement, lined with 5-pound lead. The tanks are of ample size to allow plenty of room on both sides of the plates. In each cell there are 10 Manchester positive plates and 11 chloride negative plates. Of the 140 cells, 70 are on each side of the three-wire system. Of the 70, 24 are connected to the regulating switches. The discharge rate of the battery, which was installed by the Electric Storage Battery Co., is as follows:

Rate of Discharge. Amperes.	Capacity of Each Cell. Ampere Hours.
400	3,000
560	2,630
800	2,250
1.600	1,500

The regulating cells are connected to the regulating switches by 3 x ½ inch and 1½ x ½ inch drawn copper bar. The bars are supported on porcelain insulators resting on wooden hangers. The latter are supported from the floor by iron pipes, but so arranged that when the intermediate story is put in, the bars will be supported from the ceiling. There are at present two regulating switches in multiple on each side of the system, so that the batteries can be discharged at two pressures at the same time. The bars, however, are so arranged that two more regulating switches can be put on each side, giving a possibility of discharging at four different pressures. The regulating switches are operated by hand.

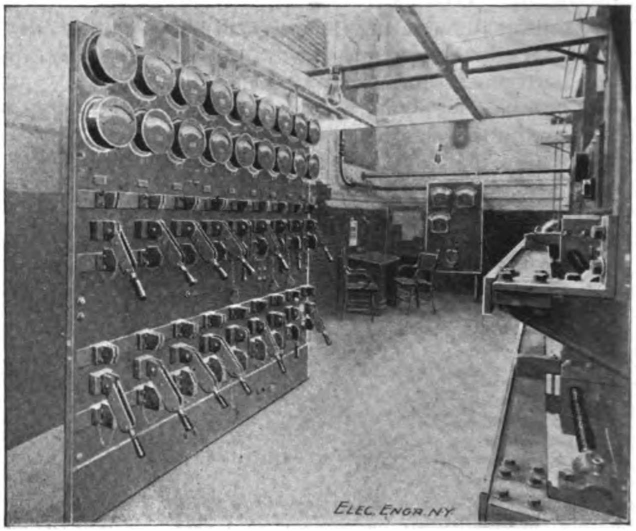


THE CELL REGULATING SWITCHES.

Immediately opposite the regulating switches is the feeder board, which has two brushes on each side of the system, and to the apparatus and feeders are connected two double-throw switches, thus permitting of the connection of any of them to either bus. This switchboard is equipped with round pattern Weston ammeters with composition shunts. The switchboard is of slate, and quite plain.

Between the two regulating switches is a slate regulating board about five feet square, upon which are mounted two Weston round pattern galvanometers with plug switches, two Weston portable voltmeters, reading to three volts, connected to the two circular cell switches, the latter being connected to the 24 regulating cells on each side of the system. On this switchboard are also mounted two booster field regulators.

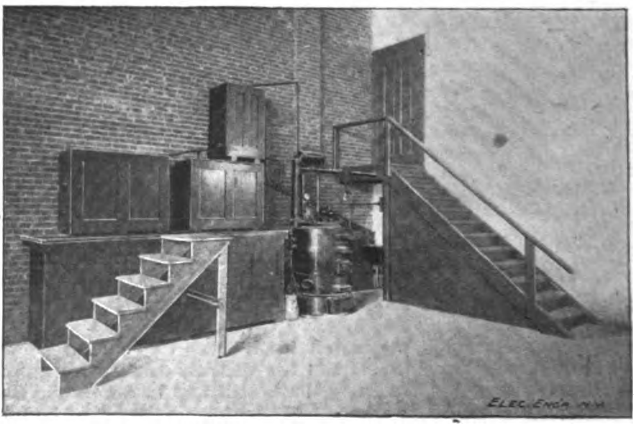
At the end of the room and at right angles to the feeder board and the regulating board is a slate indicator board, on which are mounted four Weston illuminated dial volt meters, a pressure testing switch, connected with all the feeders and busses in the station, and a Bristol recording voltmeter. On the back of this board is a switch controlling the disconnective junction box.



THE MAIN BATTERY SWITCHBOARD.

The booster set in this station is made of four 60 k. w. Edison bi-polar dynamos, the booster armatures having been rewound. On the neutral end of the battery there is an Aron meter on each side of the system and also a single-throw knife blade switch. The cables connecting the various switchboards and the feeder switchboard with the street are run in iron-armored conduit.

The fourth station is connected to the first by a one million circular mils cable feeder, which meets two of the old feeders supplying the district from the first station. At the junction of the new tie line with the old feeders there is a disconnective junction box, so that it is possible to disconnect the outer end of the feeders and make them a portion of the tie line or to supply the feeder ends from the first station or the fourth station, as may be desired. It is also possible, by the use of a booster at the first station to run these feeders from the



THE WATER STILL, SCOTIA STREET STORAGE BATTERY STATION, BOSTON, MASS.

fourth station and at the same time send current back to the first station to help over the maximum load.

Thus far, the working of the station has fulfilled all expectations, and elevators are now being run in some of the large apartment houses without in the least affecting the lighting service. The company are pretty well convinced that it is in this direction that future extensions of the system at a distance from the generating stations will be carried out.

FUSES FOR BRANCH CIRCUITS.

BY S. H. SHARPSTEEN.

THERE is much appearing in the electrical papers in relation to electric wiring, but the writer thinks that there are some points of fundamental importance that have not been touched upon.

The matter of fuse lengths for circuits of about 100 volts entering buildings for incandescent work, has never been considered as it should have been by the fire underwriters. The underwriters' inspectors will enforce many matters of no importance and will allow a small house to be connected by service wires to a circuit from a 300 or 500 light transformer. If the lightning punctures the insulation of the transformer, or if the insulation gets broken down from other causes which are common and happen every day, the house wiring is, or may be, subjected to 1,000 volts or more pressure. A weak place in the insulation of the house wiring gives way, the current goes through to the ground, the fuse blows in the fuse block on the branch, since it cannot be above 6 ampere capacity, and comply with the rules, but the 1,000 volts pressure crosses after the 6 ampere fuse has gone; since the gap will not open a 1,000-volt circuit the branch block burns up and possibly the building is fired before a fuse goes somewhere to relieve the trouble.

Until recently it has been the practice to place a fuse in bracket or fixture just large enough to carry current for the lamps on bracket or fixture. In case of a combination bracket with one 16-candle-power 100-volt electric light, a fuse of 1 ampere capacity would be large enough. If the primary current of 1,000 volts should start through the wiring of this fixture to the ground, its fuse would be very apt to be the first one blown, but the fuse gap would not be sufficiently large to open the 1,000 volt circuit; hence the porcelain would crack and fall to pieces and the wire be set on fire.

If the transformer be 500 light the primary fuse may be all the way from 25 to 40 ampere or even a piece of No. 12 copper wire. It is not absolutely necessary for the transformer insulation to break down since, either by a bare wire drawn across a service wire and 1,000-volt main or by the service wire coming in contact with a 1,000-volt main, the house wiring may get a 1,000-volt current.

The average person will suppose that the main fuse at the entrance block will go on such an occasion, but for a building of 100 lamps the main fuse would have to be at least a 50-ampere, and a 50-ampere fuse would hold for a long time on many of the 1,000-volt circuits where they run for miles and are of pretty small wire.

Many persons engaged in the electrical business may have their doubts as to getting the proper combinations for such trouble but the writer had two cases come under his notice, both in the same house and both cases only a few months apart. The house was the home of J. M. Johnson, Binghamton, N. Y.

In the first case there was evidence to convince one that the mica insulating joint and the insulation of the wire in a bracket had broken down and the rubber-covered wires that came through the porcelain tubes in the plaster were burned up for one and one-half inches into each tube; the arc had burned the tubes away somewhat. The tubes came through lath and plaster and the ends running out into the canopy had been very hot. If the outlets had not been run through porcelain tubes one can imagine what the result would have been as the cross occurred in the night.

Mrs. Johnson complained of smelling rubber burning, but no search was made. There was a black place on the wall about 14 inches in diameter, the horse shoe cut-out was in many pieces and the insulation was almost all off the insulating joint. The writer was the first one to remove the burned canopy and he asked if all the lamps in the house did not refuse to burn the next day, and the answer was, "Yes," and they also said "that another house did not have any light until after the transformer was changed."

The second case occurred in the daytime and was quite amusing. For some reason there was a gas tap in the kitchen outside of a canopy of an electric bracket. The help about the house had been in the habit of hanging some kitchen implement on the gas tap and it seems that the implement while hanging on the gas tap got against the canopy of the electric fixture and the conditions were right to ground the primary circuit of 1,040 volts. The kitchen help on seeing the fire between the gas tap and the bracket ran out in the back yard.

The fuses controlling the various branches were in a closet on the second floor and when the cross occurred one set of fuses went off, but the arc held and roared so that some of the occupants of the house who were on the floor became frightened and ran into the yard to join the others. The transformer was burned out again and another was put in its place. The branch block that was in circuit with the trouble was broken all to pieces and if it had not been on plaster might have set the building on fire. In neither case did the main fuse blow.

The writer has a lamp and socket in which the filament was burned up in the lamp and the socket gear and case are badly burned. This was on a 104-volt circuit and was the cause of trouble either in the transformer or from service wire coming in contact with arc or power circuit.

Not long since the writer called at an electric railway power house and found some men trying to pound a brass bearing off from the armature shaft of an old VanDepoele motor that had been used to drive some iron working machinery. It seems that it had been running the night before when the power house was shut down and was not disconnected from the switchboard. The generator switches had all been thrown but this shop machine had been left connected with bus bar, and bus bar connected with trolley wire and mains.

Some time after midnight the watchman heard this motor running at a tremendous speed and since all the generating machinery in the power house was shut down he concluded that the shop motor had become bewitched, and would not go near it to throw the switch to disconnect it. The result was that it kept on running and it seems that it received its current from an arc wire that had got crossed with the trolley wire and having a good big voltage ran at a tremendous speed. For the want of proper lubrication it got a hot bearing and ceased to go even the next day when it was wanted to run the shop again.

Some electricians, purely theoretical, may wonder where the current from the opposite side of the 1,000-volt circuit is going to get into the ground; this is a good subject for an article of a number of columns. But suffice it to say that in practice if there is a good ground on one leg of a high pressure circuit, the circuit being made up of weather proof wire and being strung for miles in every conceivable direction oftentimes through the leaves on trees, the current will get through on the other side, although the amount might be small. Two amperes is all that is necessary to make serious trouble and the fact that only a few amperes being able to pass might make the trouble all the more serious as the arc would hold longer without some larger fuse blowing of a greater fuse gap. This leakage might occur much easier during a rainy season. It is amusing to hear some insurance inspectors tell how secure they know circuits to be against this kind of trouble.

There is no question that it is a common thing to get the primary current of an alternating system, into house wiring or wiring intended for a pressure of about 100 volts, and since such a thing is liable to happen at almost any time, does it not seem strange that the fire underwriters will allow branch blocks with small gaps to be used? The wires are crossed when they are put into the branch block and when the branch block is cracked to pieces the wires lie one across the other.

The fire underwriters will allow as a rule but a few lamps on one branch circuit distributing current to lamps; for safety from fire each one of these branch circuits should have a pair of fuses long enough to break a current coming from the highest voltage circuit in the city.

PLAIN TALK ON ELECTRIC LIGHT AT GRAND RAPIDS, MICH.

THE Grand Rapids Electric Light Company, through Mr. W. T. Powers, its president, and Mr. J. W. Spooner, its secretary, has issued the following pithy and pertinent appeal to the local public: We desire to offer a few suggestions in regard to a municipal lighting plant, and while we may be accused of being an interested party, we want the citizens of Grand Rapids to understand our position.

We have had several years' experience in lighting the city, and know that the city could not reap any benefit from running their own plant. And at this time, when over 2,500 descriptions of real estate are advertised for sale for taxes in every Wednesday's Herald, it seems a poor time to add anything to the taxes, which are already a burden.

There is a strong competition in the electric lighting business here, and on a long contract the city could obtain a proposition from three different plants, two of them operated by water power. There is also a fourth party that has a very reliable water power within reaching distance, which is ample to give all the power that the city would need for some years to come, and we understand this party would also bid on a long contract, and could afford to do the business at a much lower rate than the city could make lights for, with coal. The claims that have been made that we were anxious to get the city into a corner and charge $150 per light is a pure falsehood, and right here it might not be out of place to let the public know how we came to charge that price for lighting. When the council determined to light the city with towers they passed a resolution specifying a certain tower, upon which we had to bid to get the contract. These 40 towers cost us $38,000, which was $14,000 more than we could have purchased just as good a tower for.

Our contract provided that at the end of three years the city could purchase the towers from us for $20,000. Consequently we were obliged to add that portion of the towers to our bid.

We are now getting from the city $107 per light for 380 lights of 2,000 candle power each, and for all lights in excess of 380 we get $97 per light, and we have made the city a proposition on a contract for $97 per light for all they need.

We have also offered to duplicate the prices obtained by the city of Detroit in their new municipal plant.

We do not pretend to say that the city could not do even better than this. The only way to find out would be to advertise for bids.

MECHANICAL

THE WELLINGTON SERIES ENGINE.—A NEW SYSTEM OF DEVELOPING POWER FROM HEAT.

THE new type of engine described below is the invention of the late A. M. Wellington, who devoted the last years of his life to its development, but who, unfortunately, was not permitted to carry out to their complete fruition the remarkable ideas embodied in his invention.

At the outset, it may be said that the Wellington series engine is an apparatus designed to convert heat into power with a greater efficiency than is obtained in the best existing forms of steam engine. For example, the very best existing steam engines convert into mechanical work some 10 per cent. to 12 per cent. of the total heat generated by the fuel burned in the boiler furnace. A thermodynamic analysis of the Wellington engine shows that it should effect this conversion with much greater efficiency; and if made commercially successful should convert into power from 25 per cent to 40 per cent. of the total amount of heat generated by the fuel which it consumes.

In general it may be described as an arrangement of several ordinary steam engines in a series, with their respective boilers and condensers arranged in such a manner that the wastes of one engine are utilized in the next. In other words, the heat discharged from one boiler is utilized in the next one of the series, and the heat accumulated by passing the cooling fluid through the several condensers in series is also utilized to economize the fuel consumption.

The general principle of operation of the engine is illustrated in the diagram plan, Fig. 1. Here A, B, C, D, E, are a row of ordinary steam engines, each supplied with steam from a boiler on one side of it and exhausting into a surface-condenser on the other side. The liquid which accumulates in the surface-condenser is pumped back into the boiler by a pump attached to the engine.

The boiler, engine and condenser, marked B, are exact duplicates of those marked A, and the same is true of the set marked C, the set marked D, and the set marked E. Evidently now if a furnace were attached to each boiler and a suitable supply of cooling water were piped to each condenser, we would have five complete working steam power plants, each independent of the other.

But now suppose that instead of burning fuel under each boiler we place a single furnace at the right hand end of the row, and pass the hot gases from it first through the tubes of boiler A, then through the tubes of boiler B, then through boilers C, D and E. Also suppose that we connect the several condensers so that the cooling water flows first through condenser E, then through D, and so on till it finally leaves condenser A. It is evident that each separate set, consisting of boiler, engine and condenser, will still be operative, and that we may expect a greater total output of power from a given consumption of fuel and condensing water than before, for by the successive passes the heat will be pretty thoroughly extracted from the furnace gases by the boilers, and likewise the condensing water will be heated up to about the point at which it is no longer efficient by the time it leaves the last condenser.

Of course, with the arrangement above described boilers A and B would make a surplus of steam, while boilers D and E would make very little. On the other hand, the condenser E would be very efficient; condenser D would be somewhat less efficient, and so on until condenser A would probably have difficulty in maintaining a proper vacuum.

If the above simple discussion is plain to the reader, he will have no difficulty in understanding the Wellington engine. In this engine, as illustrated by diagram in Fig. 2, we have a "circulating fluid" which takes the place of the hot gases from the furnaces and the cold condensing water in the mechanism just described. This circulating fluid may be either a liquid or a gas, but for the present purposes, let us consider it a liquid, which fills all of the piping in the entire circuit from the heater at the left hand end, through the tubes of the several boilers from A to E, then through the tubes of the cooler, then through the tubes of the several condensers from E to A, and finally into the heater again. The liquid is caused to circulate by any suitable form of pump. It will be seen at once that by the use of a continuous circulating fluid, all the heat which is accumulated as the fluid passes through the several condensers is not lost as in the example first cited, but is directly utilized and lessens by just so much the fuel consumption in the heater.

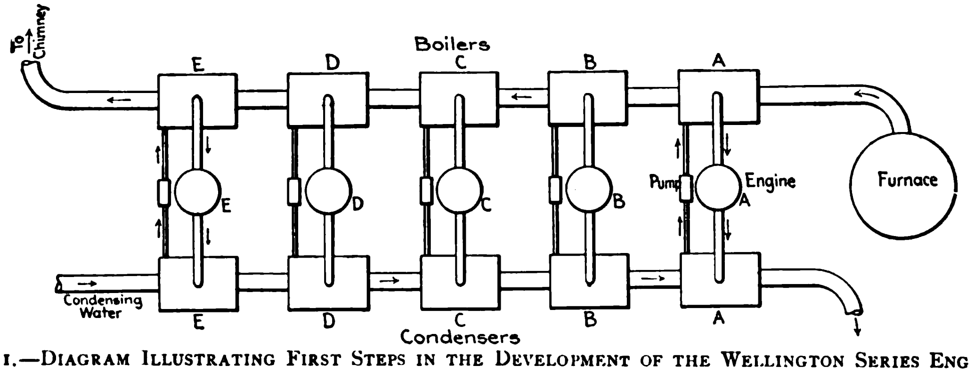


FIG. I.—DIAGRAM ILLUSTRATING FIRST STEPS IN THE DEVELOPMENT OF THE WELLINGTON SERIES ENGINE.

Now, finally, to avoid the inequality of operation noted in the first example, and to make every engine, boiler, and condenser perform the same amount of work with the same efficiency as every other one in the series, a uniform "heat interval" is adopted for each boiler and for each condenser. By the term "heat interval" is meant the number of degrees difference of temperature between the water in any boiler or condenser and the circulating fluid which is imparting heat to the water in the boiler, or absorbing heat from it in the condenser. These various temperatures are marked upon the diagram, Fig. 2.

Suppose also that the pressure of the steam in each boiler is that due to a temperature 10 degs. less than that of the circulating fluid leaving that boiler, and that a similar difference of temperature exists in each condenser between the temperature of its contents and the temperature of the circulating fluid laving it. Then the temperature in boiler A will be 434 degs., and in condenser A, 278 degs. Then the absolute pressure of steam in boiler A will be 355 pounds and there will be a back pressure in condenser A of 48 pounds. In a similar way we find that boiler B will work at a pressure of 192 pounds and a back pressure of 21 pounds will exist in condenser B. In boiler E a pressure of 14 pounds absolute will exist and the condenser E will have a vacuum of 28 ins.

It will be evident that under these conditions with water and its vapor used as the working substance in each engine, as we have assumed, the engines toward the right will do a much larger amount of work than those toward the left. But now suppose that instead of using water as the working substance in each engine, we use it for one or two engines only, say for engines A and B, and for the engines C, D and E we adopt a working substance which will evaporate at a lower temperature, so as to give approximately the same amount of work with the same drop in temperature that occurs in boilers A and B. The progress in refrigerating machinery has given us quite a list of substances which are now extensively used under conditions similar to those which would obtain here. We may mention, for example, ammonia and carbon-dioxide.

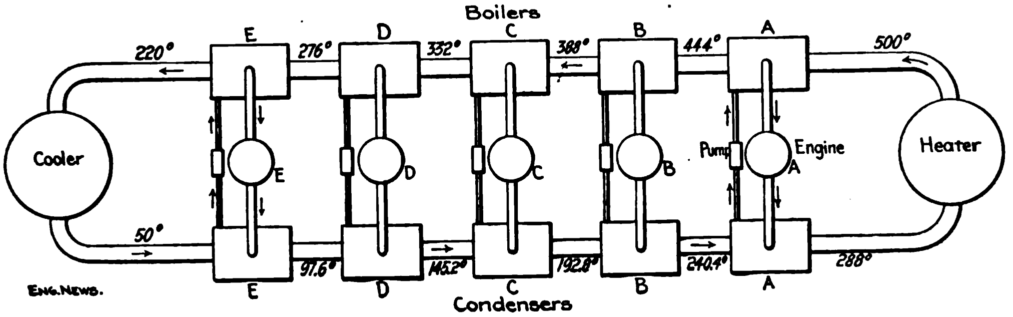


FIG. 2.—DIAGRAM ILLUSTRATING OPERATION OF WELLINGTON SERIES ENGINE.

On the other hand, it is not essential that different working substances be used in the different engines: on the contrary, the advantages of simplicity due to the use of steam alone as the working substance may cause that to be adopted except in cases where so large an amount of power is to be generated as to make the greater economy due to the use of different working substances an important object.

It will be seen, for example, that with a series of five engines, as shown in Fig. 1, we could use water as the working substance in all, and by varying the amounts of heating surface in the different boilers and condensers, we could secure the same output of work from each one of the five engines. More in detail, we would give boiler A a small heating surface, boiler B a greater amount, and so on till boiler E would have the most of all. On the other side of the circuit, condenser E would have the least surface and condenser A the most.

Turning now to the boilers and condensers to be used with this new form of engine, it is apparent at once that an entirely different structure from the ordinary boiler is required, and upon the successful design of such a structure the practical success of the invention as a whole is doubtless dependent. If a series engine were to be built with boilers of the ordinary externally fired type, their bulk and the loss of heat by radiation would alone be sufficient to make the apparatus impracticable and inefficient as a heat engine.

In the boilers of the Wellington series engine the heating surface is no longer acted upon by a hot gas, but by a hot liquid, which can convey heat to the surface many times as rapidly as hot gases from a fire. Thus a square foot of heating surface in the Wellington boilers will transmit many times as much heat as in boilers of the ordinary type. Besides, in the Wellington boilers there is nothing to cause any deposit on the heating surface, either of scale on the one side or soot on the other.

It will be apparent from the above that in point of bulk the boiler belonging to each separate engine in a Wellington series set is not to be likened to an ordinary boiler at all. It would be much more nearly like a surface condenser, though much smaller still, and every engineer knows that a surface condenser for even an engine of large power is by no means a very bulky apparatus.

Mr. Wellington in his study of this feature of his invention became convinced that it was possible to construct boilers for his engine which should have an enormous power in a small space. Practically the entire experimental work which was done upon the invention was in this field, and that it was in some degree successful will be evident from the fact that a 2-horse-power steam engine was actually operated at full load by steam from a boiler with a bulk of less than 1-10 of a cubic foot. This boiler was only 9 inches long and 5 inches in diameter, giving a volume of only one-tenth of a cubic foot. Yet in an actual test it developed 1½ horse power when evaporating a petroleum distillate with a boiling point of 80 degs. Fahr., and heated by a stream of water at 212 degs. Fahr.

The second boiler of this type is shown in Fig. 3, the tubes and tube plates being removed from the boiler shell.

The fact that a boiler of this type has actually been built and worked which generated 40 horse power with a weight and bulk only one two-hundredth as great as the ordinary stationary boiler of that power is certainly one calculated to command the attention of engineers.

Very soon after this larger boiler was built, however, Mr. Wellington hit upon an entirely new plan of boiler construction by which he hoped to go even farther in the direction above noted in the reduction of weight and bulk for a given power, and at the same time to make a boiler which would be constructed at a far less cost than the tubular boiler. Space forbids us to do little more than describe the general principles of this boiler.

It consisted of a series of copper plates about 15 inches in diameter, which are covered with peculiar corrugations or channels. These were joined together in pairs, the edges of each pair being brazed so that the two plates facing each other formed a closed chamber. A number of these pairs are placed in a tubular case and are so connected to pipes at the top and bottom that fluid can circulate through them. Pipes are also connected to the case in which these sections are placed, so that the circulating fluid which heats the working substance will pass through the narrow channels which are left between each pair of plates. In this manner an enormous amount of heating surface is obtained in a very small space. In fact, this type of boiler is far superior even to the tubular boiler shown in Fig. 3 in this respect.

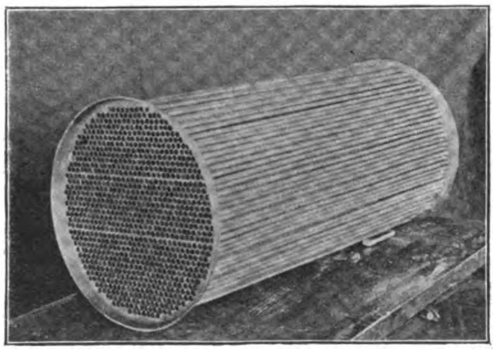


FIG. 3.—MULTITUBULAR BOILER FOR WELLINGTON SERIES ENGINE (TUBES REMOVED FROM SHELL).

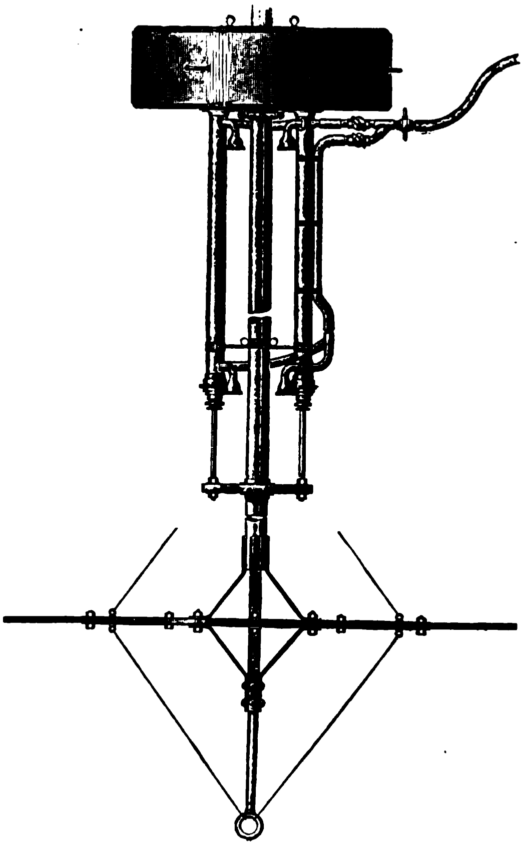
So promising did this invention appear as a means of solving the problem of the transfer of heat in small space with a small temperature interval, that a great part of the work done in the development of Mr. Wellington's invention was devoted to the design and perfection of this plate boiler. A boiler was actually built made up of 26 sections, with plates 16 inches in diameter and containing 208 square feet of heating surface and a great amount of experimental data was accumulated respecting the best methods of manufacture of boilers of this type.

Of course, in the development of this invention a great variety of details were worked over and developed; but space does not permit their description here. Our readers who desire to study the invention in more detail are advised to secure copies of U. S. patents Nos. 549,981, 549,982 and 549,983, issued Nov. 19, 1895, which cover the invention and various modifications in detail. These patent specifications form really an elaborate treatise on the series engine, including an extended discussion of its theory.

FLETCHER'S DEVICE FOR THE UTILIZATION OF WAVE POWER.

ENGINEERS have long endeavored to devise a practical plan whereby the power of the action of waves and tides may be conserved, and the energy either utilized immediately, or accumulated and stored for future usage. Granted that an efficient apparatus can be devised whereby even a tithe of the energy can be made available, it is obvious that the purposes to which it can be applied are almost without limit.

We are indebted to Industries and Iron for a description of an ingenious apparatus, invented by B. Morley Fletcher, A. M. Inst. C. E., of Westminster, which would appear to utilize ample power at a practically nominal cost. Briefly, the essence of Mr. Fletcher's invention is the provision of a point of resistance which is fixed in relation to the up and down motion of the waves. This is attained by means of a submerged horizontal plane or disc, which is anchored to the sea bottom by powerful and efficient moorings, chains, bridles, etc., due provision being made for the rise and fall of tides. This plate is placed at such a depth below the surface of the water that it is entirely unaffected by the action of the waves. The motor itself consists of two parts; first, a cylindrical tube or hydrometer at right angles to and firmly secured to the upper surface of the plate alluded to, and rising a few feet above the surface of the water. And, second, a cylindrical or other shaped buoy, which floats on the waves around the tube, and which has attached to it a pump barrel, which in its turn works around the tube immediately below the buoy. The motion of the barrel is therefore synchronous with the movement of the waves, in a vertical, horizontal, or angular position. In other words, the pump barrel moves up and down in the direction of the waves, and the fixed tube provides a piston-rod; that is, instead of the piston-rod moving in the barrel, the barrel moves up and down the piston-rod. The water pumped can, of course, be conducted by suitable means to the shore, and there used or stored for hydraulic purposes, or it can be conducted on board lightships, piers, harbors, etc., and employed in generating mechanical force in connection, for instance, with the generation of electricity, for lighting, signaling, and other purposes. The condition of the sea and weather in no way interferes with the effective working of the apparatus.



Fletcher's Wave Power Motor.

A demonstration with an experimental plant in Dover Harbor, has given results which are regarded as fully warranting the further expenditure necessary for the construction and laying down of a much larger and more powerful plant. The Dover plant, illustrated in Fig. 1, when in full work, is capable of developing about 3.7 i. h. p. with a maximum stroke of 4 feet, the diameter of the floating buoy being 4 feet, and the size of the pump barrel only being limited by the size of the buoy. A larger plant is now being constructed. This apparatus, which has an inner tube 12 in. in diameter, is designed to develop 300 i. h. p. when working at full stroke. When it is working at one-half stroke the same pressure of 150 lbs. per square inch is obtained.

Not the least ingenious portion of the design of the apparatus is the controlling gear, which is to be employed when the sea is rough. As a further precaution, the buoy is so designed and placed as to be always from one-half to two-thirds immersed, so that heavy waves will pass completely over it without in any degree interfering with the efficient action of the pump, or causing injury to other portions of the plant. Where necessary, the plant can be readily duplicated or triplicated, its low cost being an additional inducement.

One of the first uses which suggests itself for a practical invention of this kind is in contributing to safer navigation around sea coasts, in channels, the entrance to dangerous estuaries, and the like, during foggy weather. By fitting to the plant apparatus for actuating and sounding foghorns or sirens, the restless action of the sea would at once enable the navigator to ascertain his true position. A system of colored electric lights, flash lights, etc., might also be fitted on the buoy in a similar manner, and worked continuously, or at will, both by night and day, regardless of the condition of the prevailing weather, thus appreciably reducing the loss of life and property through collisions and wrecks.

TELEPHONY AND TELEGRAPHY

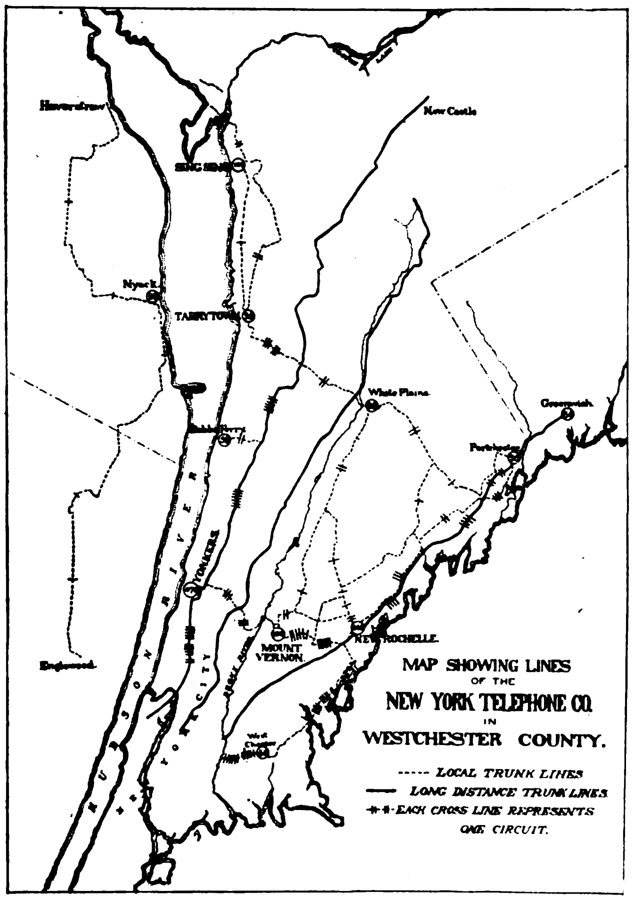
RECONSTRUCTION OF THE TELEPHONE LINES IN WESTCHESTER COUNTY, N. Y.

THE overflow of a large part of the population of New York City into the adjacent county of Westchester, rendered the annexation of a slice of that county necessary long ago; but the process of expansion still goes on, and literally the whole of what remains as Westchester is New York, all its interests being so closely and indissolubly connected with those of the metropolis. The region by its extent, beauty and rolling character, is curiously like that which stretches away southeast from London down through Surrey and Kent, and it bids fair at no distant date to afford yet another resemblance in its dense population. To meet the needs of this suburban district, the steam roads have multiplied their service, the trolley lines are reticulating it in every direction, and now the telephone system has come in for an enormous development and thorough reconstruction. For some time past the New York Telephone Company, having gathered all the people in Westchester under its wing—not overlooking a bit of affiliated territory at Greenwich, Conn., and a big strip across the Hudson in Rockland County, encircling Nyack—has been steadily improving its facilities with notable results. But just as a new hall carpet or a new piece of furniture in the parlor requires that the whole house shall be keyed up in its other appointments, so the work done has made the company resolve to equip afresh throughout and the result is that a sum in excess of $250,000 is now being spent by it in bringing the entire telephone system in that region up to its ideas of what is fit and proper.

It will surprise many of our urban readers to learn that the New York Telephone Company has in Westchester County no fewer than 1,500 subscribers, and that of these no less a proportion than 75 per cent. are on metallic circuits. The exchange groups at the time this data was collected (March 27) ran as follows: Dobbs Ferry, 53 subscribers; Greenwich, 84; Mount Vernon, 122; New Rochelle, 248; Nyack, 99; Port Chester, 95; Sing Sing, 109; Tarrytown, 95; Westchester, 46; White Plains, 88, and Yonkers, 475, making a total of 1,524. Some notion of the expense of maintaining and reconstructing telephone systems may be formed from this single case, which shows that at least two years' total receipts will be required to cover the new outlay, the bulk of the old lines, and a great deal of the old apparatus being at the same time converted into mere junk.

To descend to details, it may be stated that all the trunk lines connecting the offices named are to be reconstructed. This involves rebuilding all the pole lines between central offices, substituting larger poles, and providing copper wire everywhere. Every inch of iron trunk wire in the territory is now being taken down. In several places, the exchange lines not now in good condition, through wear and tear, are being overhauled and in many cases aerial cables will be substituted, where the number of lines permits. The general appearance of the streets will be greatly improved.

When we come to the exchanges, a great amount of work is visible. At Yonkers, a great deal of new equipment is necessary. The switchboard is being enlarged, more underground cables are being placed, and all the overhead wires will be thoroughly renovated. At New Rochelle, the company will replace the present office with an entirely new one, and put the principal lines underground. Unless suitable quarters can be obtained, the company will build its own exchange, after the plan of the admirable one-story telephone substation buildings in Buffalo and Rochester. At Greenwich, Conn., the office was completely overhauled when it was transferred from the Southern New England Telephone Company, but it is proposed to add to the facilities. Territory along the Long Island Sound will be opened up, and arrangements are now being made for the benefit of beautiful Bellhaven, which may be regarded as the Newport of Greenwich. Through all this region and elsewhere in the territory new offices are to be opened, and the pay station service is to be greatly extended.



At Port Chester, there will be an entirely new office equipment, and at Mt. Vernon, White Plains, Sing Sing, Tarrytown and Nyack, new or added equipment will expedite the service. In some of these places, the growth is relatively slow; in others it bids fair to proceed at an accelerating pace, and it is no mean difficulty to decide just what the provision for the future should be. The map we present affords an interesting basis for speculation or calculation in this respect.

The organization of this large territory is a matter of some interest. In point of fact, the center of the district is Yonkers, where the divisional superintendent is in charge of all ordinary operation, repairs, addition of new subscribers, and current maintenance. To this superintendent all the managers at the different central offices report. When we come to heavy construction and large reconstruction, all this is found to be done in accordance with elaborate plans prepared by the New York Telephone Company's city engineering department, and carried out under its direct supervision.

This article would not be complete without some reference to the charges obtaining in the district under discussion. We are therefore glad to append schedules which will show what the conditions are in this respect:

Flat rates for exchange service.—Metallic circuit.—Wall set within one mile of central office.

YONKERS.

	Annual.	Season of six months or less. Payable in advance.
Business—Direct line	$90.00	$67.00
Two-station line	75.00	56.00
Three-station line	60.00	45.00
Five-station line	50.00	37.00
Residence—Direct line	75.00	56.00
Two-station line	60.00	45.00
Three-line station	50.00	37.00
Five-station line	40.00	30.00

OTHER PLACES.

	Annual.	Season of six months or less. Payable in advance.
Business—Direct line	80.00	60.00
Two-station line	70.00	52.00
Three-line station	60.00	45.00
Five-line station	45.00	34.00
Residence—Direct line	70.00	52.00
Two-line station	60.00	45.00
Three-station line	45.00	34.00
Five-station line	36.00	27.00

Cabinet set $10 per annum, or season, extra. Extra mileage, $40 per mile, per annum, actual line measurement; $10 for each one-quarter mile.

Measured exchange service.—Metallic circuit—wall set. Within one mile of central office.—Message rates.—Sent local messages. (With the right to receive any number of messages.)

YONKERS.

	Direct Line.		Two-Station Line.		Three-Station Line.	
Messages per annum.	Rate per annum.	Excess messages.	Rate per annum.	Excess messages.	Rate per annum.	Excess messages.
500	$60.00	10 cts.	$50.00	10 cts.	$40.00	10 cts
600	70.00	10 "	60.00	10 "	50.00	10 "
700	78.00	9 "	68.00	10 "	58.00	10 "
800	86.00	8 "	76.00	9 "	66.00	9 "
900	93.00	8 "	83.00	8 "	73.00	8 "
1,000	100.00	8 "	90.00	8 "	80.00	8 "

OTHER PLACES.

	Direct Line.		Two-Station Line.		Three-Station Line.	
Messages per annum.	Rate per annum.	Excess messages.	Rate per annum.	Excess messages.	Rate per annum.	Excess messages.
500	$50.00	10 cts.	$40.00	10 cts.	$30.00	10 cts
600	58.00	9 "	48.00	9 "	38.00	9 "
700	65.00	8 "	55.00	8 "	45.00	8 "
800	71.00	8 "	61.00	8 "	51.00	8 "
900	77.00	7 "	67.00	7 "	57.00	7 "
1,000	82.00	6 "	72.00	6 "	62.00	6 "
1,100	86.00	6 "	76.00	6 "		
1,200	90.00	6 "	80.00	6 "		
1,300	94.00	6 "	84.00	6 "		
1,400	98.00	6 "	88.00	6 "		
1,500	102.00	6 "	92.00	6 "		

Extra Mileage—$40 per mile per annum, actual line measurement; $10 for each one-quarter mile.

SUBMARINE CABLES AND SUBMARINE EARTHQUAKES.

A break in the cable laid between the Senegal coast of Africa and Pernambuco in Brazil five years ago has led to an extraordinary discovery, related recently by Mr. Benest to the English Institution of Electrical Engineers. The cable was as fine a one as modern methods could devise, yet after three months it broke about 150 miles from the African coast; it was repaired and broke again. It was then found that at the place where the break occurred there was a great deal of vegetable growth resembling river weed; that the color of the sea was a dirty brownish green, indicating the presence of fresh water, and birds' feathers, pieces of orange peel, scraps of carpet, and bits of driftwood were drawn from the bottom of the ocean. The phenomenon was purely local, as the nearest river was seventy-five miles away and discharged its waters in a different direction. It was surmised that it meant the sudden breaking through of a submarine river, and the cable was moved to a distance; after two years it broke again and was moved once more, and engineers are waiting to see what will happen. Submarine rivers are known to exist in other parts of the ocean, off the mouth of the Congo and in the Gulf of Carpentaria, for instance. This explanation, however, does not account for the carpet and the orange peel.

THE B. & O. TELEGRAPH SYSTEM.

Superintendent Charles Selden, of the B. & O. Telegraph, said the other day that the average number of messages handled every day on the B. & O. system was 53,000, exclusive of train orders. The B. & O. have 22,252 miles of telegraph wire, of which they use 7,240 for company's business and the balance is leased to the Western Union. There are 384 telegraph offices on the line, of which 234 are reporting Western Union offices. Mr. Selden employs in his department 750 men, exclusive of linemen. He also has charge of the Block Signal offices which east of the Ohio River average one to every six miles. The service of the company's plant is considerably augmented by the use of several multiplex systems.

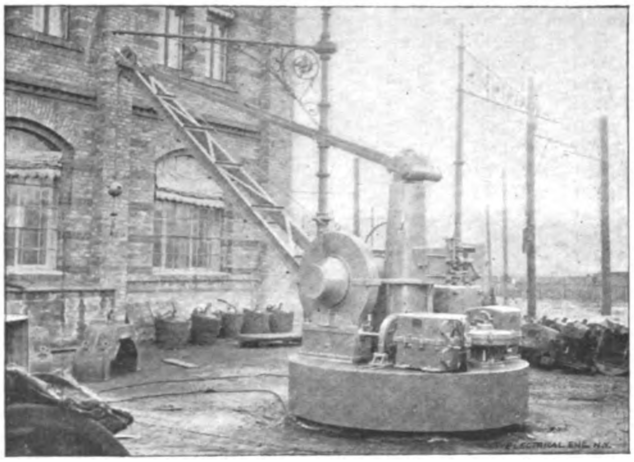
HIS OWN TELEGRAPH MESSENGER.

A drummer who travels in Maine is not greatly impressed with the rapidity of the telegraph service in that State. Recently he was in the upper part of a county and wanted to reach another town that night. He telegraphed the hotel keeper in the latter place early in the day to send a team to the station for him. When he reached the station at night no team was there, so he started to walk to the village, which was quite a little distance off. No sooner had he started than the station agent said to him: "Are you going to the village?" "Yes." "Then I wish you would take a dispatch up to the hotel." It was the dispatch ordering the team.—Boston Record.

POWER TRANSMISSION

NEW ELECTRIC SHIP CRANE ON GERMAN DOCKS.

ONE of the large German transatlantic steamship companies has recently been investigating the question of electric cranes for use on shipboard and our illustration shows a type selected for the work. It is shown standing in the yards of the factory of the Union Electricitäts Gesellschaft, Berlin. The construction of this crane is of the most substantial character necessitated by the hard usage it is likely to receive on shipboard. It is so designed that the load can be transported from hold to dock or to another boat without interfering with the bulwarks or moving the load first to the deck. This crane is both lifting and rotary and the entire construction is so simple that one man can operate it without difficulty.



Ship Hoist Built by Union Electricitæts Gesellschaft, Berlin.

The design of the gearing is such that the moment the load is raised to the requisite height, an automatic brake is applied. The raising motor is connected to a cast steel gear running in oil and driven by a pinion; a second motor serves to rotate the crane. The crane is started, the speed regulated and the motors revolved by special controllers completely enclosed. The resistances are set underneath the platform in cast iron compartments readily accessible. The two controllers as well as the two motors are operated by means of one lever and the movements of this coincide with the movements of the crane itself. Raising the lever raises the load; turning it to the right turns the crane to the right, and if the lever is raised and turned at the same time, the load is raised and turned coincidently. To guard against the action of sea water, bad weather, etc., the electrical mechanism is entirely enclosed and is water-tight. A special brake operated by the foot is used to check the movement of the motors in case of necessity.

The capacity of the crane is about 5,200 pounds and the speed of lift under full load 68 feet per minute; at no load 108 feet per minute and with shunted fields 148 feet per minute. The raising motor has a capacity of 25 horse power and the rotating motor 7.5 horse power. The length of the boom is 18 feet and the speed of rotation at the end of the crane 13 feet per second.

In a recent competition for the construction of large shipping cranes, the Union Electricitäts Gesellschaft's apparatus was selected on account of the simplicity of construction and operation of the machine. It will be seen that the electrical equipment is practically American and was selected in competition against the best European manufacturers.

In view of the satisfaction given by the crane above described the North German Lloyd has decided to equip its new ship, the Bremen, entirely with electric hoisting apparatus. This vessel will receive 16 cranes similar to that shown in our illustration, and four direct connected, six pole, 75 kilowatt, 210 revolutions, 104-volt generators. Two of these will be devoted to the operation of the cranes, a third will serve to light the ship, the fourth being held in reserve.

ELECTRIC POWER FROM A NEW MEXICO COKING PLANT.

MESSRS. H. WHIGHAM and S. A. Schomburg, of the Raton Coal and Coke Company, are now installing at Blossburg, N. M., three miles from Raton, a new coking plant, embracing about seventy-five three-foot ovens in double banks. In the center will be erected a large battery of boilers, to which the waste gases of the coal will be conducted through central flues. The power thus generated will be converted into electricity to furnish power for the whole plant inside and outside of the mine. About one and one-half miles from the coke ovens will be situated the Robinson washing and crushing plant, which is now in process of construction. It will have a capacity of 800 tons each ten hours. The waste coal from the washing plant will be taken down a larry line by a small steam locomotive in seven-ton larry cars, each car carrying a charge for an oven and delivering it directly over and into the oven. All of the machinery, from tipple to mine opening, will be driven by electric motors and in the main entry a trolley line is being built on which an electric locomotive of 150 horse power will bring the pit cars to the tipple. The latest improved mining machinery run by electricity will drive all of the entry work.

A CURIOUS POWER SCHEME.

A BILL recently introduced in the New York State Legislature is exciting considerable comment as to what the promoters of the project propose doing should they secure the rights asked for. On its face the bill incorporates the "Columbia Electric Power Company," the promoters of which are three men named Wild, residents of Columbia County. Further, the bill authorizes the formation of a company with a capital stock of $10,000,000 for the purpose, ostensibly, of damming Kinderhook Creek, a small tributary of the Hudson River, and thereby generating electric power. One remarkable fact is that the company does not seek to be incorporated under the general incorporation act, and this is in part explained by the several peculiar features of the bill, one of which is that the bill gives permission to extend the lines of the company to all parts of the State, subject only to local ordinances in cities and towns, and another which allows the taking of additional power wherever and in whatever manner it may be necessary for the business of the company. The company would also have the right to take lands by condemnation proceedings. It is pointed out that under these broad provisions the Columbia Electric Power Company could, for example, erect a plant at Niagara Falls to compete with the companies now located there, thus securing a franchise to do business at a point where the granting of further power rights is strongly opposed by the commissioners of the State reservation. Under such a franchise the company could also dam the Hudson, but the bill is being closely watched, and if it becomes law its provisions will likely undergo a great change.

LETTERS TO THE EDITOR

FIRE TUBE STEAM BOILERS.

UPON reading the article by M. C. D. in your magazine, we are prompted to enter a plea for the return tubular boiler, which he seems to think little short of a dynamite bomb.

There are to-day thousands of these boilers in use to every water tube boiler, and there is no difficulty to get them passed by the Hartford Boiler Insurance Company, who are certainly the recognized authority on steam boilers. Can the same be said of all water tube boilers?

For efficiency the return tubular will give, if properly constructed, as good results, if not better than the other class, and requires far less attention.

It is true that very little property damage is done by the bursting of a water tube, and seldom direct loss of life, but can we overlook the hundreds of cases where employés have been scalded or otherwise injured, and thus bring a loss to the company through lawsuits?

The tubes of a return tubular boiler are never subjected to the direct heat of the fire as are water tubes, and consequently are not subjected to the same strains. To this may be credited the comparatively few explosions of return tubular boilers as compared to the total number in use.

To many engineers the article would seem to prove the superiority of the water tube, which is distinctly untrue. We do not wish to run down the water tube boiler, but think the author shows great injustice to the ability of makers and users of other boilers. The explanation of the Elmira explosion may be correct, but could also be charged to other causes which would have produced the same results on a water tube boiler. After all is considered, the cause of nearly all explosions is directly due to carelessness on the part of the maker or user of a boiler, no matter of what class.

Would M. C. D. kindly let us know what make of water tube boiler he is interested in? BINGHAM HOOD,
Egg Harbor Elec. Lt., Ht. & Pr. Co.
Egg Harbor City, N. J.

ARC LIGHT CARBONS AND THE NEW TARIFF.

THE appeal of a "Central Station Man" to the consumers of arc light carbons to take up the question of the proposed rate of duty on this article, is encouraging. There is no doubt of the consumer's being not only the party to suffer from the proposed duty, but he is also the only party whose protest will have any weight at Washington, for, as correctly stated in the "Central Station Man's" letter, neither the manufacturer nor the importer of foreign carbons feels disposed to do anything in the matter, believing they will have no chance as "interested parties." The consumers of imported carbons should, however, not hesitate to unite in order to oppose the measure, as the home industry will certainly not benefit through the same. Or, do the home manufacturers—who, I am told, are the instigators of the proposed higher rate—intend to derive any benefit? They could only do so either by raising their prices—in which case the consumer would again have to pay the "piper"—or by an attempt to compel the consumers of arc-light carbons to go back to the domestic product, which so far has stood in the way of efficient arc lighting.

It is a well understood fact that the present prices of the domestic carbons are due to competition caused by over-production, which, as far as the home manufacturers are concerned, becomes more serious as the public demand for efficient arc lighting increases.

Whether the domestic manufacturers have a right to appeal to the high protectionists with a view to stop progress in arc lighting, remains for the electrical fraternity to decide.

I agree with "A Central Station Man" that American manufacturers are sufficiently protected under the present rate of 30 per cent., and it is my opinion that the preposterous rate of 50 per cent. proposed by the new Dingley tariff bill will greatly injure the electrical industry which depends upon the better article that can not be made here.

"ANOTHER CENTRAL STATION MAN."
New York, April 16, 1897.

LITERATURE

A NEW BOOK ON SUBMARINE CABLES.

A WORK entitled "A Treatise on Submarine Telegraph Cables: Their History, Construction and Working," has been prepared by Mr. Charles Bright, C. E., F. R. S. E., and will be published by Messrs. Crosby, Lockwood & Son, 7 Stationers' Hall Court, London, provided that a sufficient measure of support can be obtained beforehand. The size of the proposed book is super royal 8vo., and it will contain about 600 pages, fully illustrated with drawings and diagrams specially prepared for it. The price to subscribers will be two guineas ($10.30), but after publication the price to non-subscribers will be three guineas.

Mr. Bright has been continuously occupied in submarine cable work for over fifteen years, so that he is amply qualified from extended experience to deal with the subject from the practical point, while the papers of his father, the late Sir Charles Bright, have provided him with unequalled material for the historical section.

Mr. Bright's work contains a complete history of submarine telegraphy, treating the subject from the financial and political as well as from the technical side; it deals with the science and practice of cable laying and working in all their engineering and electrical details, including description of the latest improvements in high speed machine transmission. The subject of insulation is dealt with exhaustively and the methods of manufacture in producing gutta percha and India rubber covered core are completely described. A valuable feature of the book, too, is the section devoted to patents in which all master patents are described fully and categorically. The book is one, in short, that an electrical library will scarcely be complete without, while it will specially appeal to the specialist in telegraphy, telephony and insulated wires. Orders for copies may be sent to this journal, or directly to the publishers at the address given above.

THE LIVING AGE.

The publishers of the "Living Age" have purchased the serial rights to the publication of "In Kedar's Tents," by Henry Seton Merriman, author of "The Sowers." "In Kedar's Tents" is an attractive story of adventure in Spain during the Carlist war. It is said to be full of incident, and to contain some clever sketches of character. The first chapters of this work appear in the "Living Age" of April 3, and continue through fifteen numbers.

The early April issues will contain some other papers of striking and timely interest. Among them, Mr. Gladstone's pamphlet on the Eastern question, which has so aroused the attention of the English people; Max Muller's Literary Recollections; Francis de Pressense on the Cretan Question; Leslie Stephen on Gibbon's Autobiography; and a reply by Sir Frederick Pollock to the article on the Hidden Dangers of Cycling which appeared in a March number of the magazine.

ANGEWANDTE ELECTROCHEMIE (Applied Electro Chemistry). In three volumes. Vol. 1., Primary and Secondary Batteries. By Dr. F. Peters, Vienna, A. Hartleben. 338 pp., 5 x 7 inches. Paper. Price, $1.60.

This is a new volume of the well-known popular series of the Electrotechnische Bibliothek. It gives descriptions of the more important primary and secondary batteries, proposed or used up to June, 1896. The work is made specially valuable by copious references to original sources of information.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
120 Liberty Street, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - - 1564 Monadnock Block, Chicago, Ill
Philadelphia Office - - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - - .10

[Entered as second-class matter at the New York Post Office, April 9, 1888.]

Vol. XXIII. NEW YORK, APRIL 21, 1897. No. 468.

Notice of Removal.

THE ELECTRICAL ENGINEER.

is now occupying its handsome and commodious new suite of offices, entire south wing, eleventh floor, of the Beard Building, 120 Liberty street, New York City. It is not only thus most advantageously situated at the heart of the machinery and electrical district, but enjoys an increase of several hundred feet floor space. The offices are convenient to all railroads and ferries, and an invitation to visit them is cordially extended to all friends and patrons of the journal.

SMALL MARGINS OF PROFIT.

MARGINS of profit are generally small in these days, and depend to a great extent on economies. The recent meeting of street railway accountants has its value in helping to bring out the necessity of standardizing accounts, for only in that way can the operating of one road be compared with that of another or a group of others. We believe it possible to effect economies in almost every department of railway or lighting plants as they exist to-day, without lowering the salaries of competent men or lessening the efficiency of the system. But the managers and engineers must get together to find out how to do it, and this is the main raison d'etre of the great national associations of the local companies. The statement is quoted in regard to steam railroads, by Mr. J. H. Maddy, press agent of the B. & O., that the difference of one mill per ton per mile on freight carried by all railroads in the United States makes a difference of $80,000,000 in revenue. In a recent article in Scribner's Magazine, Mr. P. G. Hubert, Jr., mentioned a number of very curious and suggestive facts bearing upon the nature of the margin of profit in various industries. A girl who uses the left hand in adjusting a certain movement of the spindle instead of the right, does it about a fifth of a second faster than the girl who uses the right hand. When this apparently insignificant period of time is multiplied by millions it will be seen that the mill in which the faster method is enforced will forge ahead of the one in which it is not. In a flour mill in Indiana, the year's profit once came from using ten hoops on its barrels instead of twelve, as in former years. A large match manufacturer saved $8,000 in one year by the use of a machine which pasted the labels on the match boxes. Before that the work was done by girls—who put on 20,000 labels a day, and got 80 cents for doing it, or at the rate of 250 for one cent. If any of our readers can match these figures with corresponding items from electric lighting or street railway experience, we shall be delighted to give them the wide publicity of our pages; and we seize the opportunity of advising our central station friends to get ready for the interchange of ideas on economical practice at the Niagara Falls convention of the National Electric Light Association in June.

WATER OR FIRE TUBE BOILERS?

ELECTRICAL distribution has stimulated the steam engineer in many directions, and next to the steam engine, the boiler has come in for a good share of the attention of manufacturers of that still indispensable adjunct to central stations not fortunate enough to be situated in the vicinity of a water power. But while the battle of competing steam engine men has been waged along rather narrow lines of differentiation in details, a broad line of demarkation has separated the boiler men. The old return tubular boiler, which has done good service for many years in the well established manufacturing industries, has found itself hard pressed by the water tube boiler in electrical work, in spite of the fact that its cost has thus far been greater than that of its predecessor. It must, we believe, be accepted as an established fact, adduced from the experience of the past, that any piece of apparatus fetching a higher price in the market must possess advantages of some marked character to lead to its general preference over another of less cost. As regards the two types of boilers, the question is still open to debate, whether, properly managed, the efficiency of one over the other is such as to make this factor the predominating one in the choice. There must then be other points of superiority which have given the water tube boiler its present ascendancy in electrical work, at least in America. Its greater immunity from destructive explosions; the readier mode of cleaning and inspection; its greater efficiency in unskilled hands; its quick steaming qualities; its greater capacity for forcing without undue priming—all these are points which the advocates of the water tube boiler have urged successfully and no doubt justifiably. The recent explosion of a set of boilers in the Elmira, N. Y., railway power house called forth a communication in our columns last week from an eye witness who ascribes the disaster directly to the employment of the return tubular boiler. In reply to this criticism a correspondent this week comes to the aid of the older type, but fails, in our estimation, to make a very strong case. We agree with our correspondent that with due precautions, a return tubular boiler may be made as safe as such a type of boiler can be made, but unfortunately that type of boiler carries within it elements of deterioration and danger not found in its rival. It is just here that the precautions usually taken fail of accomplishing their ends. As to the other causes which have made the water tube boiler the favorite in up-to-date electric central stations, we need not enlarge upon them, preferring to leave this to the manufacturers. We are firmly convinced, however, that the water tube boiler has come to stay, and that with the tendency to lower prices which has manifested itself of late, it will make the return tubular boiler a rarity in electric central stations of the future.

TELEPHONIC HOODOOS.

A CURIOUS report comes from Alabama, on good authority, as to the objection of some of the farmers to the long distance telephone wires, on the ground that they are directly responsible, by their physical presence, for the low price of cotton. The craze or superstition has spread even in districts which not long ago voted solidly against gold on the same grievance. Poles and wires have been freely cut down, and one line from Gadsden to Walnut Grove has been badly damaged half a dozen times. It is stated that one farmer has devised a new way of "hitching his wagon to a star" by tying one end of a broken wire to the tail of his cart and then tearing down a consecutive seven miles of the circuit. It does not yet appear, however, that cotton goes up as the wires go down. Perhaps the prevalence of this superstition is exaggerated. We hope so. It reminds us of the prejudice of the Chinese, who pull down the telegraph poles and wires because their shadows are likely to be cast across the cemeteries where their dead relatives lie and because that is prejudicial to happiness in the next world. A similar prejudice prevails among West Indian negroes, but they overcome the hoodoo by hanging empty bottles on the fence of their yam patches.

THE WELLINGTON SERIES ENGINE.

ELECTRICAL engineers have always been as alive to any promised improvement in the utilization of steam as to any advance made in electrical apparatus or its application, and for obvious reasons. The coal bill of an electric light station, while not the largest item of expense, is always of sufficient magnitude to make any reduction in it desirable, and cases could probably be cited in which reckless use of steam has been the millstone which has ground the dividends down to an impalpable condition. Modern steam engineering has made such progress that nothing but crass ignorance or carelessness can account for such a state of affairs in the absence of other factors, but none, we believe, would be more ready to admit the possibility of improvements in steam utilization than steam engineers themselves. Indeed, the very fact that their best energies are devoted to this end is sufficient evidence of the present state of the art. Aside from the general progress in details of construction of engines and boilers, the great advance in steam engineering standing out most prominently is the steady rise in the steam pressure used. The introduction of higher steam pressures has already effected remarkable economies in coal consumption and the highest authorities on steam look for still further advances, so that 300 and 400 pounds pressure per square inch may be expected. As a matter of fact such pressures were used by Perkins many years ago and with success, only minor difficulties having been encountered with it. But it would seem that in connection with high steam pressures, methods of working can be employed which have not thus far been contemplated; or, indeed, that lower pressures can be worked to advantage in a way to increase their thermodynamic efficiency. A noteworthy system of this kind is that embodied in the Wellington series engine, to which we devote considerable space in this issue. In the absence of an actual test of a completed engine, or rather engine system, of the Wellington type, it would be difficult to express an opinion on the merits of this radical departure. Theoretically it unquestionably presents advantages, but even if the cost of the system did not exceed that of the present system of equal capacity, the multiplication of apparatus on the engine side might lead to collateral disadvantages which would militate against it. Thus the question of relative area occupied, cost of attendance, repairs, etc., would have to be taken into account before a final answer could be vouchsafed as to the practicability of the new idea. Nevertheless there is such evident merit a priori in the Wellington system that it is to be hoped that the experiments already begun will be carried out to conclusion.

THE handling of crowds on trolley roads is not a small problem, and at far-famed Coney Island it presents itself in a very pronounced form. The Nassau Electric Railroad Company, in building a new station, have proposed a unique plan, the adoption of which will enable visitors to dispense with the cost and formalities of a regular ocean bath. Last year it was customary to use several gates in order to let incoming passengers off before those leaving the Island could reach the cars. The company was not satisfied with the arrangement, although at the time it could not very well be obviated. President Johnson's plan, however, will attempt to remove the difficulty. It consists in a canal about sixty feet long and eighteen inches deep, which will be constantly kept filled with water up to the level of the tracks. Incoming cars will discharge their passengers on the far side of this canal, and, when empty, will cross to receive passengers leaving the Island. Any passenger who attempts to cross the track before the outgoing car reaches its proper place will do so at the risk of wading through this sheet of water. President Johnson is firmly convinced that this plan will be capable of producing all the good he had in view when he conceived it. All that is necessary is to use salt water, and the 5-cent fare to or from the Island can be advertised as including a dip in the sea gratis.

ONE'S notice is often attracted by handbills and "dodgers" stuck on poles, and it would seem that the advertiser who adopts this method secures a part of the publicity he seeks. But the practice has various disadvantages, not to say dangers, and should be forbidden generally, as it already is locally, in some cities. The practice is very annoying to the men whose duty it is to climb up and down the poles, tearing their garments and scratching their clothes on the nails and tacks which are put in to hold the bills and cards. The companies cannot object to the use of their poles as hitching posts, but cover them with strap iron to prevent them being injured by the horses. That has resulted once or twice in the throwing down of a weak pole by a restive horse, and occasionally a bad ground has added a litle stray excitement; but a further objection to the advertising card nuisance is that it gives a very ragged and disorderly look to the poles.

INDIANAPOLIS is just now very much interested and excited over the new three-cent-fare law which the street railway company refuses to recognize. All along the lines last week were enacted lively scenes in the boarding of the cars by determined three-centers and their ejectment by the company's men when the full five-cent fare was not forthcoming. The act provides for the recovery of civil damages not to exceed $100 for a refusal to accept the fare; and all employés collecting in excess of that amount for a single ride are subject to fine. The company holds the law to be invalid and has retained ex-President Harrison to ask for an injunction against it, in the Federal Court. Savannah, Ga., by the way, has just returned to five-cent fares.

JUDGE BUNDY, an Indiana jurist, ruled a few days ago that he would admit a telephonic talk in evidence. He admitted that he could find no authorities in the books, but was quite willing himself to establish a precedent. A somewhat similar question came up in Boston recently, when it was sought to prove that previous to the terrible gas explosion in the subway, the gas company had been called up and notified from the scene of the trouble. The gas manager said it was not so, but a little blue strip was produced, showing time, places and names of caller and callee. That settled it. It would be an easy thing with the aid of a device like the calculagraph to verify with fair approximation all conversational episodes about which it was desirable that no doubt or question should arise later. Even the body or topic of the conversation could be noted down with little trouble.

HITHERTO thieves on breaking into an empty house have contented themselves with stopping short at the removal of the plumbing pipes. From Dayton, O. it is now reported that some professionals have entered a vacant residence and carried off the electric bells and the wiring. It should not be difficult, and would be highly proper, to connect such a house with the local burglar alarm system, if any exists. A protection of that kind for vacant houses might pay pretty well. Even now it is not unusual.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—VI.

BY JOSEPH APPLETON.

[Copyright, 1897.]

INSTALLATION, CARE AND MAINTENANCE.

(Continued.)

THE capacity of a battery will naturally decrease as the rate of discharge increases; the curve, Fig. 19, shows the capacity of a battery at various rates of discharge. There is one point in connection with the capacity of a battery which is often misunderstood, namely, when discharging a battery at excessive rates, and, consequently, obtaining a smaller capacity, it is thought that the efficiency is correspondingly reduced. Take, for example, a cell having a capacity of 1,000 ampere hours at normal rate; at the maximum or one hour discharge rate the available capacity is about one-half the normal, or 500 ampere hours. It is frequently assumed that the loss in efficiency is in the same proportion as the loss in capacity, namely, 50 per cent., whereas the battery is not really empty, the active material being only partly discharged, but unable to give more effective capacity on account of polarization.

In charging a battery after a discharge at excessive rates it will be found that only the capacity of the discharge plus the usual 10 per cent. excess is required to bring the cell back to a fully charged condition. If during a discharge at excessive rates the discharge is occasionally interrupted for a short period it will be found that the cells will give practically the same capacity as at normal rates, as the rest gives the cells time to recuperate and so avoid polarization.

The use of a recording amperemeter is advantageous during a discharge to indicate what charge will be required, but unless it records not only the amount of current taken out during discharge but the rate at which it is taken out it is of little value to show what capacity remains in the battery. For the same reason it is difficult to construct an automatic switch which will cut out the battery when the voltage during discharge has reached the limit, as the voltage per cell varies with the rate of discharge, and a switch of this type operating entirely by voltage, irrespective of the rate of discharge, would cut out a battery when discharging on high rate long before the capacity had been obtained, simply because the voltage had reached the limit of normal rate.

It is quite as important to take occasional readings with low reading voltmeter and hydrometer on individual cells during discharge, as in charge, in order to ascertain if all the cells are in normal condition. This is preferably taken towards the end of a discharge, when the cells have done considerable work. A battery should never be allowed to stand for any length of time in a discharged condition, as the plates will soon become seriously injured. If it is not possible to fully charge the battery immediately after the completion of a complete discharge, the charge should be continued until the cells are at least half full, in which condition they will not be hurt by standing for a little time.

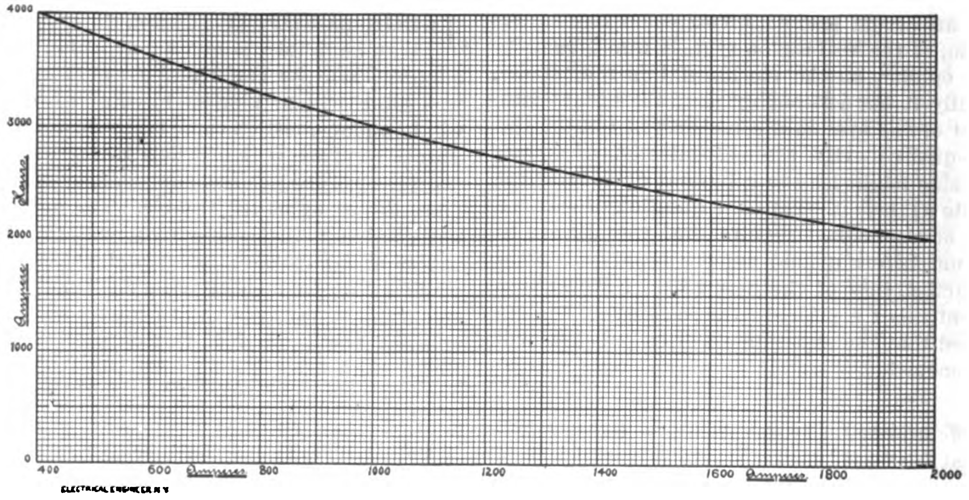


FIG. 19.—CURVE SHOWING VARIATION OF CAPACITY AT DIFFERENT DISCHARGE RATES.

The attention which a properly installed battery requires is very small, not as much as must be given to an engine and dynamo. A careful and regular examination of the cells, together with the observance of the above mentioned precautions, will prevent a battery plant, if properly designed and installed, giving any trouble. If a storage battery always received the same amount of care and attention that other portions of the installation get, there is no doubt as to which would prove the cheapest to maintain.

There is one feature about a storage battery which renders it liable to abuse, namely, the capability of overworking it without its showing visible signs of distress. An engine or dynamo when overloaded will make the fact known by its actions, or perhaps quit altogether; while a battery can be overloaded to practically any extent without showing any ill effects at the time; yet, nevertheless, the injury is done and will eventually make itself felt by the early depreciation of the plates. A cell looks the same, to all intents and purposes, when discharging on practically a short-circuit, as when standing on open circuit, and it is, therefore, necessary to protect a battery against abuse in this way by proper precautions and careful attention.

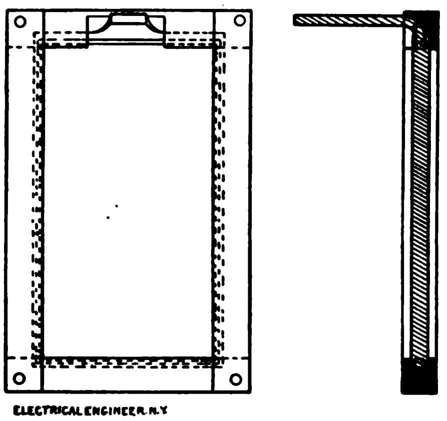


FIG. 20.—CADMIUM TEST PLATE.

With a good modern storage battery very few troubles are liable to occur, provided proper attention is given to keep the regulation of the charge and discharge within proper limits, and if the cells are properly supplied with electrolyte. The only thing likely to happen and cause trouble is the formation of short circuits between the plates, causing the cell to discharge through itself. There are two ways in which short circuits are liable to occur; one, the scaling or peeling of the active material, the pieces which become detached lodging between the plates and forming a circuit between the positive and negative plates, through which the cell can discharge. The other cause of short circuit is the presence of some foreign material which has fallen into the cell.

When a cell is found to be backward in charge and discharge it should be immediately examined for short circuits. The best way to do this, is to probe between the plates with a thin piece of hard rubber; thus removing any material which may have formed a connection between the plates. After a backward cell has been examined and tested in this way, it will require extra charging to bring it up to the same condition as the rest of the battery. This may be done by leaving the cell in circuit for the charge and taking it out for one or two discharges; this is easily done by disconnecting one of the poles before the discharge is commenced, and connecting across the two poles of the adjoining cells. One or two extra charges in this way will soon bring the cell back to its original condition.

A very interesting and accurate test to ascerain the condition of the cell can be made by taking a piece of cadmium, immersing it in the electrolyte and measuring the e. m. f. between it and the positive and negative plates in the cell. By this method it is possible to ascertain at any time during the charge or discharge whether the positive or negative plates are in proper condition or otherwise, thus locating at an early stage any sign of irregularity and trouble. The best form of cadmium test piece is that shown in Fig. 20, consisting of a sheet of cadmium mounted in a hard rubber frame, so that it can be laid on the top of the element. The following readings show the e. m. f. between the cadmium and respective plates in a cell under different conditions:

Cell fully charged and after standing for several hours, e. m. f. between cadmium and negative plate .16 volt, the cadmium being negative to the negative plate.

Cell during discharge at 10 hour rate, two minutes after discharge commenced:

Pos. and Neg. of Cell.	Neg. and Cad.	Pos. and Cad.
2.07	.18	2.25

Same discharge at end of five hours:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.925	.20	2.125

At end of above discharge, but before stopping the current:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.70	.23	1.93

Cell during discharge at three hour rate, two minutes after discharge commenced:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
2.02	.20	2.22

Same discharge at end of one and one-half hours:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.88	.22	2.15

At end of the above discharge, but before stopping current:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.70	.30	2.00

Cell during discharge at one hour rate, two minutes after discharge commenced:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.96	.215	2.175

Same discharge at end of one-half hour:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.83	.26	2.09

At end of above discharge, but before stopping current:

Pos. and Neg.	Neg. and Cad.	Pos. and Cad.
1.60	.33	1.93

During charge the cadmium reads negative to the negative plate until the cell is about full, when the reading should be zero, the charge should be continued in order to get the battery really full, until tne cadmium is .20 volt positive to the negative plate while charging at normal rates. It will be noticed that during charge the cadmium changes its polarity with regard to the negative plate.

In order to obtain the most accurate results the cadmium plate should be shaken occasionally while in the cell to free it from any bubbles of gas which may have accumulated thereon; it should also be rinsed in water every time it is taken out of the electrolyte. A low reading voltmeter is required for this test, and care must be taken with the readings; it is a most reliable and useful test when taken with ordinary care.

Of course, the readings during discharge will vary somewhat with each make of cell, depending upon the proportion of capacity existing between the positive and negative plates; but it is a very easy matter and one well worth undertaking to ascertain by experiment the actual figures for each installation. The figures given refer to a well-known make of cell.

"IT WILL LIVE FOREVER."

An old subscriber was notified by us in the usual way that the time for renewal had run its length and that "the paper would stop." He sent his check in at once and said: "No it won't; it will live forever."

THE NON-FEASIBILITY OF BURGLARIZING SAFES BY ELECTRIC HEAT.

MR. E. G. NOE, superintendent of the engineering department of the General Electric Company, at Chicago, in a letter to A. G. Burton & Son, of that city, furnishes the following interesting discussion of the feasibility of burglarizing safes by electricity. It will be noted that he takes the same view as Prof. Elihu Thomson, Mr. J. J. Wood and Mr. C. O. Mailloux, whose expert opinions were printed in The Electrical Engineer, of March 31. In a lecture before the Kansas City Medical College on March 18, Prof. Lucien I. Blake, of the Kansas State University, gave a practical demonstration of "how impossible it would be for a safeblower to use electricity to drill a hole in a safe." Mr. Noe's letter is as follows:

With reference to our conversation and experiments as to the practicability of burning a hole through a safe by electricity, I beg to say that this is possible, but it requires so much apparatus, and in most cases such a great quantity of power that it makes it practically impossible to be operated by a novice or any one without making special arrangements for it. In fact, I might state that it is utterly impossible for a piece of work to be performed of this kind in the average city of from 60,000 to 70,000 inhabitants; that is, when you are depending upon the facilities of the local lighting companies to secure the necessary energy, as to perform this work it requires an enormous current, and the most economical method that could be employed would be an alternating current, from the fact that what is required is quantity of current at low pressure or voltage. The voltage can range anywhere from 30 to 50 volts, but the quantity of current necessary must be from 300 to 700 amperes. Now, if we take an average case, as talked of, suppose we fix the current necessary at 350 amperes at 40 volts pressure. This will equal 14,000 watts, or practically 19 horse power. Now, in order to convert alternating current energy to this form so that the application would be made easy it would be necessary to introduce a specially made transformer that would transform this energy from a primary voltage of 1,000 or 2,000 volts, as the case might be, to 40 volts secondary current. A transformer of this kind would not be generally found throughout the country, although there are a number of transformers in service with their secondary winding arranged for 50 volts, but they are all of such small sizes that they would not furnish sufficient current to be of any service in an operation of this character. Therefore a special transformer must be constructed and attached. A transformer to do this work would weigh in the neighborhood of 1,300 lbs., which would require considerable labor to cart it about to put it in a convenient place for service. Then from this transformer to the place of operation would have to be run a very large wire, almost one-half inch in diameter, in order to convey the necessary current to do the work without heating up or fusing the wire itself. The connections, and every detail would have to be carefully calculated to insure success, and even with the most skilled mechanics I think the operation of going through a 4-inch or 5-inch safe would fail nine time out of ten. It is rather a dangerous piece of work to undertake, from the fact that 350 amperes of current would make such a tremendous arc that it is hardly safe to handle it. Again, the fusing of the carbon and metal would generate so much gas and smoke that it would be impossible for an operator to remain in a close room or vault to perform his work, as he would be suffocated with gases and smoke before the operation was half completed. Further, it is almost impossible to find electric lines throughout the country so constructed that this amount of power could be taken from them without seriously interrupting the successful operation of the plant, and as all electric lines are equipped with safety fuses or automatic cut-outs, the minute a line would be overloaded or caused to carry or deliver more energy than intended for it, the automatic device in the circuit would open and leave the operator without any current.

The above case covered the most economical operation that could be obtained. Suppose we undertake to get the necessary energy from a street car line? This is a direct current with a primary voltage of about 500 volts, and the form is entirely different than with the alternating current. Now, suppose we require from the trolley line a current of 350 amperes. This 350 amperes multiplied by 500 volts would equal 175,000 watts, which would represent about 255 horse power. It is true that you would not require this high voltage at the point of operation, but you have only one means of reducing this voltage, namely, to introduce a rheostat or resistance coil to cut the voltage down to the amount required. The current, however, you must have. Therefore the difference in energy between that used at the point of operation and that originally taken from the trolley line, is consumed in the rheostat or resistance employed. You will see from this how absurd it would be for any novice to undertake to tap a trolley wire or street car feeder in the street and take 235 horse power from it successfully. Again, suppose we consider the electric current used by a large building in Chicago. For isolated lighting a pressure of 110 volts is usually employed. Therefore if we require 350 amperes from this line we must take it at the voltage of the line, namely, 110.

This would represent 38,500 watts, or practically 52 horse power. Such a connection as this would mean that the operator would be obliged to tap the main wires going from the generator, and the minute this load was put on, the man operating the dynamo and lighting plant would immediately discover that there was some trouble on the lines throughout the house, or that they had turned on the majority of the lights in the building, and would immediately commence to investigate.

More likely, however, the safety cut-outs or automatic circuit breakers would be opened when this amount of power was turned on. This same thing would apply if the wires of a public vender or street service lines were tapped. A fuse or safety device in some part of the line would be opened no doubt and the current shut off. So far as performing a task of this kind from an arc light circuit, that is where arc lights are fed from a regular arc lighting machine, is concerned, it would be practically impossible as the majority of the arc light dynamos only deliver 10 amperes of current, which would be far short of the amount required.

ELECTRIC TRANSPORTATION

AMERICAN STREET RAILWAY FINANCE.—II.

BY E. E. HIGGINS.

AMERICAN street railroads are in possession of their territory by virtue of franchises and charters of varying value. The great majority of them of much less value than corresponding charters and franchises under which steam railroads operate. In a large number of the States of the country, in fact, I think, in nearly all, the charters granted under general railroad laws, or under special railroad laws expressly reserve to the State the right to modify or amend, practically without limit. As far as I know, that right has never been exercised to any serious extent. Lately there has been a slight movement in the direction of appealing to the State authorities to modify or amend the charters in order to accomplish what the municipalities cannot accomplish by the franchises which they have granted; but that is not at all general, and probably will not be resorted to to any serious extent.

The municipal franchises granted to street railways within the last few years are of much less value, with few exceptions, than the earlier ones. The early franchises of New York, Pennsylvania, and one or two other States, are practically for perpetual operation, nine hundred and ninety-nine years' time being allowed for charters and municipal franchises. In Illinois franchises are much less valuable chiefly because they have an extremely short time limit, fifteen years only, by present law, although in a few cases, where the franchises were granted before that law was passed, they are for longer periods. Thirty and fifty year franchises are being granted nowadays far more frequently than used to be the case, and this is having a very serious effect upon the prosperity of street railroads; and, in fact, where the time limit is very short, the people cannot expect and will not receive the service which will be given by a road whose franchises are for long periods, for the simple business reason that companies cannot afford to take chances.

In Massachusetts the condition of affairs is even worse; that State is almost unique in some respects, in that the street railway companies are practically tenants at will of the city and State, and while there is no definite limit placed upon their charter and franchise rights, the practical limit is the willingness of the companies to comply with the demands of the city and State,—a sword constantly hanging over the companies which can be used with great force by the authorities who may say, "If you do not do such and such things we will do such and such things," and they can. As a matter of fact, however, the actual danger in Massachusetts is not great, for the people there have a good common sense way of looking at things, particularly at the rights of property and investment, and I do not think there is much danger to be apprehended by the street railway companies. The police regulations which govern in almost all American cities have been expanded by practice in later years to cover almost every kind of burden. The franchises for the operation of roads by electricity have been used to impose additional burdens of a very serious nature.

It is thought by the newspapers of the country, or at least it is so expressed by them, that the street railways of this country are not paying to the municipalities anything like what the franchises are worth and all sorts of comparisons are made between what is being done across the water in that line, and all sorts of possible contracts with the city are brought up; but many things are lost sight of. It is impossible to generalize on this question of franchises any more than it is on a thousand other street railway matters. There is perhaps no branch of industrial life where generalizing is so unsafe as in street railroading. At the same time this thing is particularly true, that whatever may have been the original conditions under which street railways were granted the rights to operate roads, the conditions to-day are such that they have exceedingly heavy burdens, as heavy I believe, all things considered, as are found in any of the cities of Europe.

These burdens come in a number of ways. In the first place, the introduction of electricity made it necessary to tear up the streets. The cities promptly utilized the power which they had to impose burdens, by obtaining from many of the companies a contract to pave and keep in repair a large portion of the streets through which their lines run. One conspicuous example of this is a certain company operating several hundred miles of track which is obliged to pave and keep in repair perpetually every mile of street, from curb to curb, through which its cars run, and the condition is the more burdensome from the fact that in that particular city the mileage is almost entirely of single tracks. Again, the taxes on gross receipts are now a common feature of municipal finance. This tax runs anywhere from three to ten, fifteen or twenty per cent.; in one case, six thousand per cent., but I believe that road is not operated. (Laughter.) Other burdens are the usual ones of taxes on real estate and personal property, which are always imposed, I think without exception, and car licenses; and taxes on pretty nearly everything where a tax can be by any means imposed, are not uncommon features of street railroading as it is found to-day.

In addition to all this there comes the fact that where a franchise is granted for but twenty, thirty, forty or even fifty years, without any statement in the contract as to what is to occur at the end of the franchise period, the question resolves itself into one of a tax on franchise, because something has got to come out of earnings, and be put aside to take care of any possible changes at the end of that time. For example, a street railroad company has no knowledge as to what will happen at the end of twenty years; it may be obliged to sell its equipment, buildings, tracks, etc., for old stock. It is at the mercy of any company which comes in at the end of that time and bids for the franchise. Now these things are pretty serious, and, taken all in all, you will find that the gross tax paid by street railway companies of the United States to the State and municipal authorities—the municipal authorities as a rule—are a very considerable proportion of their entire receipts.

TRAFFIC.

The theory of the American system of operating street cars is based on the practical wisdom of a uniform fare. I do not suppose the reasons for that were ever argued pro and con and established on a theoretical basis; at the same time, the test of the theory lies in the fact that no attempt has ever been seriously made to change over from the uniform fare rate to the differential rates common in Europe. A differential rate placed on traffic as it is found here, would mean here as it has meant in Europe, that the cities would be condensed in area. As soon as you say to a man that if he goes out three miles away from the heart of the city he must pay six cents, and if he lives within two miles, he must pay but four cents, he begins to figure up at once what the four cents a day excess for the round trip amounts to in a year's time, and in the case of the workers, whose patronage is the backbone of American street railroads, it means a great deal, and in many cases that they will go to tenement house living.

European cities are extremely congested, very small in area, with great population density. American areas on the contrary are large, have always been larger than in Europe, but during the last six or eight years they have expanded in a way which you all know and to an extent which is marvelous. I am looking forward with a good deal of interest to see the results of this outgoing force as it will be shown by the next census. I believe the results will be such as to fill us all with a profound sense of gratitude to the street railway companies, and to electricity as a motive power; for it is only by means of a cheap, flexible, rapid, easily controlled motive power that such a result could possibly be accomplished.

Short distance riding is profitable on a street railroad. Long distance riding is in many of the cities distinctly unprofitable traffic. If the entire passenger traffic of any large city were doubled as to the distance traveled, it would probably mean bankruptcy; or, to put it another way, if all the passengers on the street railroad system of a city were to travel on an average 75 per cent. of the longest distance which they could travel according to the track mileage, instead of perhaps 40 or 50 per cent.—no one knows exactly what the percentage is—it would probably mean very serious financial difficulties. Of course this means that the few who choose to ride the short distances have to pay a part of the fare of the long distance riders. From a socialistic point of view that is perhaps a proper burden; in other words, the many will gain at the expense of the few, and the few who have to ride the short distances may be presumed to be financially able to do so. It may be said that those who live in the outskirts will not be the many, but the few; however, the many gain in the increase of city areas, assessed valuation, reduction of taxes, and the general improvement in the condition of living. The difference between Europe and Ameria—between England and Amrica—is something astonishing. I have not with me figures to show it, but if you will compare cities of the same population—you will find that the street railway mileage in English cities is from one-third to one-half the street railway mileage in American cities, and the traffic, that is, the use which the public make of the street railway service, is anywhere from two to five or six times greater in America than in England.

Now, at the end of the horse railroad period, and at the time when electricity was being introduced, came up exaggerated notions of profits to be derived from electric railroad operation, and exaggerated ideas of what could be done in extending into the suburbs, and the consequence is that coincident with the increase of speed and increase of traffic due to the adoption of better motive power, came an increase in mileage. Competition came in. The old companies which had been operating carefully and conservatively their horse railway properties, found it necessary either to suffer from the effects of competition on parallel lines built by syndicates which were anxious to put in electric railways wherever they could find streets to put them in, or else build the mileage themselves.

ELECTRIC RAILWAYS OF EUROPE.

OUR contemporary, L'Industrie Electrique, has just published a complete list with details of the electric railways now operating on the continent of Europe and in Great Britain. The summary, which we print herewith, shows that Germany is far ahead of any other European country in both the number of electric railways and in the length of mileage, etc. It is interesting to note also that Germany has four roads using storage batteries and France five such roads. Switzerland also makes a very good comparative showing. Considering the number and density of the population of Europe, that continent ought to be a veritable paradise for manufacturers of electric railway apparatus:

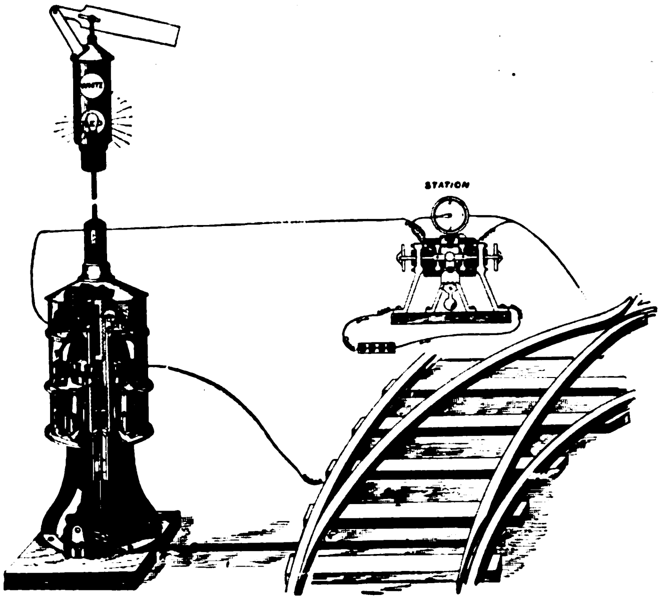
	Total Length of Lines in Kms.	Total Power on K. W.	Number of Motor Cars.	Lines with Aer. Cond.	Lines with Undergr. Cond.	Lines with Centr. Rail.	Lines with Accum.	Total No. of Lines.
Germany	642.69	18,963	1,631	45	2	..	4	51
England	109.42	4,670	168	10	1	6	1	18
Austria-Hungary	83.89	2,589	194	7	2	..	1	10
Belgium	34.90	1,220	73	4	1	..	..	5
Bosnia	5.60	75	6	1	..	..	..	1
Spain	47.00	600	40	3	..	..	..	3
France	279.36	8,756	432	19	1	1	5	26
Holland	3.20	320	14	..	..	..	1	1
Ireland	18.00	486	32	1	..	1	..	2
Italy	115.67	5,970	289	9	..	..	..	9
Sweden-Norway	7.50	225	15	1	..	..	..	1
Portugal	2.80	110	3	1	..	..	..	1
Roumania	5.50	140	15	1	..	..	..	1
Russia	14.75	870	48	2	1	..	..	3
Servia	10.00	200	11	1	..	..	..	1
Switzerland	78.75	2,622	129	17	..	..	..	17
Totals	1,459.03	47,596	3,100	122	8	8	12	150

THE SMITH ELECTRIC SELF-LOCKING SWITCH AND SIGNAL APPARATUS.

THE accompanying illustration shows an electric apparatus for operating railroad switches and signals from a point distant from the location of same. Its chief value lies in its positive action and the facility with which it can be worked in a complete system of switches and signals, also making block signal systems efficient and economical. That it is self-locking will be apparent from its construction, thus dispensing with the interlocking devices. As will be seen, the switch rod is operated by a bell crank, the horizontal arm of which engages an upright rod extending to the signal light and semaphore, which it operates, its motion being perpendicular only. This motion is effected by an electric motor fastened to a sleeve, the inside of which is threaded and revolving about the screw upon the perpendicular rod, thus securing a powerful and simple motion, which of itself produces a positive lock.

Above the motor, fastened to the sleeve, is a commutator, consisting of two metallic discs, having radiating and insulated extensions. The upper disc is in continuous contact with a brush communicating with a cut-off, in contact with a line wire. The lower disc has in contact with it a brush connected to the ground wire.

Stationary on the rod and above the screw is placed a rack operating a gear wheel, the circumference of which is equal to the motion of the perpendicular rod up or down. Its shaft carries a crank which operates a pitman, whose far end moves a sliding head housed in a standard in contact with a line wire. Back of this "sliding head standard" is another standard, which is in connection with the brush in contact with the upper disc of the commutator, and from which suspends a swinging arm, weighted at its free end. This arm is in contact with the "sliding head standard," excepting at the last moment of the gear wheel's revolution, when it is tripped by trigger on the sliding head and falls free, thus cutting off the current and stopping the motor. The weight of the ball then compels the arm to fall back again into contact, when it is ready for the next operation of the switch.



SMITH'S ELECTRICALLY OPERATED RAILWAY SIGNAL.

Repetition of the motion is prevented by an instrument in the office or tower from which the motor is operated. This instrument consists of an electro-magnet, excited by the same current and in the same direction as those in the motor at the switch. At each end of this magnet is an armature, either end of which, depending upon the direction the switch is to be thrown, is held against the core as long as the current is continued, but when interrupted by the cut-off (at the track) described above, the armature falls back, impelled by a weighted segment, the movement of which throws the instrument out of contact, in which position it remains until the current is again turned on by the operator. This falling back of the armature is a guarantee that the operation at the switch has been completed. This motion also records the position of the switch at the track, by simply recording on a dial, in figures, the last direction of the current. For switching purposes the motor, commutator and cut-off may be laid horizontally between the tracks, the screw rod directly operating the switch rod. This ingenious apparatus is the invention of Mr. Charles G. Smith, of Pittsburg, Pa.

CHEAP RAILWAY FARES AT SAGINAW, MICH.

A special dispatch from Bay City, Mich., of April 2 says: The war between the steam and electric lines doing business between here and Saginaw is on again, the 20-cent agreement rate having expired to-day. It is the Interurban electric road against the three steam roads. The latter have cut the rate to 10 cents, selling tickets in blocks of ten, good either way on any road, and transferable. The distance between the cities is nearly thirteen miles, making the fare much cheaper than by mileage. The Interurban will meet the cut at once, and May 1 will increase the number and speed of its cars, and endeavor to maintain its business between the cities, which is much larger than that of the railroads.

ROENTGEN RAYS

THE X-RAY PICTURE OF A BONE GRAFT.

BY ORRIN E. DUNLAP.

MEDICAL circles of Western New York have been very much interested in an operation that was performed on F. H. Moir in the Lexington Heights Hospital, Buffalo, some weeks ago. Mr. Moir is the foreman of the calcium carbide works at Niagara Falls, and on Jan. 1 the tibia of his left leg was fractured by the bursting of an air drum. Dr. William H. Hodge and Dr. William C. Cross were called to attend him, and at first there was every probability that the leg would have to be amputated. It was evident that the ordinary methods of instituting a new growth of bone and the proper joining would not be successful. They therefore resolved upon a remarkable operation to save Moir's leg. When all the conditions were right Drs. William Hodge, Dewitt G. Wilcox and William C. Cross performed an operation.

To the two ends of the broken tibia they engrafted a piece of bone from the femur of a sheep. The piece of bone inserted was five inches long, and the ends were placed in the ends of the tibia. The wound was then sewed up and the leg placed in a cast made of plaster of Paris, an opening sufficient to allow of the proper dressing and examination being left.

X-RAY PHOTOGRAPH OF GRAFTED BONE.

Ever since the operation was performed the patient has been the subject of unusual attention, for many physicians watched his condition. The X-ray picture presented on this page was taken just 41 days after the bone had been grafted. Drs. Wilcox, Hodge and Cross are very much pleased with what it shows. It is clear that the sheep's bone has taken life and the process of repair is rapidly going on. It is easy to trace the line of new growth along the graft. This growth is progressing from the two ends, and at each end it is clearly defined. Around the shaft is an organized blood clot, through which numerous bone cells can be traced. It is expected that this clot will, in the course of time, become a bony mass, when the result will be complete. Throughout the trying ordeal Mr Moir has kept up his courage, feeling most hopeful that he will finally have the full use of his injured leg. Naturally, it will take some months yet for the bone to grow so that he will be able to stand on the leg, but it is expected to soon place it in a heavier cast, so that he can move about on crutches. The doctors say there is no doubt of the final success of the operation, the patient's condition being of the best. The operation is remarkable from the length of the piece of bone inserted.

PHOTOGRAPHIC CANDLE POWER OF X-RAY TUBES.

SOME time since, on Prof. FitzGerald's suggestion, writes F. T. Trouton in the London "Electrician," I made an estimate of the number of candles necessary to produce the same photographic effect as a Crookes tube can while emitting X-rays. As no estimate of this kind seems to have been made, it may not be without interest to give ours.

The rays from the tube had to pass through thin cardboard, so that only X-rays acted. They were not, however, seriously diminished by the thickness of cardboard used. Between the candle and the sensitive plate, of course, nothing was interposed.

The method adopted was to arrange time and distance so as to get photographic actions of the same amount from a candle as that got from the X-rays emitted during one "spark" through a Crookes tube of the focus pattern.

From previous experiments (Report British Association, 1896, p. 711), the length of time the X-radiations continued to be emitted was known.

It was assumed for convenience that photographic effect is proportional to time of exposure, and also that the plates used gave consistent and uniform results. Making these assumptions, the "candle power" lay between 1 and 5 for the different kinds of spark used. With the spark as ordinary, and taking its duration at about 1-800th of a second, the mean "candle power" came out to be about 1. On the other hand, when the duration of the spark was curtailed to 1-10000th of a second, by arranging that a parallel spark in air should occur, the "candle power" was greater—as much perhaps as 5.

These values would point to the radiation falling off rapidly in intensity with time during the duration of the spark.

EDUCATIONAL

TEACHING BY CORRESPONDENCE SCHOOLS.

The recent twenty-fifth anniversary of the founding of the Stevens Institute of Technology was the means of bringing together a number of active and progressive mechanical and electrical engineers who are engaged in professional work, as educators in colleges and as editors of technical papers, and as consulting engineers, superintendents of motive power in railway work, manufacturers, draftsmen, etc. Having a common and well founded belief in the efficacy of an education at Stevens, it was natural that some of the chief topics for discussion should be the value of their education, how an education can be best obtained, and of what an education should consist.

As the president of the Correspondence School of Technology was present, it was natural that the work of that institution was made a subject of inquiry by many of the alumni, and it was quite a surprise to many to learn that that institution is furnishing an education not only to many whose previous theoretical training had been very meager, but also to a large number who were college graduates, including graduates from some of the principal technical schools of the country. The fact was developed that the Correspondence School of Technology has many students ranging from 25 years of age up to 55, and among whom are men of very considerable professional attainments, and occupying good positions both in professional and business circles, and who found that it paid to review work which they had had in their earlier days and also to take up new studies and be brought up to date by means of the opportunities offered by the above school. Some of these men are technical graduates, whose college courses had trained them for a specialty quite different from that into which they had drifted; some are civil engineers, who have taken up mechanical engineering, and vice versa, and very many of both having gone into electrical work. In some cases men have even been prepared at college for the course which they are now reviewing in the Correspondence School; the review is valuable, and at the same time many practical suggestions of great value to them in their work are obtained.

A specialty of the school is also its course in advanced mathematics, which includes differential and integral calculus. This course is taken by quite a number of professional men and also by instructors in schools and colleges.

Although, as above stated, a large portion of the students of the school are men of mature years, nevertheless, there are quite a number of young men taking the complete course with the intention of afterward going to college, a course in the school enabling them either to devote less time to their college course, or to devote more time to laboratory work when in college. To those who know of the professional standing of the instructors in the school it is not surprising to learn of its success along professional lines; nevertheless, it is gratifying to know that the work has been recognized, and its students attest its value.

SOCIETY & CLUB NOTES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 115th meeting of the Institute wil be held at 12 West Thirty-first street, New York City, on Wednesday, April 21, 1897, at 8 o'clock p. m. A paper will be presented by Dr. A. C. Crehore and Lieut. Geo. O. Squier, entitled "The Synchronograph; A New Method of Rapidly Transmitting Intelligence by the Alternating Current." The paper will be illustrated by lantern slides, and advance copies will be distributed at the meeting.

A meeting of Western Members will be held at the Armour Institute, Thirty-third street and Armour avenue, Chicago, at the same date and hour (April 21, 8 p. m.) where the paper will be read by Dr. Frederick Bedell.

The next meeting of the Institute will be the annual meeting for the election of officers, the reception of the yearly report, etc., which will be held at 12 West Thirty-first street, New York City, May 18. The general meeting for the reading and discussion of professional papers will be held at Greenacre-on-the-Piscataqua, Eliot, Me., beginning July 26.

PERSONAL

MR. E. G. ACHESON.

On Saturday, April 17, Mr. E. G. Acheson, president of the Carborundum Company, of Niagara Falls, and the discoverer of the new abrasive which has won such popularity, sailed for Germany to establish a plant for the manufacture of carborundum in that country. He was accompanieyd by Mr. James Hipple, who has been associated with Mr. Acheson for several years and is thoroughly familiar with the process of making carborundum. When he sailed, Mr. Acheson expressed the opinion that they would be absent at least three months. It is expected that the plant in Germany will be about the size of the plant now in operation at Niagara Falls, which now uses 1,000 horse-power. The idea of erecting the plant in Germany is to protect the German patents, and Mr Acheson could not say whether they would simply make the carborundum, or whether they would also manufacture wheels and the various other articles made from the abrasive. He expressed the belief that they would sell the carborundum to other parties who would manufacture the several articles. The law in England is not so stringent as to the erection of factories and the process of manufacture in order to protect the patents granted by that country; and it is to supply the English market, as well as the increasing American demand, that the Niagara Falls factory is to be enlarged. The Niagara Falls plant has been a great success, and on May 17, or thereabouts, the Canadian plant will be in operation at Niagara Falls, Ont.

MR. J. D. REID, U. S. Consul at Dumfermline, Scotland, celebrated the close of his seventy-eight year by playing one game of golf, and hailed his birthday by playing another "in quite a gale on the Ferryhills." God bless the Grand Old Telegrapher! May he indulge in a birthday foursome these many years to come.

PRESIDENT SAMUEL INSULL, of the Chicago Edison Co., was an Eastern visitor last week.

MR. J. W. GODFREY, general manager for Habirshaw wires and cables, has just returned from a long trip, during which he went as far as California. He reports general business as better and his own trade as booming. Dr. Habirshaw is still in Europe.

MR. W. F. LEWIS, manager of the Evanston exchange of the Chicago Telephone Co., eloped to Milwaukee with Miss F. C. Richards, niece of a banker, and married her there. The banker was surprised, but a reconciliation has been happily effected, and the exchange is in regular operation.

LEGAL NOTES

THE SCOPE OF THE ROOSEVELT TELEPHONE SWITCH DECISION.

WE have received from the Western Telephone Construction Co., of Chicago, the subjoined statement in regard to the recent decision by Judge Grosscup noted in our last issue:

The Western Telephone Construction Company recently scored another victory over the Bell Company by its defeat of the Western Electric Company in the suit brought by the Western Electric Company against the Western Telephone Construction Company for alleged infringement of the famous Roosevelt patent, No. 215,837. For many years back the Roosevelt patent has been considered the fundamental automatic telephone switch patent, and so broad and sweeping were its claims that it was supposed to cover every conceivable form of switch for changing from the calling to the talking circuits, and vice versa, by the mere act of taking the receiver from, or replacing it on, its point of support. So much faith did the Bell authorities have in the strength of this patent that they paid Roosevelt and his heirs a royalty of ten cents on every hook switch manufactured by that company during the life of the patent, and said royalty amounted in all to over $30,000.

The devices used by the Western Telephone Construction Co., which were claimed by the complainants to infringe the Roosevelt patent were not only their old form of semi-manual switch, where the hook had to be pulled own after hanging the receiver upon it, but also on their automatic form of hook switch, similar to that which they are now turning out, where the only movement necessary to operate it is to remove the receiver from, or replace it on, the hook.

Judge Grosscup, in his decision, refers to the previous art which disclosed means for cutting the telephone and call bell alternately, in circuit, by means of a switch operated manually. This decision, although it does not affect the general public directly (the patent having expired by actual limitation) is very significant. It, and the decision on the Watson switch hook patent, which latter was handed down by Judge Showalter, of the same court, a few weeks ago, shows conclusively the attitude that the courts are likely to take in the consideration of the broad patents for auxiliary telephone apparatus owned by the Bell Company; and it also shows that the public have long been suffering needlessly at the hands of the great monopoly.

The case was tried by Barton & Brown for the complainants, and by Stanley S. Stout for the defendants. The Judge held that the Roosevelt patent covered purely an automatic switch; one which acted without the volition of the operator, and that it did not cover any switch which required any manual operation at all, or required the removal or replacing of the telephone from its point of support.

HARRISON INTERNATIONAL TELEPHONE COMPANY.

Judge Grosscup, in the United States Circuit Court, in Chicago, has declined to appoint a receiver for the Harrison International Telephone Company on the bill of several stockholders. He based his refusal to interfere on the ninety-fourth rule of the court, which requires stockholders who claim fraudulent conduct on the part of a corporation to first seek redress of the wrongs through the official board of the corporation. This was not done in the case of the complainants.

$15,000 FOR PERSONAL INJURIES.

The judgment obtained by Lawyer Frank Dudley Tansley in favor of his client, Chas. H. Blair, against the New York Electric Equipment Company for $15,000 in the United States Circuit Court and appealed to the United States Circuit Court of Appeals, has been affirmed by the latter. Blair was injured in April, 1895, in the New York Life Insurance Building by a pipe falling from a bundle being raised by the employés of the Equipment Company. The precaution of using bagging on the end of the bundle was omitted. Blair, as the result of the injuries he sustained, became paralyzed on his right side. He had been warned not to omit the precaution.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

BY MAX OSTERBERG.

Dynamos and Motors:

ARMATURE REACTION DUE TO MAGNETIC WHIRLS. —By Ch. Westphal. The question is discussed to what extent whirls influence the electric conditions in an alternator; this is principally of value in connection with the construction of diagrams. It is found that these currents increase the armature reactions.—"Elek. Zeitschr.," March 11, '97.

Electro-Chemistry:

REFINING BISMUTH BY ELECTRICITY.—It is reported that B. Zakorski has produced a satisfactory method for refining bismuth. He employs impure bismuth as an anode in an electrolytic tank with a solution of nitric acid as an electrolyte. Carbon, pure bismuth or platinum may be employed as the cathode. Pure bismuth is deposited on the cathode, from whence it falls or may be asily removed. It is then washed in dilute nitric acid, dried and fused.—"Elec.," March 24, '97.

Electro Therapeutics:

MOTOR GENERATOR IN THERAPEUTICS.—By Edwin W. Hammer. The writer explains the advantages and disadvantages of the different kinds of currents that are employed in electro-therapeutics and also the various machines that have been introduced into practice.—"Elec. Journ.," March 1, '97.

Lighting:

SOME FACTS RELATING TO GAS AND ELECTRICITY. —By J.F. Seamon. The writer gives a comparison of the developments of gas and electricity for the last twenty years, stating the uses that they have had and how they stand at the present time.—"Am. Gas Lt. Journ.," Feb. 15, '97.

GAS ENGINES FOR ELECTRIC LIGHTING.—This article relates to the question whether it is advisable to operate a dynamo in connection with a gas engine, pointing out one or two serious difficulties that arise, the main one being the irregular way in which a gas engine runs.—"Prog. Age," March 1, '97.

METHODS OF CHARGING FOR ELECTRICITY SUPPLY. —By R. P. Wilson. An article relating to the different methods employed for charging consumers for the amount of current they use, pointing out the advantages and disadvantages of the various systems.—"Electricity," March 24, '97.

Measurements:

INSULATION MEASUREMENTS.—By Rudolf Kutsch. The writer of this article prepared an instrument (sketches and instructions for same accompany the description), whereby he measures the insulation between any two or three wires on a high potential system. He tries to determine the resistances of the principal sections as well as of the system as a whole.— "Elek. Zeitschr.," March 11, '97.

Miscellaneous:

NOTE ON THE DIELECTRIC CONSTANT OF ICE AND ALCOHOL AT VERY LOW TEMPERATURES.—By Profs. James Dewar and J. A. Fleming, FF. R. S. The most important section of this paper consists of four tables, including the determinations of several observers. (1) Dielectric constant of water by various methods. (2) The electrical refractive index of water for electric waves of various wave lengths. (3) The dielectric constant of ethyl alcohol, and (4) the electrical refractive index of ethyl alcohol for the electric waves of various wave lengths.—Lond. "Elec.," April 2, '97.

PREVENTION OF FIRES DUE TO LEAKAGE OF ELECTRICITY.—By Fred. Bathurst. A comparison between electric wiring and gas piping, pointing out necessary precautions to be taken in both cases as regards materials, etc. The statement is made that fires are often prevented by leakage currents blowing fuses.—"Am. Gas Lt. Journ.," April 12, '97.

Power Transmission:

ELECTRICITY AT THE BLAST FURNACE.—This article shows how the electric motor is taking the place of other kinds of machinery in running cranes, hoists and the like.— "Am. Man.," March 19, '97.

ELECTRIC HOISTS.—Description of a number of mines that have introduced electric hoists, showing the great saving in operating expenses and the advantage that they can be controlled from most any point.—"Age of Steel," April 3, '97.

Railways:

ELECTRIC SELF-LOCKING SWITCH AND SIGNAL APPARATUS.—Illustrated description of a new system, whose chief value is said to be in its positive action and the facility with which it can be worked.—"Am. Man.," April 9, '97.

THE NEW HEILMANN LOCOMOTIVE.—Abstract of an article by F. Drouin. A few of the important features of this locomotive and results of efficiency tests. The total efficiency of the locomotive is 73.4 per cent., while the commercial and available efficiency has been worked as follows:

The power absorbed by the locomotive itself can be deduced from the efficiency of the locomotive as an apparatus for traction; that is to say, the relation between the power available at the drawbar and the I. H. P. of the cylinder. This efficiency naturally varies with the profile of the line, the weight of the machine, the speed, etc. Assuming that the locomotive is running at full load on the level, at 62 miles an hour, with a total weight of 132 on the locomotive (this weight assumes that the engine, which weighs about 120 tons, is followed by a tender which can carry 20 tons of water, that this stock is half exhausted), the effective horse-power absorbed by the machine would be 342, and hence the power available at the drawbar would be 664 horse-power. The efficiency of the locomotive is then 48.4 per cent. 660 horse-power at the drawbar should draw 250 tons of ordinary rolling stock (or 350 tons of rolling stock on bogies) at 62 miles an hour.—Lond. Elec., April 2, '97.

OVERHEAD CONSTRUCTION FOR SUBURBAN LINES.— By J. F.Macartney. In laying out the overhead work the conditions to be taken into consideration in laying out feeders are as follows: (1) Number, weight, speed and headway of cars. (2) Grades and curves. (3) Distance in feet from source of power to a center of distribution. (4) Cost of power in station, which determines the amount of power which may be economically lost in the feeder. Further on a calculation shows that one mile of span work, poles 110 feet apart, allowing for one curve and one turnout, may be constructed for $1,200.—Str. R'y Journ. Elec. R'y Gaz., April, '97.

STREET RAILWAY SYSTEM OF SYRACUSE, N. Y.—The entire street railway system in the above named city has been completed and is explained in detail with illustrations of power house, trolley line, feeders, etc.—Str. R'y Journ., March, '97.

SAFETY DEVICE FOR TROLLEY LINES.—Before Franklin Institute. By L. G. Rowand. This device consists of a differentially wound magnet with the same amount of current running through both sections, so that the magnet remains neutral. If the trolley line which is in series with one winding should break, the other winding would energize the magnet and draw up an armature, which, acting as a circuit breaker, would disconnect the trolley line from the cable or main supply wire. Another device in connection with this sends an alarm to the power house or repair station, giving the number of the trolley section that is disabled so that the repair wagon can immediately start for the scene.—Electricity, Mar. 24, '97.

Roentgen Rays:

THE PRACTICAL VALUE OF THE ROENTGEN RAY IN THE ROUTINE WORK OF SURGICAL OFFICE PRACTICE.—By H. M. Richardson, M. D. A communication in which the writer points out the value of the Röntgen ray for purely diagnostical purposes, mentioning many examples which have come up in his practice.—"Elec. Journ.," March 15, '97.

Telegraphy, Telephony, Etc:

SPAN OF TELEGRAPH WIRES OF IRON AND BRONZE. —By H. Dreisbach. Data for expansion and contraction as well as increase and decrease of elasticity with varying temperature, derived from practice, are given and as a result it is found that iron or bronze wires may be put on the same poles without causing undue strains, since the curves of span remain approximately parallel.—"Elektr. Zeitschr.," March 11, '97.

ACCUMULATOR PLANT IN THE MAIN TELEGRAPH STATION AT PARIS.—By J. A. Montpellier. Diagrams showing the methods of connection, and description of plant with details concerning the manipulation.—"Elek. Zeitschr.," March 18, '97.

Transformers:

OIL INSULATION IN TRANSFORMERS.—The problem of utilizing oil insulation is discussed, editorial reference being made to Prof. Garnett's experiments, which show that oil has the tendency of absorbing water, and in many cases where transformers are left open on top, cause a short circuit in the transformer wire.—"Elektr. Zeitschr.," March 18, '97.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 6, 1897.

Batteries:—

COMPOSITION OF MATTER FOR MANUFACTURING BATTERY-CASES, ETC. W. Morison, Montclair, N. J., 580,139. Filed Nov. 24, 1896.

Consists of asphaltum, gutta-percha, asbestos and sulphur in suitable proportions.

Conductors, Conduits and Insulators:—

CABLE ATTACHING DEVICE. J. Stephens, Forest City, Pa., 580,165. Filed Nov. 13, 1896.

Comprises a pair of members arranged to open and close, hollowed out inside to hold a coiled portion of the cable, and means for locking the sections together.

Distribution:—

ELECTRICAL TRANSFORMER PLATE. R. W. Blackmore, Peoria, Ill., 580,206. Filed Nov. 20, 1896.

A transformer plate in which are two openings for receiving a given coil of the transformer, and provided with two cuts, one communicating from one hole to the outside edge of the plate, and the other communicating from one hole to the other hole, and both cuts lying in a rectilinear line, which coincides with an edge of each hole.

Dynamos and Motors:—

ARMATURE CORE. S. H. Short, Cleveland, Ohio, 580,011. Filed Jan. 19, 1897.

An armature-core built up of laminae and having spacers interposed between the laminae and separated therefrom.

MAGNETO AND DYNAMO GENERATOR. C. H. Wade, J. Moores, and H. O. Farrell, Manchester, Eng., 580,180. Filed Jan. 5, 1897.

Comprises a contact block in combination with a series of terminals connected with sections of the armature coil, the block or device being moved over the terminals by centrifugal action.

ELECTRIC BRUSH HOLDER. T. J. Loughridge, Oshkosh, Wis., 580,144. Filed June 1, 1896.

A clamp for holding electric brushes while being trimmed.

Electro-Metallurgy:—

PROCESS FOR PRODUCING METALLIC CYANIDS. C. Kellner, Vienna, Austria-Hungary, 579,988. Filed Feb. 11, 1896.

Consists in decomposing a suitable nitrate or nitrite by the heat of and in an electric arc between carbon electrodes.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. W. J. Davy, London, Eng., 580,256. Filed Dec. 9, 1895.

Feed mechanism.

Miscellaneous:—

KEYBOARD ATTACHMENT. H. W. Shonnard, New York, 580,010. Filed Aug. 24, 1895.

Adapted for musical instruments in keyboard attachments on which a key striker is actuated by electro magnets.

ART OF AND APPARATUS FOR GENERATING AND DISTRIBUTING MUSIC ELECTRICALLY. T. Cahill, New York, 580,035. Filed Feb. 4, 1896.

The tones are produced by the translation of electrical vibrations.

ELECTROMAGNETIC COIL. W. E. Harrington, Philadelphia, Pa., 580,276. Filed Jan. 15, 1896.

An electromagnetic coil having radially deep and axially narrow composite windings, said composite windings being made up of two or more separate bars, each of substantially rectangular form connected in multiple and the outer ones being coiled on those next within to form the composite windings.

APPARATUS FOR MANUFACTURING OZONE. C. J. Yarnold, London, Eng., 580,244. Filed Aug. 20, 1896.

Compresses a casing provided with passage ways for the gaseous fluid, expansion chambers at the ends of the generator of greater cross sectional area at the middle than at their ends.

URINAL. F. C. Rees, Hampton, Va., 580,329. Filed Feb. 27, 1896.

Consists of a receptacle normally concealed beneath a flooring, a trap door obscuring the receptacle and electrically operated means for automatically and simultaneously opening the trap door and elevating the receptacle.

Railways and Appliances:—

ELECTRICAL RAILWAY SYSTEM. W. Robinson, Boston, Mass., 580,057. Filed Jan. 21, 1895.

Sectional conduit system.

CONDUIT SYSTEM FOR ELECTRIC RAILWAYS. A. Q. Babendreier, Washington, D. C., 580,246. Filed Oct. 26, 1896.

Comprises an insulator support embodying a casing provided with outwardly projecting lugs at each end, brackets fixedly secured to the lugs, and means for supporting the brackets within the conduit.

Switches, Cut-Outs, Etc.:—

ELECTRIC PUSH-BUTTON. R. L. Moore, Statesville, N. C., 580,092. Filed June 30, 1896.

Consists of a cap carrying contact devices, and fasteners comprising pieces of wire which are bent into eyes and secured to the cap, the fasteners being adapted to receive securing devices.

MAGNETIC CIRCUIT BREAKER. W. E. Harrington, Philadelphia, Pa., 580,277. Filed Jan. 15, 1896.

The cut-out switch is actuated to sever connection with the circuit in which it is placed with a rapidity bearing an inverse ratio to the amount of excessive current flowing through the circuit.

ELECTRICAL CUT-OUT. H. C. Jones, New York, 580,320. Filed Aug. 12, 1896.

Details of construction.

ELECTRICAL CIRCUIT CLOSER. O. F. Allen, Springfield, Mass., 580,339. Filed Dec. 18, 1896.

Comprises two electrodes normally out of contact, coated with easily fusible conductive metal, in combination with a receptacle adapted to hold the molten fusible metal in contact with both electrodes.

Telephones:—

MAGNETO ELECTRIC GENERATOR. W. Gillette, New York, 580,975. Filed July 31, 1895.

Comprises a series of permanent magnets, with their extreme ends presented to the face of the armature with a shunting device, a shaft driving a train of geared wheels.

TELEPHONE CIRCUIT. J. S. Stone, Boston, Mass., 580,166. Filed June 26, 1895.

The current is supplied to the transmitters from the central station.

ATTACHMENT FOR OPERATING TELEPHONE CALL BELLS. H. W. Libbey, Boston, Mass., 580,335. Filed Sept. 19, 1893.

A lever secured to the casing of the instrument one end of which is over the push-button, and the other end having a block with a beveled hole through it, a cord passing through the block, and wound around a spool adapted to rotate the bell shaft when the cord is pulled out.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 13, 1897.

Alarms and Signals:—

CIRCUIT CONTROLLING APPARATUS. F. M. Brinkerhoff, Matteawan, N. Y., 580,519. Filed March 10, 1896.

Comprises a switch jaw and a moving member actuated through suitable connections by the passage of a train.

BURGLAR ALARM SYSTEM. D. M. Munro, Gaithersburg, Md., 580,552. Filed May 25, 1896.

Consists of a normally closed night circuit through the entrances, a relay, and lines therefrom, a normally open local circuit adapted to be closed by the relay, a switch in the night circuit, and an independent switch in the day circuit.

ALARM LOCK. J. H. Doscher, Brooklyn, N. Y., 580,680. Filed March 26, 1896.

The insertion of the key into the lock causes an electric bell to be rung.

Batteries, Primary:—

GALVANIC BATTERY ELEMENT. G. Laura, Turin, Italy, 580,497. Filed Feb. 27, 1895.

A diaphragm for double liquid cells, consisting of a paste composed of a pulverized plant of the order of Malvaceae and a conductive substance, as a solution of sodium chloride.

GALVANIC BATTERY. R. W. Gordon, Boston, Mass., 580,523. Filed Oct. 1, 1894.

A solution of caustic soda is used for the exciting fluid and black oxide of copper as the depolarizing agent.

Batteries, Secondary:

ELECTRODE FOR SECONDARY BATTERIES. F. W. Schneider, Triberg, Germany, 580,428. Filed Aug. 15, 1896.

Comprises a supporting frame, electrodes consisting of carriers having a perforated top and an imperforated bottom and an open-top trough-shaped receptacle within them supporting the active material.

Connectors, Conduits and Insulators:—

ART OF INSULATING ELECTRIC CONDUCTORS. A. J. Robertson, Chicago, Ill., 580,584. Filed Sept. 6, 1895.

Consists first in hermetically inclosing an electric conductor in a hollow conduit and then exhausting and drying the air in the conduit.

INSULATOR AND INSULATING CONDUIT OF TUBING FOR ELECTRICAL PURPOSES. F. G. Treharne, Lainishen, Eng., 580,628. Filed Oct. 28, 1896.

Consists of silicates impregnated with electrical non-conducting cement.

Dynamos and Motors:—

SYSTEM OF CONSTANT CURRENT GENERATION AND REGULATION. T. H. Hicks, Detroit, Mich., 580,490. Filed Nov. 5, 1894.

Comprises two electrical generators with a work circuit, each of the generators having two sets of field magnet coils; one field coil of each generator and the work circuit being connected in linear series with each other, one field coil of one generator being arranged in multiple arc with the work circuit, and the remaining field coil being supplied with current from the other generator.

Electro-Metallurgy:—

ELECTRIC DEPOSITING DEVICE. J. W. Conchar, Dubuque, Iowa, 580,451. Filed June 22, 1896.

Consists of a tank and fixed rods for the hooks which support the articles to be deposited upon in the bath, mounted above the tank, combined with an endless belt.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. A. C. Seibold, Mount Vernon, N. Y., 580,734. Filed May 11, 1892.

The electrodes are enclosed in a small normally air-tight casing, provided at its ends with closures engaging the electrodes, one or both of which constitute valves.

ELECTRIC SEARCH LIGHT. R. M. Hunter, Philadelphia, Pa., 580,836. Filed Aug. 1, 1891.

Employs means to cause the reflector to be vibrated for the purpose of causing the beam of light to be vibrated at its distant end with a sufficient rapidity to continually illuminate an area greater than would be otherwise illuminated.

Measurement:

ELECTRICAL INDICATING WATTMETER. T. Duncan, Fort Wayne, Ind., 580,384. Filed Dec. 3, 1896.

Comprises a plurality of field coils whose magnetic axes cut each other at right angles, and a volt coil pivotally mounted therein and having its magnetic axis at right angles to one of the magnetic axes of the field coils and actuated by them.

ELECTRIC RIVETING APPARATUS. E. Thomson, Lynn, Mass., 580,475. Filed June 14, 1889.

Comprises a transformer whose secondary is a bar, a metallic anvil secured to one terminal bar, and a metallic heading tool mounted opposite to the anvil upon the other terminal of the bar.

NON-INDUCTIVE ADJUSTABLE CARBON RESISTANCE. S. P. Blackmore, Johannesburg, South Africa, 580,657. Filed Sept. 23, 1896.

Applicable to lightning arresters for use with electric light and transmission of power conductors.

ELECTROMAGNETIC LOCKING DEVICE. E. J. M. Scheeren, Denver Col., 580,820. Filed Oct. 13, 1896.

Appliance for locking doors, whereby the movement of the spring-held bolt by the knob is prevented by pressing a push button.

ELECTRIC HOIST. J. A. Lounsbury, Chicago, Ill., 580,457. Filed July 13, 1896.

Comprises a motor frame of annular form having an integral extension providing a bearing for a sheave shaft.

Railways and Appliances:—

SUPPORTING MEANS FOR ELECTRIC RAILWAY SUPPLY CONDUCTORS. H. P. Davis, Pittsburg, Pa., 580,380. Filed June 10, 1896.

Comprises a plate provided with a plurality of radial grooves, a cap plate and means for clamping the conductors between the plates.

SUPPORTING MEANS FOR ELECTRIC RAILWAY SUPPLY CONDUCTORS. H. P. Davis, Pittsburg, Pa., 580,381. Filed June 10, 1896.

Consists of a bar having a longitudinally grooved upper edge and a curved lower edge, and provided at one side with a perforated ear.

ELECTRIC HEADLIGHT. R. P. Schwerin, San Francisco, Cal., 580,557. Filed Sept. 30, 1896.

Adapted to be carried by electric cars.

TROLLEY CATCHER. R. Orme, Racine, Wis., 580,708. Filed July 23, 1896.

Comprises a gravity actuated weight to which the cord is attached, a catch releasably supporting the weight, and means by which the catches are actuated by the raising of the weight to automatically release it.

ELECTRIC LOCOMOTIVE. W. S. Elliott, Pittsburg, Pa., 580,598. Filed June 27, 1896.

A truck frame comprising an upper motor and car supporting framework, and friction-driving mechanism supported upon the wheels, and a lower framework provided with housings and car axle boxes mounted in the housings, and means for adjusting the housings toward or from each other.

Switches, Cut-Outs, Etc.:—

MEANS FOR CONTROLLING ELECTRIC CURRENTS. E. Ellicott, Chicago, Ill., 580,663. Filed Aug. 6, 1896.

Adapted for use in stage lighting.

ELECTRIC SWITCH. T. H. Brady, New Britain, Conn., 580,678. Filed Jan. 9, 1897.

Four-pole spring switch.

Telegraphs:—

PRINTING TELEGRAPH. H. Kreusler, Kreischerville, N. Y., 580,617. Filed March 6, 1896.

Comprises a switching arm, a keyboard, a screw shaft for swinging the arm, a local circuit controlled by the keyboard for controlling the arm, the keys of the keyboard being so located as to arrest the motion of the arm.

Telephones:—

TELEPHONE TRANSMITTER. A. Stromberg and A. Carlson, Chicago, Ill., 580,434. Filed Nov. 9, 1896.

Comprises a diaphragm, a sheet of wire gauze mounted upon its rear face, a sheet of wire gauze mounted opposite the sheet of gauze upon the diaphragm, and granular carbon between the sheets of gauze.

OBITUARY

J. J. STORROW.

Mr. J. J. Storrow, the well-known attorney of Boston, who recently represented the Venezuelan Government before the commission appointed by President Cleveland to determine the boundary line between Venezuela and British Guiana, died suddenly on Thursday afternoon, April 15, in the new Congressional Library Building, Washington. Mr. Storrow was on his way from Florida with his family. He left his family at Fortress Monroe and went to Washington on business before the Supreme Court. He was looking through the new library building when he suddenly fell to the floor and died in a few moments.

He was one of the most eminent lawyers in Boston. He was born in that city in 1837, the son of Charles S. Storrow. He graduated from Harvard in 1857, and three years later was admitted to the Suffolk Bar. He early acquired a reputation as a patent lawyer, and was chief counsel for the Bell Telephone Company from 1879 until his death. His strong and able telephone arguments are among the classics of electrical litigation.

When, in November last, opposition arose in some quarters in Venezuela against the treaty, Mr. Storrow accompanied Señor Andrade, Minister to the United States, to Caracas, and was largely instrumental in bringing the treaty into favor there and securing its acceptance. He returned to Washington on December 28.

He leaves two sons, J. J. Storrow, Jr., and Samuel Storrow, the former just chosen to represent Harvard as Walter Camp represents Yale in matters of dispute between the universities. The deceased leaves a brother, Charles Storrow, and a sister, Mrs. Eben Dale.

MR. JOHN KENNAN, father of Mr. George Kennan, the noted Siberian traveler and writer, has just died at Montclair, N. J., aged 93. He was for forty years a resident of Norwalk, O., and in charge of the Western Union office. He was the oldest telegrapher, it is said, in the United States.

MR. B. ECKHOUT, member of the electrican engineering firm of H. D. Bayne & Co., has died suddenly of hemorrhage of the lungs at Colorado Springs. He was born at Glasgow, Scotland, and was only 29 years of age.

THE STOCK MARKET

WHAT WILL THE EFFECT OF WAR BE?

At last Greece and Turkey are officially at war, having been so in an unofficial but very practical way for a month past. The effect on the various markets is now to be seen. As far as can be judged, the immediate effect on American products must be excellent. Wheat went up 5 cents Saturday and bids fair to rise further this week, with corn in close attendance. There are few things, even to munitions of war, that this country cannot furnish to the European combatants. When we come to securities, even our worst show up pretty well as compared with Greek and Turkish "obligations." At the same time, there is likely to be a drawing in of credits everywhere by European bankers, and that will affect prices adversely. One can never tell where an ugly little war like the present will end.

The tremendous floods through a large section of the Southwest have checked trade, and there is a prospect that this year's cotton crop will be greatly reduced there. On the other hand, farmers are happy over the prices of cereals. Business failures last week fell off to 195 as compared with 244 a year ago. That tells how things are going.

With sales of only 6,445 shares, General Electric closed last week at 30⅞. Western Union, on 13,104 shares, closed at 80⅝. American Bell telephone rose from 218½ to 224. It may be noted that General Electric bonds, deb. 5s, sold at 96.

REPORTS OF COMPANIES

NATIONAL CONDUIT AND CABLE CO.

The National Conduit Manufacturing Company and the National Underground Cable Company have been consolidated under the name of the National Conduit and Cable Company. The new organization is the sole owner of patents for paper insulated wires and cables for telephone and telegraph, electric light and power service, and wrought iron cement lined tubes for electric subways. It also contracts for complete subway systems. The mills of the new company are at Hastings-on-Hudson, with its New York office in the Times Building, and branch offices in Boston, Chicago and Philadelphia. The officers are Edward S. Perot, president; C. Gallagher, vice-president; Jas. P. McQuaide, treasurer, and Geo. J. Jackson, secretary.

CHASE CONSTRUCTION CO.

The Chase Construction Company, of Detroit, Mich., have just been incorporated, with an authorized capital of $25,000. The company will devote itself to construction and equipment of central station lighting, electric railways, steam and water works plants, having just secured a contract to build the electric railway running between Cleveland and Lorain, O., for the Lorain and Cleveland Electric Railroad Company, which is to be completed by June 1. The officers of the company are: George E. Fisher, president and treasurer; O. D. Chase, secretary and chief, engineering department, and E. N. Chase, vice-president and superintendent of construction. The active men in the company are pioneers in the electrical business. O. D. Chase, whose name the company bears, was electrician and superintendent of the Commercial Electric Engineering Company, while George E. Fisher was its business manager. During the term of the Commercial Company's existence, they installed 56 central station lighting plants and 167 isolated plants, in addition to a large volume of the other electrical work. The Chase Construction Company have secured the services of E. F. Mann as superintendent of railway construction, a practical man of large experience in railway work, having superintended the construction of the systems of the Detroit Electric Railway Company, Niagara Falls, Toronto and a number of the Cleveland roads, covering a period of twelve years. The company have handsome offices in the new Majestic Building, in Detroit, and anticipate a very active business during the coming season.

J. G. WHITE & CO.

ANNOUNCEMENT is made in this issue of a new corporation. J. G. White & Co. has been organized under the laws of the State of New York, with a fully paid cash capital of $100,000. It succeeds to the business of the White-Crosby Company, of 29 Broadway, New York, and of Baltimore, formerly conducted by J. G. White & Co., in which firm the "company" was nominal.

When the White-Crosby Company was organized, it was planned that Mr. Oscar T. Crosby, who had severed his connection with the General Electric Company, in order to participate in the business of the new corporation, would devote a large portion of his time to the affairs of the company with which his name was associated. About the time the new company was organized, the very arduous work that Mr. Crosby had been doing for the General Electric Company and the Thomson-Houston Electric Company produced its natural effect, and consequently Mr. Crosby decided to take a recuperative trip to Europe. After returning to this country, Mr. Crosby decided to become more largely interested in local properties, and with this end in view, he and Mr. Charles A. Lieb acquired a controlling interest in one of the smaller street railways in Washington, D. C., and later organized a power and lighting company, which has grown into a large and flourishing institution. This and other local interests, such as those recently acquired in New York, have gradually and finally absorbed all of the time and attention of Mr. Crosby. In re-incorporating, under the laws of the State of New York, instead of under the laws of the State of West Virginia, it was finally, after mature deliberation, decided that as Mr. Crosby had voluntarily withdrawn from active participation in the business of the company, any chance of confusion as to its affairs would probably be lessened by adopting the name under which the business of the concern had been carried on prior to the date of the incorporation of the White-Crosby Co.

Mr. J. G. White, president of the old White-Crosby Company, and now of the J. G. White Company inclusive, was graduated at Pennsylvania State College in 1882, and having obtained a second degree (Ph. D.) at Cornell University, in 1885, taught physics in the University of Nebraska for two years. At the end of this time (1887) he formed the Western Engineering Company, with headquarters at Lincoln, Neb. In this enterprise he was joined by Mr. D. C. Jackson, now professor of electrical engineering at the University of Wisconsin, and Mr. Harris J. Ryan, now professor of electrical engineering at Cornell University. This company was sold to the United Edison Electric Manufacturing Company in the spring of 1890, Mr. White at the same time making a special agreement with the Edison Company as to contracts for the construction and equipment of electrical railways.

During the summer of the same year the Edison General Electric Company was formed, and Mr. White considered it expedient to decline the salaried position then offered him, and to begin business in New York on his own account. This was done in the fall of 1890, and the business then started was conducted continuously until the formation of the White-Crosby Company in May, 1894.

This firm, under the various titles above mentioned, has equipped a considerable portion of the electric railways of the country, having had contracts in Spokane,, Washington, Salt Lake City, Utah, Sherman, Texas, and in many cities and towns between these far-away points and the New England coast.

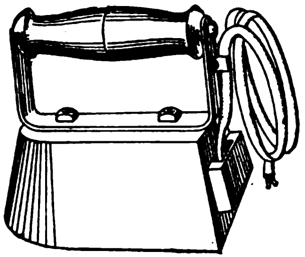
During the last five years, the contract work done in Baltimore alone has aggregated some three millions of dollars, and many other contracts have been carried to a successful completion. Amongst the more prominent of the recent contracts was the bulk contract for the Buffalo and Niagara Falls Electric Railway, and the contract for the transmission line complete, a few months ago, for the Cataract Construction Company, for carrying Niagara Falls power into the city of Buffalo.

The company has, at the present time, contracts for the complete construction and equipment of the street railways of Charleston, S. C., the changing of the "Blue Line" of the Baltimore City Passenger Railway Company from cable to trolley; the electrical engineering for a large transmission plant near Helena, Mont.; the building of extensions for the Norwalk (Conn.) Tramway Company, as well as other similar work.

As will be seen from the above, Mr. White was among the first in the electric railroad construction business, and the new corporation will have the benefit of his long and varied experience and of his well established reputation for first-class construction, careful and intelligent attention to details, and fair dealing. A continuation of his wonted success may confidently be expected.

TRADE NOTES & NOVELTIES

HATTERS' ELECTRIC IRON.

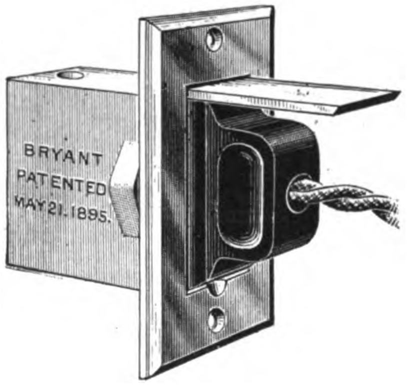


This is the conventional form of "Hatter's Iron" with polished sides and is used in many of the large retail establishments throughout the country, as well as by manufacturers. It is perfectly clean at all times, heats quicker than by other means, effectually doing away with leaky gas connections and other objectionable features incident to the older methods of heating. It is made for all lighting voltages by the American Electric Heating Corporation, of Boston.

THE CHAPMAN RECEPTACLE.

UNDER a recent arrangement made with Mr. F. A. Chapman, the patentee of the well-known Chapman receptacle, the Bryant Electric Company, of Bridgeport, Conn., are now the exclusive manufacturers of this excellent device.

This device has been on the market for a little over a year, and the fact that it has been indorsed by the underwriters and adopted by many of the leading engineers for use in some of the finest office buildings in the country is sufficient recommendation to the trade. Up to the present it has been made in one form only, as shown by the illustration, but it is the intention of the Bryant Company in the future to place several different designs on the market and make a number of improvements.



THE BRYANT-CHAPMAN RECEPTACLE.

THE EXCELSIOR ELECTRIC CO'S DYNAMOS AT THE WEST CHICAGO PARK.

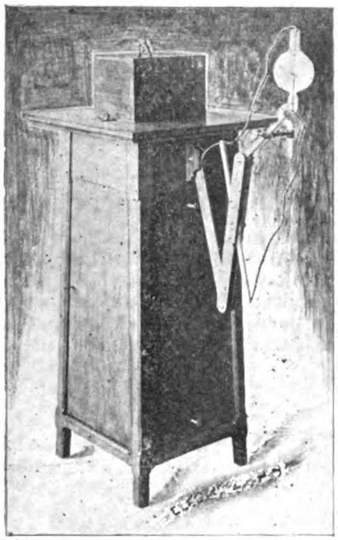
The Excelsior Electric Company, New York, are pushing hard for business in the Western States, as well as in other parts of the country, and have had good success in their efforts. One of the most important of the plants where their machines were installed within the past year was that of the new West Chicago Park's lighting station, where they placed seven of the largest arc dynamos that have ever been constructed, each having a normal capacity of 10 amperes at 7,500 volts. These machines are of their well-known arc lighting type and work in a remarkably easy manner, there being apparently very little difference in a machine running a few lights from any of the others which were carrying their full complement of 150 lights. These machines contain most valuable features, and make high tension work practical, and successful. For instance, if there should be an open circuit caused by any means, instead of the voltage suddenly rising and breaking down the cable, the machine simply flashes and spills over, and all danger of puncture is immediately avoided. These machines will run from one to one hundred and fifty lights with not more than 2 per cent. variation of current, thereby showing the perfection of the automatic regulator. The Excelsior apparatus has always had a good name, and stands higher than ever to-day.

FESSENDEN X-RAY MACHINES.

The latest development in the art of producing Röntgen rays is a remarkable machine which has just been placed upon the market by the Fessenden Manufacturing Company, of Pittsburg, Pa., operating under the patents of Prof. Reginald A. Fessenden.

The main points of this machine are simplicity both in design and operation. The Fessenden Company has proposed as its chief object, the production of a machine, which while giving the maximum spark results, which it is possible to obtain in the present state of the art, can be operated easily by any man of ordinary intelligence without knowledge of electricity or mechanics.

The induction coil is built perpendicularly and the resistance and condensers are so arranged that no adjustment of those appurtenances is necessary. The cost of operation of the machine is reduced to a minimum, a little oil and a few brass contact pieces, costing altogether only a few cents, being all that is necessary after a considerable run. The projecting rod on top of the machine is used as a starting device, it being only necessary to throw in the switch, push starting rod, and the machine at once starts up without any further attention or adjustment. The speed is regulated by an adjustable brush holder device. All of the starting and regulating device is so grouped that the operator may manipulate the same with one hand, while at the same time, holding the fluoroscope and taking views.


THE FESSENDEN X-RAY OUTFIT.

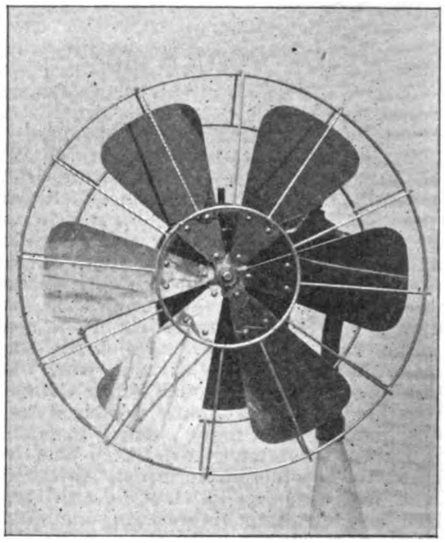
The framework of the machine is handsomely done in oak, mounted on castors, and altogether the apparatus is particularly suitable as an article of furniture in a doctor's office. These machines are made to operate from either direct or alternating current circuits.

THE SCHNEIDER WATER MOTOR FAN OUTFIT.

SUPPLY houses and central electric light stations are often called upon to furnish electric fans in territory which is inaccessible to electric light current. A great many central electric light stations are not running their plant during the day time, and during this time their customers desire the fans. To meet this condition, the Schneider Manufacturing Co., of 121 Euclid avenue, Cleveland, Ohio., have brought out the novel water motor fan outfit, illustrated in the accompanying engraving. This motor is designed on strictly scientific and mechanical principles by its inventor, Mr. G. P. Schneider, who has spent several years in bringing it to its present state of perfection.

The illustration shows a new six blade clover leaf fan which is very attractive and gracefully put together and perfectly balanced, so much so, that a slight breeze will turn the blades. Particular attention is called to the fan blade guard which is symmetrical in every way and makes the motor an ornament.

This motor is as easily installed as an electric fan, taking up very little space; the connection is made with any convenient hydrant or water pipe and is guaranteed not to leak. The motor is very economical in its consumption of water and can be operated on pressures ranging from 30 to 100 pounds pressure. The breeze produced by this fan is powerful, steady and noiseless, and the speed can be readily regulated.

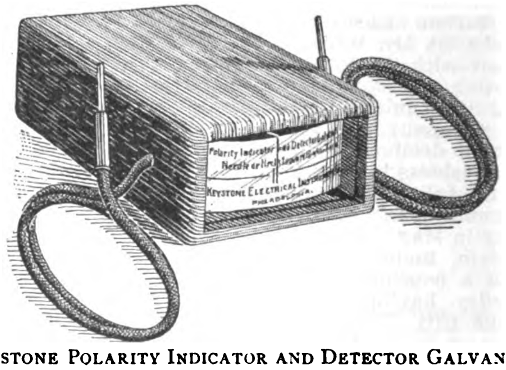

THE SCHNEIDER WATER MOTOR FAN OUTFIT.

We may add that Mr. R. C. Foster, formerly of the Brush Electric Co., of Cleveland, is president of the Schneider Co.

THE KEYSTONE POLARITY INDICATOR AND DETECTOR GALVANOMETER.

THE accompanying engraving represents a very handy little instrument built by the Keystone Electrical Instrument Co., of Philadelphia. The instrument is designed to indicate polarity of light and power mains on two and three-wire circuits, also the polarity of dynamos and batteries. It will indicate on circuits from 1 volt to 700 volts and a short-circuit cannot be made through it. It will be found very useful in setting arc lamps or motors.

The instrument is mounted in a neat polished walnut case, small enough to be conveniently carried in the pocket; its size is 3½ x 2½ x 1⅜ inches; weight, 4½ ounces, and is fitted with terminal leads. The pointer always deflects toward the positive terminal. It will further be found very useful as a pocket detector galvanometer and is applicable to all uses for which detector galvanometers are adapted. The workmanship and material are the best throughout and with careful treatment the instrument should last a lifetime. We may add that there is no liquid embodied in the polarity indicator.


Polarity Indicator and Detector
Keystone Electrical Instrument
Philadelphia
THE KEYSTONE POLARITY INDICATOR AND DETECTOR GALVANOMETER.

THE MICHIGAN PIPE WORKS IN FULL BLAST AGAIN.

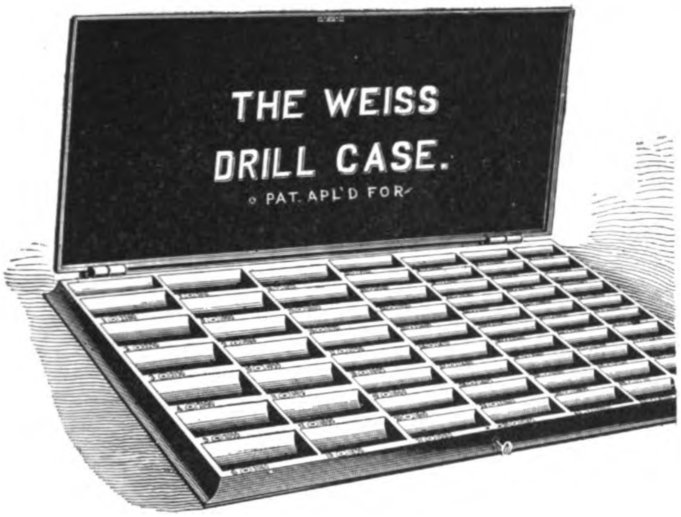
The extensive plant of the Michigan Pipe Company, of Bay City, Mich., which was destroyed by fire on the night of Dec.

8, 1896, has been rebuilt and started to work last week on a large order of pipe for a Western gold mine and on a large contract for treating cross arms for the American Bell Telephone Company. Their works have been completed in time to take care of this season's business for creosoted conduits for underground wire and have already made shipment of creosoted conduit and lumber for New England.

THE WEISS DRILL CASE.

ONE of the many petty annoyances of machine and repair shops is the time wasted in hunting up drills, and as time is money in a machine shop and as drills that cannot be found have to be replaced by new ones, a convenient means of keeping track of drills will be recognized as a paying investment. This has been provided for in the novel drill case brought out by Messrs. Weiss Bros., of 286-290 Graham street, Brooklyn, N. Y.; indeed the drill case, which is represented in the accompanying engraving, is the outcome of Messrs. Weiss Bro.'s sad experience in handling drills in their own machine shops.

As will be seen, the case consists of a cast iron hollow base having sixty round bottomed receptacles, No. 1 holding 16 and No. 60 about 200 drills. At the side of each compartment is a hardened and accurately ground drill gauge let into the case as a bushing, so that the workman can test the drill to see whether it is of the proper size. Beside the gauge is stamped the size of the drill in thousandths of an inch, so that a double check is thus afforded, and there is also given the exact size of drill to use for all standard taps.



THE WEISS DRILL CASE.

The cover of the case is provided with a spring hinge bar so that the cover cannot be slammed down, and so that it opens up by applying the tip of the finger.

The arrangement evidently shows at a glance every drill in the case and ought to be a valuable adjunct to every machine shop.

THE BERLIN IRON BRIDGE CO.'S WORK IN THE NARRAGANSETT ELECTRIC LIGHTING STATION, PROVIDENCE, R. I.

IN the description of the model composite station of the Narragansett Electric Lighting Company, at Providence, R. I., appearing in our issue of April 7,, we inadvertently omitted to mention the important work of the Berlin Iron Bridge Co., represented in the construction and working of the station.

The company's work consists of the roof, including the columns in the sectional view of the boiler room, on page 363, the roof work and columns shown in both illustrations on page 365, the roof work and traveling crane shown in the cross section at the top of page 368, and roof work and traveling crane in the arc dynamo room shown in the view at the bottom of page 368.

The Berlin Iron Bridge Company also furnished all the structural work of every kind in the building, including the roof covered with their patent anti-condensation corrugated iron covering. In fact, the original dynamo room in this plant was the first building ever covered with their patent anti-condensation corrugated iron roof covering.

A NOTABLE CONSOLIDATION.

Rumors appeared last week in the New York papers as to the proposed consolidation of the Sprague Electric Elevator and Interior Conduit & Insulation Cos., and the removal of the latter's factory plant to the Sprague works and grounds, at Bloomfield, N. J. The report is not officially confirmed, but is understood to have good foundation. Mr. J. P. Morgan is a large stockholder in both concerns, which between them do a very large and rapidly growing business under the energetic management of Messrs. E. H. Johnson and F. J. Sprague.

ADVERTISERS' HINTS

THE PURITAN ELECTRIC CO., New York and Boston, say that the Puritan enclosed arc lamp will bring business to central stations that otherwise could do no arc lighting.

THE ANCHOR ELECTRIC CO., 71 Federal street, Boston, ask if prices alone govern in deciding which switch to use, and offer to send descriptive catalogue of the Anchor switches whose good qualities are admitted by every one.

THE AMERICAN DISTRICT STEAM CO., Lockport, N. Y., will be glad to tell central station managers how they may increase their income. They have figures and examples to authenticate their claims.

THE NATIONAL CONDUIT AND CABLE CO., Times Building, New York, has been formed by the consolidation of the National Conduit Mfg. Co. and the National Underground Cable Co., and will carry on the business of both concerns. They have branch offices in Boston, Philadelphia and Chicago.

THE KEYSTONE ELECTRIC CO., Erie, Pa., claim twice as many electric elevators are operated by their special reversible motors and controllers as by any other make.

THE LECLANCHE BATTERY CO., New York, remind the public of the merits of the Gonda batteries and especially of the new "Vole Cell" which received the highest award at the World's Fair, Chicago.

THE MANHATTAN GENERAL CONSTRUCTION CO., New York, have sold over 12,000 enclosed arcs which are in successful operation nightly.

FISHER & CRAMPHORN, Congress and A streets, Boston, are the sole manufacturers of the Lyon brake handle. They also manufacture car brakes.

THE SAWYER-MAN ELECTRIC COMPANY, 125 Robinson street, Allegheny City, Pa., announce that the old, original Sawyer-Man lamp is still made and sold by them.

THE NEW YORK DYNAMO AND MOTOR CO., 257 Broadway, New York, are already behind on their orders for fans, which they are selling at $15.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, are ready with their stock of swinging-ball lightning arresters.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, have installed another large plant in Boston. It is described elsewhere in this issue.

NEW YORK NOTES.

THE ELECTRICAL CONTRACTORS' ASSOCIATION, of New York City, will hold their dinner on Wednesday evening, April 21, at the Hotel Flouret, Fifth avenue and Eighteenth street.

THE NEW YORK HEAT, LIGHT AND POWER COMPANY, holding very valuable franchises and established way back in the fifties, has been leased by Messrs. C. A. Lieb and O. T. Crosby, who will devote particular attention to the development of the company's light and power business which already covers a considerable territory in the lower part of the city. Pending a general remodeling of their plant the company is in the market for a good second-hand engine and 250-volt direct current generator of 200, 300 or 400-kilowatt capacity, either direct or belted, direct preferred, however.

OSTERBERG & SUTTON have removed from the Thames Building, New York, and are now in the Bowling Green Building, where they have gone into partnership as consulting electrical engineers and experts. One of their first pieces of work is the Bay Shore Electric Light Co.'s plant, which will have a capacity of about 100 horse-power.

AUTOMATIC ELECTRIC PUMP COMPANY has been formed at Brockton, Mass., with a capital stock of $1,000,000. It is to make pumps at Brockton, and will begin with a force of 100 men.

GREATER NEW YORK TELEGRAPHIC COMPANY has been formed in New York City by J. Fleischhauer, A. Lexow, R. J. Gersette, J. Fleischhauer, C. K. Lexow, J. Kienan, and J. Heffernan, with a capital stock of $5,000.

WESTERN NOTES

THOS. MUIR & SON, 31 Larned street West, Detroit, are pushing their aluminum reflectors and their automatic motor starter, and write: "We are greatly pleased with results from advertising in your paper."

MR. S. F. B. MORSE, who recently resigned the general Western agency of the Kerite wire products, has taken Mr. John D. Earle into partnership and will continue to do business at his old quarters, 1014-1015, the Marquette Building, Chicago. It is Mr. Morse's intention to remain in the same line of business in which he is so widely known, and he states that he is prepared to fill orders for a high class rubber-covered wire in connection with the other electrical goods for which he has the agencies, including the Pioneer enclosed arc lamp which is receiving considerable attention; the well-known goods of the Iron Clad Rheostat Company, O. K. junction boxes, and other thoroughly first class electrical specialties. On Mr. Morse's abilities as a hustler, and his sterling good qualities it is not necessary to dilate, as they are already well known. We merely wish him every success.

PRESIDENT F. H. FORD and his brother, A. H. Ford, of the Peoples' Electric Company, Madison, Wis., visited Chicago a few days ago, and called to the office of The Engineer. The Messrs. Ford state that things are brightening up considerably in their locality and that they are looking forward to good business from now on. As an evidence that business is rapidly improving in Madison, they state that their store is too small for their trade, and that they have to keep some of their goods some distance away, which is not altogether convenient. It is a matter of impossibility to get hold of a good large store now, as premises have been at quite a premium for some time past.

FOREST CITY ELECTRIC COMPANY, Cleveland, Ohio, report that their factory was visited by fire on April 12, and that several belting pulleys, etc., were destroyed by fire. Fortunately, no damage was done to the machinery itself, and by this time the company are busily turning out as usual their roll-drop commutator bars and other specialties.

THE FISCHER FOUNDRY & MACHINE COMPANY, of Pittsburg, Pa., builders of the "Fischer" single and four-valve engines, desire to contradict certain unfounded reports that have been in recent circulation, to the effect that the manufacture of engines has been discontinued by the company. On the contrary, it may be stated that additional features have been introduced, which, combined with the already known merits of the original makes of these engines, have especially adapted them for electric lighting and street railway purposes. An inspection of the company's shops in Pittsburg reveals a thriving and prosperous industry, and the business outlook for 1897 is flattering. Foster & Louis, general Western agents, have offices at 1000 and 1002 Fischer Building, Chicago, where the many friends of the Fischer engine, and, in fact, all visitors, will be cordially welcomed.

PHILADELPHIA NOTES

THE DICKSON MANUFACTURING COMPANY, of Scranton, Pa., have commenced the construction of a new boiler shop 130 feet wide and 225 feet long. This building will have a steel framework throughout. The sides will be covered with corrugated iron and the roof with composition roofing on plank. The main boiler shop is about 52 feet wide and 45 feet high. Thirty feet above the ground is a runway made of substantial steel girders which carry a 30-ton power traveling crane. At one end of the main shop is a riveting tower 25 feet by 50 feet, having a runway carrying a 20-ton crane 50 feet above the floor level. The crane in the riveting tower runs at right angles to the one in the main shop below. Adjoining the main shop is a punch room which is about 50 feet wide, extending the full length of the building. Attached to the roof trusses of this portion is a traveling crane of 5 tons capacity, which covers the whole floor surface. Adjoining the punch shop is a space for the flange fires and other furnaces, 25 feet wide and 225 feet long. All the main posts of the building are arranged so that jib cranes can be attached to them, and the trusses are arranged so that shafting and other machinery may be attached at convenient points. This building when completed will be without doubt the handiest and best equipped shop of its kind in the country. The steel work was designed and will be furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

MR. H. B. COX, of Cox thermo-electric generator fame, has sailed from England for this country and is expected during the present week.

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The Electrical Engineer.

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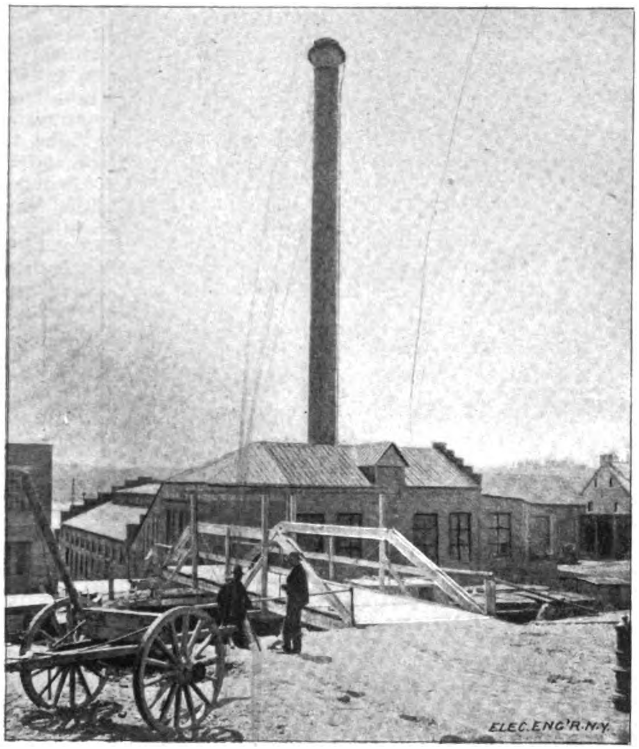
ELECTRIC LIGHTING

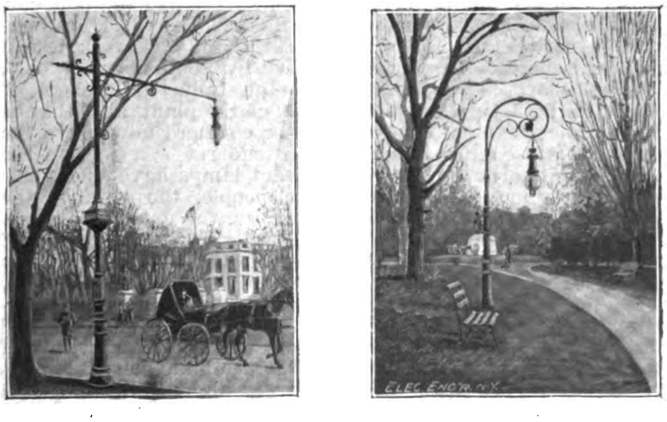
THE STATION OF THE POTOMAC LIGHT AND POWER COMPANY, GEORGETOWN, D. C.

BY N. MONROE HOPKINS.

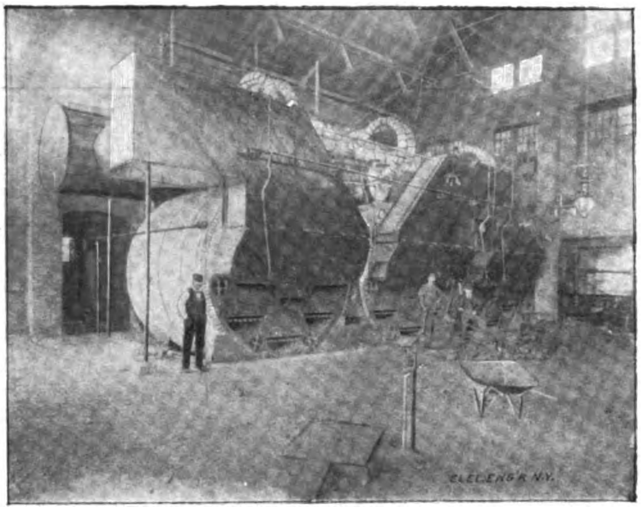
SITUATED on the river front at the foot of Thirty-third street, Georgetown, D. C., is the power station of the Potomac Lighting Company, operated under the personal control and management of Mr. Oscar T. Crosby and Mr. C. A. Lieb. An old building, at one time used for foundry purposes, now covers a modern electric plant and answers admirably for the purpose, although located as it is, on the incline of one of the steepest hills in Georgetown. The engines and dynamos occupy the elevated portion of the building and the battery of boilers the lower portion near the river. Water is taken from the canal that runs past the station at the top of the hill, and passes by gravity through a filtering plant having a capacity of 200,000 gallons in 24 hours. The water as it leaves the filters is taken up by Worthington pumps and fed to the boiler battery which consists of three 600-horse-power Scotch fire tube boilers of Cramp manufacture. Steam is furnished at 125 pounds initial pressure through asbestos covered pipes; the system of steam distribution being entirely in duplicate.



Power House, Potomac Light and Power Co.

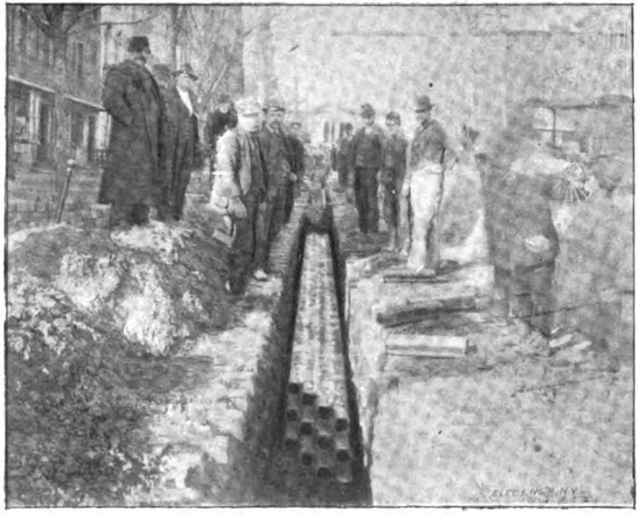


Electric Light Poles in Public Parks, Potomac Light and Power Co., Washington, D. C.



Boiler Room, Potomac Light and Power Co.

By ascending several steep flights of stairs which climb the hill, one reaches the engine room and is immediately impressed with the beauty of the splendid modern engines and generators. The main engines are two in number, of 1,200 horse power each of the cross-compound condensing type, having cylinders 48 x 18 inches, with 48-inch stroke. They are of the American Wheelock type, equipped with the Hill automatic cut-off valve gear, and built by the Cramp Ship and Engine Building Company, of Philadelphia. The generators are directly connected, being mounted between the high and low pressure cylinders the armatures revolving with the engines at 90 r. p. m. Each generator has ten poles and is of General Electric manufacture, with a capacity of 500 kilowatts and delivering the current at 550 volts.


ELEC. ENG'R. N.Y.

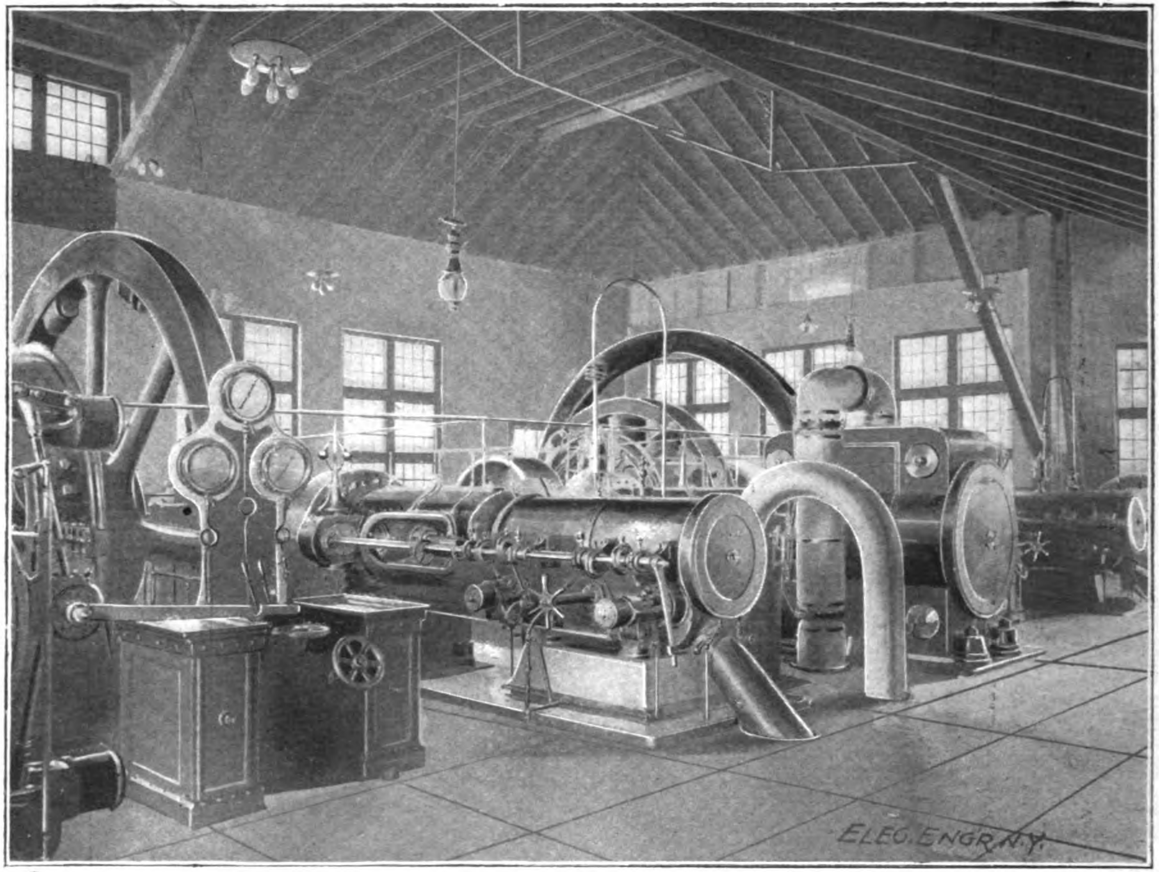
Laying Underground Conduits, Potomac Light and Power Co.

Adjoining the main engine room to the left on ascending the steps, is another, smaller in size, and equipped for furnishing alternating currents. Two Stanley alternators of 120-kilowatt capacity furnish power at 2,000 volts when running at 800 revolutions per minute. One generator is driven by a Crocker-Wheeler four-pole motor of 125 horse power wound for a 550-volt supply, the second is driven by an Ideal horizontal steam engine built by the Harrisburg Foundry and Machine Company, which is also run on a condenser, and is of 125 horse power.

The main switchboard is of black slate mounting General Electric and Weston instruments and is situated in the main engine room.

At present the station supplies Washington with about 200 arc lights distributed through the numerous parks and squares. The system of distribution is entirely by conduits of vitrified material laid in cement and broken stone with approved manholes at frequent intervals. In the engraving can be seen the type of arc light poles in use designed by Mr. C. A. Lieb. The arcs in the parks are suspended only eight feet above the ground, and give a steady, powerful light.

In addition to the current for the arc lights, the station also furnishes power for five electric railroads, as follows: Georgetown and Tenallytown, operating at this season about six cars; Great Falls Railroad, with four cars; Fort Meyer and Arlington Railroad, with two cars; Falls Church Railroad, with two cars, and the Glen Echo Railroad, with two cars.


ELEC. ENGR. N.Y.

Engine and Dynamo Room, Potomac Light and Power Co., Washington, D. C.

MUNICIPAL OWNERSHIP AT ALAMEDA, CAL.

We are indebted to a correspondent for the following "Object Lesson in Municipal Ownership," which lesson comes from the operation, at Alameda, Cal., of a municipal electric lighting plant: "The present city officials of the city of Alameda acknowledge the cost of each electric street lamp, per annum, to be $90; hours of lighting, 1,300; cost per hour per lamp 6.8 cents. The city of Oakland, Cal., under existing contract, pays for each lamp per annum, $151.34; hours of lighting, 3,600; cost per hour per lamp, 4.2 cents. Loss by municipal ownership on each lamp per annum, $33.80—assuming $90 to be correct. Loss of taxation on plant should also be added. Actual cost to taxpayers in Alameda has been, per lamp per annum, about $135; cost per hour, 10.3 cents; loss per annum, on 100 arc lamps, $7,930."—Am. Gas Light Journal.

CO-OPERATIVE ELECTRIC LIGHTING IN THE VILLAGE OF BORSBEKE, BELGIUM.

BY PROF. H. SCHOENTJES (University of Ghent).

Borskeke is a village or commune in Eastern Flanders, situated in a rural district on the line of the railroad between Brussels and Courtrai. It has a population of 1,150 souls and has a co-operative dairy or milkery affiliated with the agricultural committee of Herzele, under the supervision of M. Versnick. At the beginning of 1896, the growth of the dairy having made necessary a steam engine, the administration resolved to buy one of larger power than was actually required and to use the surplus for public and private lighting. The installation having been decided on, an extension of the co-operative plan was decided on to handle it, and a new company or society was formed, of which I have had the honor of being selected as the consulting engineer. The work was entrusted to Bouckert & Co., of Brussels, and the work begun about the middle of July was finished by September 20, 1896. After a short course of study at the Industrial School of Ghent, M. De Lange became director of the plant, and, thanks to the same means of study, a former cowherd now plays the part of steam engineer and dynamo tender.

Since September 20, the incandescent lamps have shed their soft beams in the houses of the people, the church, the thatched cottages, the barns and stables, the dairy, the wine-shops and the railway station of Terhaegen. The evening of the inauguration two arc lamps were installed temporarily for the banquet in the schoolhouse. It is true that the bare poles, lines of wire, and glaring white insulators do not harmonize with the picturesque aspect of the green pastures and the great poplars of this rural region, but the farming folk of Borsbeke are in general indifferent to aesthetic considerations while they rejoice in the fact that every night 40 incandescent lamps, like shining beacons, indicate the silent streets and brighten up roadways hitherto plunged in deepest darkness.

The expenses of the electrical installation reached about 19,-500 francs ($3,900), which comprised half the cost of the steam engine, the boiler plant and the smokestack. The co-operating parties interested in the plant subscribed each for one share of 100 francs per lamp of 16 candle power and pay annually 10 francs for the maintenance of each lamp. They have also the privileges of taking up the share of stock in 12 payments of 9 francs per annum; in which case they pay annually 19 francs per lamp. The amount for the stock not taken up was advanced by Burgomaster De Vuyst and his son Agricultural Inspector De Vuyst, at a rate of 3 per cent. interest. Each co-operator pays half the expense of his lamp renewals. The commune of Borsbeke is stockholder like individuals, and takes forty lamps for public lighting. Its stock cost it 4,000 francs, and it pays 300 francs per year for service instead of 400 francs, a reduction being made in this way to all large users. It also gets a reduction for lamps not burning often. The railway station at Terhaegen and the church take six and seven lamps respectively; but as the railroad company and the church cannot join the co-operative society each pays a definite amount fixed on the above ratios.

The steam engine was made of Lebrun, of Nimy, and is of 23 horse power, non-condensing, although a condenser is to be added. The fire tube boiler has a heating surface of 30 square meters, and was furnished by Brouhon & Co., of Liege. The dynamo is a two-pole, shunt-wound Schuckert, of 10 kilowatt capacity, and it is supplemented by a battery of 65 Julien accumulators, of a capacity of 15 amperes for 10 hours. The switchboard is of Schuckert make and permits the following combinations: Direct supply to the system by the dynamo; charging batteries; supply to both the batteries and the system at once; lighting by the batteries alone. The 40 lamps on the public highways are protected by globes and have enameled shades. They are carried on swan's-neck metal poles, which also support the conductors. The circuits run out in four directions, and the furthest lamp is 800 metres from the plant. The installation is of the two wire type and current is furnished at the regular 110 volts. The public and private lighting circuits are separate, and the network is supplied by three feeders. The centers of distribution are the public lamp posts. Villagers living in the vicinity of one of these posts throw on the current for that section at a given hour by closing the switch, which is affixed to the post in an oaken box.

The regulation of the system is as simple as possible. At full load the voltmeter of the dynamo shows 124 volts, and all the attendant has to do is to manipulate the rheostat in the field to keep the indicator needle steady between its limits. Two colored lamps and a bell are in the circuit in the dairy building, and guided by these the attendant dispenses with all other means of control. The system is figured out for 150 lamps of 16 candle power. It started with 125; at the time of writing it has reached 165, and in the near future it will touch 200. Of course there is never a time at which all these lamps burn together.

In the morning, the steam engine runs the dynamo for charging the accumulators and operates the dairy. In the evening, the engine and dynamo are given up to the public and private lighting. When the street lights are shut down, the system is switched over upon the Julien batteries and all the rest of the plant is stopped. The engine and boiler plant are freely used by the two co-operative societies together, at times, under very favorable conditions. In summer, when the lighting is at its minimum, the power necessary for the dairy is at its maximum. On the contrary, in winter, the dairy does but little work and the lighting is in full demand. The society now proposes to extend its operations, and will endeavor to furnish electric power to the various farms for different classes of agricultural machinery. A third co-operative society is being formed, for an agricultural distillery, and this is also to derive its power from the dairy plant. One of the cultivators of the village has been sent to the Industrial School at Ghent to learn the methods of operation, so that he can take charge of the new plant; just as was done in the case of the electrical installation.

Such in brief is the history of the electric lighting of the village of Borsbeke. The modest little commune in creating its plants has taken an initiative which ought to be fertile of imitation, and has the credit of making the first application of the principle of co-operation on this basis, to a public service.

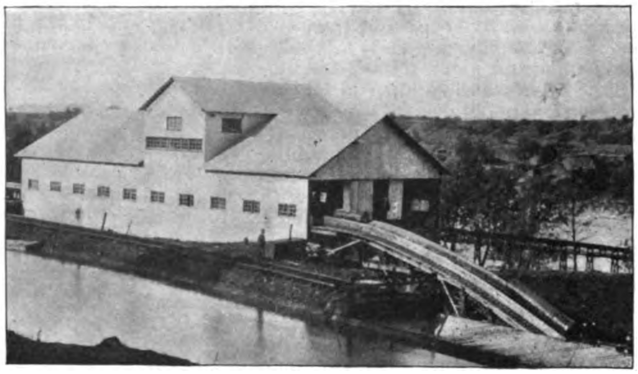
NEW YORK CITY.—A bill has been introduced in the State Senate by T. D. Sullivan, to confer very considerable powers on the New York Electric Light Company (R. B. Ayres, T. B. Robertson and J. B. Hawes), to furnish electricity and gas and to put down a subway system anywhere they choose. It is exempted from existing restrictions in all respects. The capital stock is $500,000. It is hardly conceivable that such a bill can go through the Legislature.

THE NEW ORLEANS DRAINAGE BOARD is considering the plan of the operation of its pumping stations by electric motors furnished with current from a central power plant.

POWER TRANSMISSION

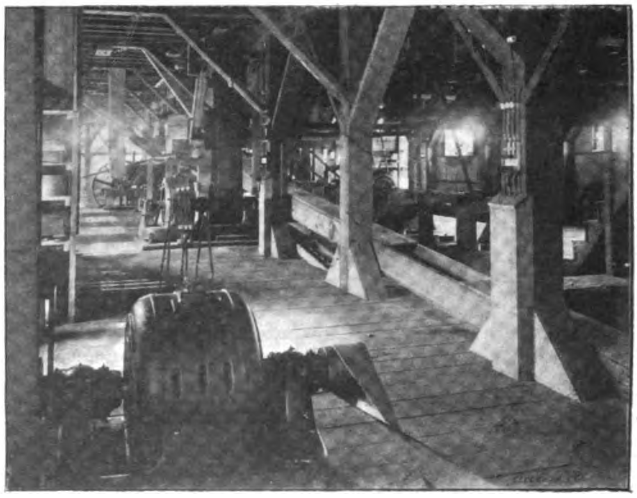
ELECTRIC SAW MILL AT FOLSOM, CAL.

THE electric power transmission from Folsom to Sacramento, Cal., has been described fully in our pages and is deservedly looked upon as one of the most successful undertakings of this kind thus far carried out. But in utilizing the American River, the source of power, the projectors of this enterprise also had in view the application of power close to its source of generation and consisting of the driving of saw mills to saw the timber of the forests situated above Placerville, between the South and Middle Forks of the American River.



ELECTRIC SAW MILL OF THE AMERICAN RIVER L. & L. CO., FOLSOM, CAL.

The American River Land and Lumber Company own about 20,000 acres of this forest land. Into this tract they have built a railroad nine or ten miles long. Powerful donkey engines are used to haul the logs to this railroad—in some instances a mile distant—by a wire cable. They are then loaded on cars. At the lower terminus of the railroad, from a point 1,300 feet above the level of the South Fork, a chute 3,000 feet long has been constructed and the logs are shot down it into the river, from the terminus of the company's railroad. They bring up without injury in a deep pool about a mile long made by the erection of a dam below. From this dam to the booms above Folsom is about forty miles, and the logs are during the spring freshets caused by the melting snow readily and very cheaply driven to the booms, arriving there by the middle or last of June.



INTERIOR OF ELECTRIC SAW MILL, FOLSOM, CAL.

The big electric saw mill built by the company at Folsom, the first saw mill in the world to be run entirely by directly transmitted electric power, started up Dec. 4, 1896.

For the saw mill a switchboard panel has been placed in the electric power house of the Sacramento Electric, Gas and Railway Company at Folsom, and the power is transmitted direct to the mill, 600 feet away, through three No. 1 B. and S. gauge wires, and it is calculated that this direct application of power by the means of electricity, doing away with much belting, shafting and other machinery, will save fifty horse power.

The motors are all on the lower floor except one, which supplies the filing room in the upper story. The motors are all of the induction type. First in size and importance is the 75-horse-power motor that runs the big band saw by direct power. It has a speed of 600 revolutions per minute. This and the next largest motor have a voltage of 720. Next comes the 50-horse-power motor that runs the edger, with 700 revolutions per minute. These take power directly from generators at the power house.

There are three 30-horse-power motors, with 900 revolutions per minute and 200 volts. One of these runs the log roll and the sawdust and slab conveyors. The second runs the log carriage and friction plugs to reverse it. The third runs the trimmer and live rolls and the sawdust conveyor. In the filing room on the floor above is a 5-horse-power motor that runs the saw filer and some minor machinery.

The filing room contains a machine that is simple, but is perfection. The big saw is placed in an elliptical frame, teeth upward, around the machine, which is run by the 5-horse-power motor. When the machine is started, two "tenders," or ratchets, one on each side of the machine, catch each tooth in succession and move the saw the length of a tooth at each jerk. An emery wheel rises along the back of the tooth, grinding and pointing that side of it and then dropping between it and the next tooth, grinds the front of it. The saw is moved steadily around until it is ground to the satisfaction of the operator. The transformers in the mill transform the voltage for the three 30-horse-power motors from the generator down to 200 volts, and the 150 incandescent lights are also taken from the transformers.

The mill is entirely lighted by electricity. All the motors are of the induction type built by the General Electric Company, who also furnished the generators and electric machinery in the power house of the S. E. G. and Ry. Co.

ROENTGEN RAYS

THE X-RAY ARC.

BY R. W. WOOD.

I NOTE in The Electrical Engineer of April 14 a short description of a new method of producing the X-rays by an arc discharge, discovered by Mr. Tesla. For the past three months I have been using this form of discharge for the production of the rays for diffraction work, and on March 31, several days prior to Mr. Tesla's announcement, sent a very brief note to "Science" on the subject, which appeared in the April 9 issue of that journal. A more detailed account of the work had already been sent to Wiedemann's Annalen.

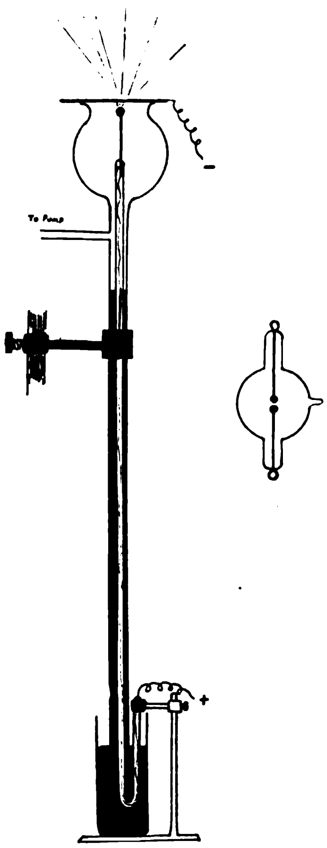
Curiously enough, one form of tube which I have used is almost identical with the one described by Mr. Tesla, and illustrated in the Engineer. The discharge-bulb is a so-called "thistle tube," with a very thin plate of aluminum, which serves as a cathode, cemented over the top, Fig. 1. The anode is a small ball of platinum close to the plate, on which the arc plays, and from which the X-rays emanate, passing through the aluminum plate into the air.

The platinum ball is carried on the upper end of a tube bent into a U at the bottom, and passing up through a mercury barometer column into the bulb, the arrangement being that devised by the writer for determining the temperature curves in the stratified discharge in Geissler tubes, by means of a sliding bolometer[1].

By means of this device the distance between the ball and plate can be nicely adjusted, and I have had no difficulty in producing a steady discharge of the arc, which Mr. Tesla says is maintained with considerable difficulty.

A form of tube shown full size in Fig. 2 has been found more serviceable in many respects, and has been used rather more than the other. In general it has been made with one electrode moveable like the first, but I find that it can be made to work with fixed electrodes, and when removed from the pump, as shown in the figure. Here the arc passes between two small platinum balls. The anode gives off X-rays and is eaten away into a crater, while the cathode has a brilliant deposit of platinum built up on it.

Mr. Tesla does not state the degree of exhaustion of his tube or with what sort of a current he excites it, but presumably his method is in general identical with mine. The vacuum can be somewhat lower than that usually found in Crookes tubes and a spark gap in the external circuit seems to be necessary for the production of the arc. I have used for the most part the current of a 12-plate Wimshurst machine, since for the work on which I am engaged it is better to have only one ball radiate. With the alternating discharge from a high frequency coil both balls would radiate, but as they are but one-twentieth of an inch apart this would be no disadvantage.



ELEC.ENG'R.N.Y.

FIGS. 1 AND 2.—WOOD X-RAY ARC APPARATUS.

It seems quite likely that tubes made on this principle can be constructed sufficiently well insulated and small enough, to be introduced into the cavities of the body. With the one shown in Fig. 2, which is less than an inch in diameter, I have seen the bones of the forearm quite distinctly.

The work spoken of in this note has been done during the past winter, in the physical laboratory of the Massachusetts Institute of Technology, through the courtesy of Prof. Cross, who placed every facility at my disposal.

X-RAYS IN AN ACCIDENT CASE.

A special dispatch from Wichita, Kan., says: Lucien I. Blake, Professor of Electricity in the University of Kansas, arrived in the city to take a Röntgen shadowgraph of the wrist of Pete Noel, who has brought suit in the District Court against the Atchison, Topeka and Santa Fé Railroad for $10,000, claiming that the company's physician damaged him to that extent by bunglingly setting his fractured wrist. The shadowgraph will be introduced in evidence, plaintiff and defendants having agreed to accept it as final evidence.

MR. M. H. CRUMP, B. M., Cadet Adjutant, Kentucky Military Institute, Lyndon, Ky., writes us: "Your paper is regularly received and read with great interest. It grows more and more interesting with each number. The articles on the storage battery are of great use to me in my classes."

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[1] Wood, Wied. Annalen, 59, p. 241. Physical Review, Vol. IV., No. 21, p. 200.

TELEPHONY AND TELEGRAPHY

THE VIADUCT TELEPHONES, FACTORY AND PERSONNEL.

THE Viaduct Manufacturing Company is keeping abreast of the times by issuing new and improved apparatus for telephone purposes, as will be seen by cuts on this page. We also show a view of its extensive works at the Relay Station, B. & O. R. R., between Baltimore and Washington. These works are directly under the Great Viaduct from which it derives its name "Viaduct." This is the first stone bridge constructed in the United States for railroad purposes. It was commenced in 1833 and finished in 1836 and serves for the passage of trains from Baltimore to the capital. It is a remarkable bridge, or viaduct, having stood for over sixty years. There never has been an accident of any kind upon it, the repairs are almost insignificant, and with from 70 to 100 trains a day passing over it. It is a matter of fact that the B. & O. R. R. were compelled to make this curve and erect this viaduct where it is located to accommodate the former owner of the viaduct property. He insisted upon this location in order to accommodate the mill which he owned and ran by water power. Portions of the same mill are now used by the Viaduct Company in carrying on their extensive electrical factory. The Viaduct Manufacturing Company purchased this property in 1880; it has been twice burned to the ground, the last time in 1894, when there was nothing left to tell the tale. The present buildings were quickly constructed and filled with the most modern machinery for the purposes required.

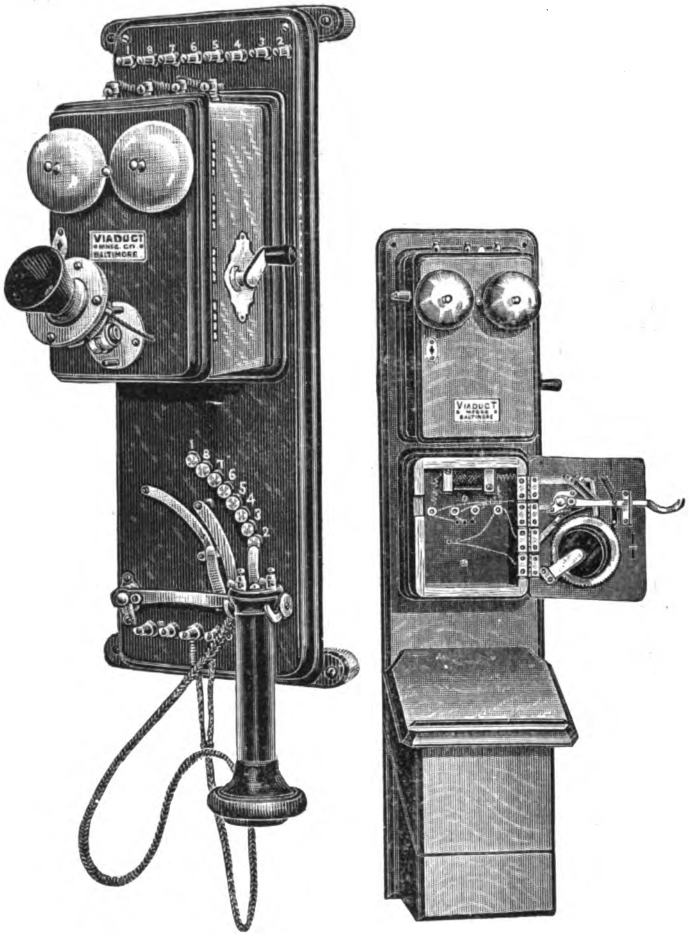
ELEC.ENG'R.N.Y.

A. G. DAVIS.

VIADUCT MFG. CO.'S FACTORY, RELAY STATION, BALTIMORE.

Everything connected with a telephone outfit is manufactured in these buildings. It is said to be the most extensive establishment in this country of its kind, with the exception of the American Bell Telephone Company's factories of the Western Electric Company, in Chicago and New York. Its capacity is almost unlimited; it owns the water power and 25 acres of ground with all the buildings contained thereon, some twelve in number.

Mr. A. G. Davis, the president and principal owner of this company, is an "old-time telegrapher," having learned the art under his cousin, Prof. S. F. B. Morse, inventor of the telegraph, in 1849, and he had charge of the Poughkeepsie telegraph office at that time. In 1853 he went to Canada and had charge of the Grand Trunk Railway telegraph system until the war broke out in 1861, when he moved to New York, and thence to Baltimore, and was superintendent of the B. & O. and Western Union telegraph system for many years.



INTERIOR, OR WAREHOUSE TELEPHONE SET AND DEVICE TO REVOLVE TRANSMITTER.

He originated the American District Telegraph Company of Baltimore and other places; also the Gold and Stock Ticker system in Baltimore; and the Maryland Telephone Company, now the Chesapeake and Potomac. He was the original licensee of the American Bell Telephone Company for the State of Maryland, and his factory was also a licensed manufacturer for that company during the early stages of the telephone.

The telephonic apparatus here shown is new and is typical of the variety and ingenuity of the products of Mr. Davis. The "Interior" or warehouse telephone set is a very compact arrangement and provides for a number of lines centering conveniently on the backboard. The other cut illustrates the ingenious arrangement to prevent the "packing" of the loose carbon which is so serious a defect in transmitters of the Hunning type. In this Davis transmitter, every use of the telephone—every removal and replacement of it on the hook—revolves a step the carbon box or receptacle, thus giving it a gentle shake up and new adjustment. In this manner, the carbon never stays long enough in one position to pack, and the sensitiveness of the apparatus in speech transmission is enormously increased.

AUTOBIOGRAPHY OF THE OLDEST WOMAN TELEGRAPHER IN THE WORLD.

BY MRS. JULIA ABRAMS.

IN response to the inquiries of The Electrical Engineer and the kindly interest manifested in myself, and my early career as a woman telegrapher, I will endeavor to give the desired information, hoping the history may be of interest to the telegraphers of to-day, who know little of the varied duties and difficulties that the early workers had to endure and overcome, especially by women who were in those days considered outside the lines of womanly work. My husband, Leonard Abrams, was one of the earliest operators in the profession. He was an operator when I was married to him, and I learned telegraphy in his office, the Atlantic, Lake and Mississippi line, at Massillon, O., during the winter of 1849 and 1850. The spring of 1850 Mr. Abrams was called to Cleveland, O., to relieve an operator in that office for two or three weeks, and I was placed in charge of Massillon office. I well remember the consternation of a commission merchant who desired to send a telegram, and found Mr. Abrams absent. He would hardly be convinced that his message could be handled by a woman, but decided to risk it if I would permit him to come inside the office to oversee the sending. Pittsburg answered promptly, I sent the message, and assured the doubting man that it was gone. Fortunately a quick reply was received and the customer was convinced that a woman could do what a short time before he had supposed an impossibility for anybody.

Soon after, Mr. Abrams was called to Cleveland for a permanent position, and I was again left in Massillon office until relief could be found. Meanwhile the business men were so well pleased with my services that they wished arrangements should be made for me to remain in charge. In 1856, Mr. Abrams accepted a position with the Michigan Central Railway, at Niles, Mich., in connection with another man operator. In 1857 the other operator was transferred, and I was appointed to fill the vacancy, working with my husband in that office until the fall of 1865, when we both retired from the business, to spend our declining years in Niles, Mich., where Mr. Abrams died in 1889.

During the years of our service Niles had no city telegraph offices, as now, but all commercial business was handled by us in connection with our railroad work. During the War of the Rebellion the business was heavy. We also handled the ticket office, which was in our office, as a part of our railroad duty. We taught quite a number of pupils, who were sent out into the service, and so far as known to us not one proved a failure in the profession. Stephen Robinson, for some years manager of the Board of Trade office, Chicago, and now a prosperous man on "the Open Board," was one of our students; also his brother, Byron Robinson, for some years, and at present, in the telegraph service in the Union Pacific Railway; Millard Bullard, who was superintendent of telegraph for the Missouri Pacific Railway, some years, and until his death, was another of our "boys"; Elbe Howe, agent and operator for the M. C. R. R., Dearborn, Mich., the past thirty years, and with the M. C. R. R. about thirty-five years, was also taught by us. We also had one young woman student, Rebecca S. Bracken, who has been nearly thirty-two years in continuous service with the Michigan Central, all the years (except her first office six months in Buchanan, Mich.), in Niles, Mich., where she is yet manager of the M. C. R. R. office, which has grown into an important division point, with many wires and heavy work. As a pioneer woman in telegraphy, I was called to endure many hardships, and overcome obstacles, but by the help and under the practice of my good husband, I was able to meet all in a true womanly way, that won the respect of the public, and I have now an honored place in society. A volume would hardly contain all the vicissitudes of my experience, yet looking back from my now eightieth year, I find nothing to regret, but much to remember with pleasure, while I wait the last "call" that I must answer for promotion to be with the husband who was summoned before me.

Niles, Mich., April 3, 1897.

TELEPHONES FOR KANSAS CITY SCHOOLS.

The Kansas City Board of Education has made a contract with the Missouri and Kansas Telephone Company for telephone service in all the public schools. A switchboard will be placed in the secretary's office and private lines run to all the school buildings. This service was decided upon by the board for sake of convenience and for use in case of fire in any of the school buildings, or to give the alarm to the teachers if a heavy storm be approaching. The city has had some lively experiences with cyclones and parents like to get their children home out of the way.

VENEZUELA TELEGRAPH MONOPOLY.

Jacob Schwed, who represents a syndicate organized by the banking firm of Henry Clews & Co., has returned from Venezuela. It was announced at the office of the firm that he has secured from the government a concession, already noted in The Electrical Engineer, which gives to the syndicate a complete monopoly of telegraph, cable and telephone lines in Venezuela. The concession is for 30 years, and the syndicate is to pay the government of Venezuela one hundred and fifty thousand dollars a year. The syndicate will take over the existing lines, which are owned by the government, and it may begin operations under the concession any time within the next six months. At the end of thirty years the lines will revert to the government on payment by the latter to the syndicate of their appraised value.

ELECTRIC TRANSPORTATION

AMERICAN STREET RAILWAY FINANCE.—III.

BY E. E. HIGGINS.

It is easy to see that the people of a city will, as a rule, be anxious for more facilities, and they will naturally further any efforts made by outside people to come in and build more street railways. The common councils were naturally anxious to have the same things done, and knowing that the people were behind them, it was quite easy to obtain franchises by the old or new companies. The consequence was a great over-building of street railway lines in many of the cities, not only of building for the future, which is legitimate for a long time investment; not only running into the suburbs and generally into places where traffic can be created in time; but the actual parallelling of existing roads where the service was not necessary on a broad view of the traffic conditions in the given city, and consequently the necessity of keeping up the mileage and operating cars over it, and all the consequent evils of over-building.

That fact is particularly noticeable I think in the West. Partly because of this over-building, and partly because roads were put into small cities, we find such significant features in the statistics which I read a few moments ago. For example, while the Eastern States contain sixty-four per cent. of the large cities they contain only forty-four per cent. of the mileage. The Western States, however, contain six per cent. of the cities above fifteen thousand inhabitants, and sixteen per cent. of the mileage; in other words, a very much larger proportion of mileage to the cities served than is found in the East. The Central States have nineteen per cent. of the cities, and thirty-two per cent. of the mileage. The South has eleven per cent. of the cities and eight per cent. of the mileage. There is not so much over-building in that section, it would appear from the figures, as there is in the West, but there are one or two cities of the South which have suffered from considerable over-building. It may be said that while the Western cities contain six per cent. of the cities, they have ten per cent. of the total capitalization of the country, while the Eastern States have sixty-four per cent. of the cities, and fifty-seven per cent. of the capitalization.

Now over-building is a pretty bad thing for street railroads. It means not only the maintenance of track, but it means excessive car service. Suppose you have two parallel streets in a rather small city on which you have railroads; you cannot give a five-minute service on both streets and live. The usual way of solving the problem is to give a ten-minute service on each street which practically gives a five-minute service on both streets the cars being started every five minutes, considering the two lines as one. This, of course, implies a knowledge of schedules on the part of the public, and the minute you begin to talk about schedules on street railways, people begin to walk. They do not want to bother with schedules. If they know they can get a car by waiting five minutes they will do so; otherwise they will probably walk so far that when the car overtakes them they will not consider it worth while to ride the rest of the distance they intend going. This principle can be applied in many ways, and nothing more need be said upon this point.

When we come to transfers, we run across another series of difficulties all having at their root the inherent disposition of the American people to cheat a corporation. I had a transfer problem presented to me the other day which was very interesting. The business center of the town was so situated that the lines converged at that point, all coming from opposite directions. Ninety per cent. of the traffic of that city daily comes in from the outlying sections to the business center and goes back again; sometimes it may be ninety-five per cent. In this case the street railway company estimates it as ninety per cent. at least.

Now if that company grants transfers they are going to have difficulty. Many people will come in on a certain line and take a transfer whether they require it or not, and will either dispose of the transfer to some storekeeper, or make arrangements with some one to exchange them, and they will spend fifteen minutes in doing it each day so that the tickets may be used. Time is no object when it comes to saving five cents and a street railway company is the loser. Perhaps ten per cent. of these people want to go on these lines running out from the center of the city. If you have a transfer agent at this point, it means a great expense and many tickets will be given away to those who are not entitled to them. Many men make a daily practice of getting close to a car and when it stops they slip in with the crowd and get a transfer ticket. A gentleman who was talking with me about this particular city said that he made an investigation to see what the transfer system in New York City amounted to, and he went to a certain point where they had an agent in the street and he tried that little trick of going up with the crowd eight times in succession and he got his transfer eight times and was not detected in doing so.

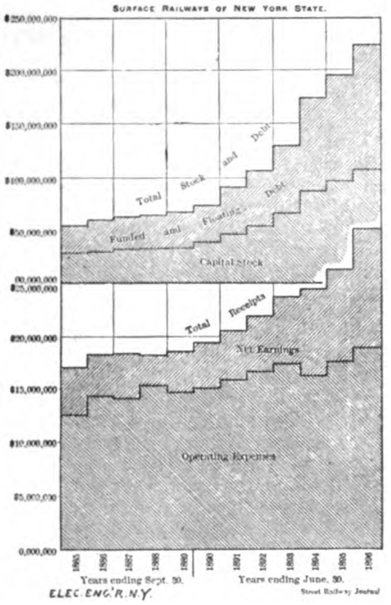


FIG. 1.

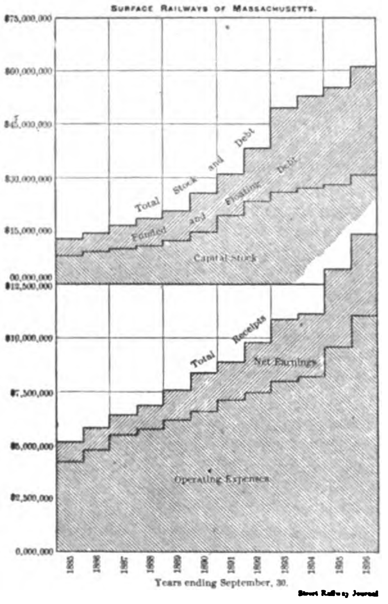


FIG. 2.

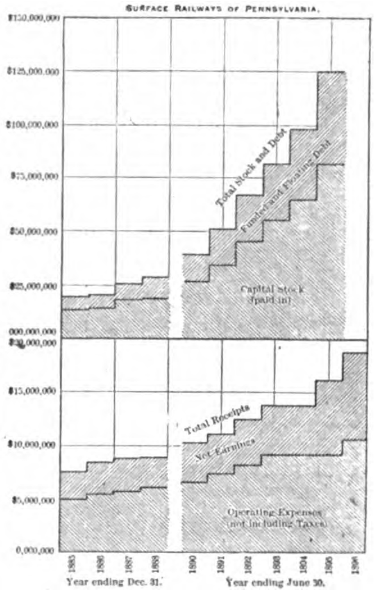


FIG. 3.

It seems rather a hard thing for a city to compel a company in a case like that we are considering to put a transfer system on for the benefit of ten per cent. of the people who ride on the cars. It necessarily means in a case like that, where the number who want to transfer is so small, a large reduction in income because of the loss and misused ticket; it means that a force has to be established to take care of transfers and check them up, or the conductors will dispose of them in saloons. These difficulties are hard to explain to the residents of a city through the press, and the press itself is oftentimes misled about them. It is a matter of conditions. Citizens of certain cities see that transfers are being granted in other cities. A few men may happen to want transfers to go to some point which cannot be reached by a single fare, and they think it is a shame that they do not get them. Sometimes it is a good thing for the company and for the citizens alike that transfers shall be issued. Frequently transfer systems are introduced with the idea of increasing the revenue, but it is a question of conditions, and conditions are so different in various cities that it is by no means a truism that all the cities ought to have the transfer system.

There is one other feature of the traffic question which should be mentioned. In the thickly settled cities of the East, car speeds are small, necessarily small, because it is difficult to thread one's way through and among the cars and drays, etc., in the principal streets. In the West there is not nearly so much of that obstruction, and car speeds are very much greater, and the car miles per day, or the mileage per day per car is much greater. That has been the financial salvation of many of the Western roads, their ability to get more service out of their equipment and out of their car force, conductors and motormen, than can be done in the East. We find frequently that the Western roads operate at eight or ten cents a car mile, whereas in the East fifteen to twenty-five cents is the general run of expenses. It makes a great deal of difference whether you divide your expenses by 150 or 175 miles per car per day, or whether you divide them by 80 or 90 miles per car per day.

I pass from these general considerations to discuss very briefly a few of the financial conditions surrounding American street railways. In the first place, I think a definition of a correct financial system of an operating property is perhaps necessary. When a man invests a hundred dollars in a share of stock he expects two things. He expects to get an annual return on that stock and he expects to get back his principal when he wants it, or at the end of the operating period. He takes his chances on the first, but he expects that the managers of a property will so conduct its affairs that if it becomes at any time necessary to wind up the existence of the company, he will get one hundred cents on the dollar for his investment. If a company is not able to do that it is not operating on a correct financial system. If it pays out too much in annual return and does not provide for contingencies which are likely to occur in any operating venture, trouble is likely to come. A correct financial system for the operation of the road is one where the investors are able at the end of the operating period to at least obtain their full investment, together with an annual return during the operating period if a return is earned.

Now that brings me to the subject of capitalization. I suppose that the old horse railroad systems prior to 1888, were capitalized very conservatively. I imagine there was very little water of any kind contained in their capitalization with a few exceptions. In fact, I think that in a large proportion of the systems, a good part of the earnings were turned back into the property and not capitalized. It is impossible to tell whether that is so or not. At all events the capitalization per mile seems reasonable and not excessive in any way. Now when electricity came into the field, as I said before, there was an exaggerated idea of its value as a profit earner.

There are two ways of capitalization. One is to capitalize on the basis of cost, and another on the basis of earning power. Both systems can be defended with substantial arguments according to the point of view. If you capitalize a system on costs, that is, strictly speaking, the correct system. The earning power then is a percentage upon the actual cost in the investment. If, however, the earning power should be, for example, 10 per cent., per annum, in a community whose safe investments yield but 5 per cent. per annum, on an average, and if its investors consider this particular street railway investment as sufficiently safe, they may pay two hundred for the stock instead of one hundred of a property which is capitalized on cost, and that is but another way of capitalizing on earning power. The investor depends on the earning power of the road to receive through a period of years a return of ten dollars a share, or five dollars per hundred dollars of investment.

Those who capitalized the street railways at the beginning, and in the continuing period of electric railway operation capitalized in many cases practically on earning power. For example, they found a horse railway property which was yielding to its owners a certain return on investment. Now these owners could continue operation indefinitely and obtain, we will say, 5 per cent. a year. Moreover, they could reasonably expect an increase of their income, particularly if they had been far-sighted enough to build for the future and for suburban business. Any syndicate proposing to buy that road naturally could not get it on less than a 4 or 5 per cent. basis. They would then find it necessary to discard 60 or 70 per cent. of what stood on the books as "assets," or "cost of road and equipment." The track would be of no use and the cars good for nothing. The horse railway barns, stables and buildings—practically all the property except the real estate—would have to be closed out at a selling value of not more than 10 to 20 per cent. of its book value.

Now it would be an extreme of purism in accounting to refuse to the syndicate the right to capitalize the cost of that plant, minus its selling value, plus the cost of the necessary investment for electricity. What the syndicates did, however, in many cases was this: Having bought these properties and put in electricity they issued bonds for the cost of the properties plus the cost of the electric equipment and reconstruction; they then issued stock which practically meant at that time little or no investment.

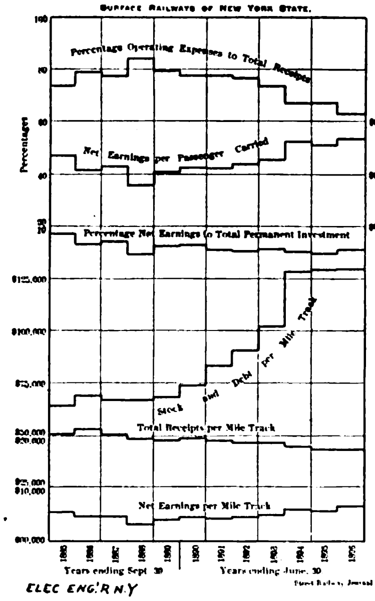


FIG. 4.

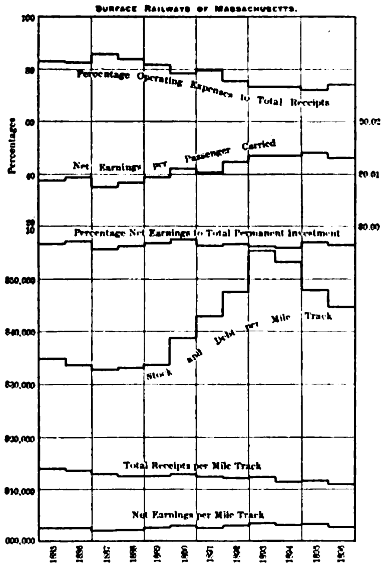


FIG. 5.

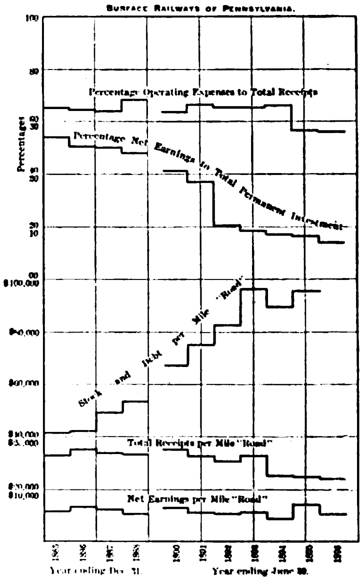


FIG. 6.

This method of capitalization was practised in a few cases, but by no means in a majority. In a large number of instances the old owners retained control of their properties, put on electric equipment, and simply charged up the net cost to their roads. But in the extreme cases where stock was issued without any quid pro quo, the present condition is that that stock does represent a very large investment in one form or another. The early equipment was very high priced—in the case of motors, four or five times present prices were charged and nearly double present prices for rails and other items of plant and equipment were usual. The equipment purchased at that time, moreover, was very poor, that is, it was insufficiently developed; the science of electric traction had not become fully understood and was more or less of an experiment in every sense. The result was that the syndicates had to put their hands into their pockets two or three years later, and buy new motors, frequently new cars, almost always new track joints, and now new rails. They had put a first mortgage on their property, and now had to create a floating debt, or capitalize earnings, or in other ways put more money into the enterprise, so that the cost of the properties to them to-day stands, I think, in a large majority of cases, at pretty close up to the total capitalization, including bonds and stock. In other words, there is to-day comparatively little over-capitalization of street railway properties except in certain isolated cases.

The result of electric traction has been an increase in gross receipts, a very large increase. If you will look at the diagram, Figs. 1, 2 and 3, you will see that in the States of New York, Massachusetts and Pennsylvania, which comprise over 30 per cent. of the entire mileage of the country, these gross receipts have grown at a very rapid ratio. At the close of the horse railroad period in 1889, the total receipts in Massachusetts were $7,500,000, and at the end of 1896, $14,852,000. In New York they were a little less than twice as much in 1896 as in 1889, and in Pennsylvania they were something more than twice as much as in 1889. The ratio of increase was small during the horse railroad period, the increase being fairly normal and due partly to increase of population, and partly to the increase in mileage. In the electric railroad period the growth was much more rapid, and was evidently due to the influence of electricity as well as increased mileage.

When you come to examine this increase carefully certain interesting results appear. In Figs. 4, 5 and 6 it will be seen that the gross receipts per mile of track have decreased in every State; in other words, as a whole, the street railways of New York, Massachusetts and Pennsylvania are earning quite a little less per mile, gross, to-day than they were in the horse railway period. Now, that is partly due to what might be called the generosity of the street railway companies in building for the future in the suburbs, and it is partly due to the increase of interurban traffic, which has a less earning power per mile than is the case in the cities, and naturally brings the earning power down. The gross receipts per car mile have also come down very materially, due again to the generosity of street railway companies in giving a much better service to the people either in increase of car speeds or in the greater frequency of cars.

It has been believed by street railway companies, particularly since the beginning of the electric era, that in order to get the maximum profits, you must give people frequent service; you must run cars at half the schedule intervals of the old horse railway era. That that has been, in a good many cases, overdone, there is no question. The companies have given a service which has brought the gross receipts down from 20 or 25 cents a mile to 15 or 20 cents. The more cold-blooded of the street railway managers have adopted a rule in some cases to govern their schedules by their receipts per car mile, or per car; in other words not to send out cars unless they are able to earn a certain sum per trip. There are various ways of looking at the policy of that method. In some cases, it is an absolute necessity.

The gross receipts per passenger carried have fallen off somewhat in the three States mentioned. Previous to 1890, they were, in all the three States, a very little in excess of 5 cents. They are now somewhat below 5 cents per passenger, but not much.

The changes in gross receipts per capita cannot at the present time be known except in one or two sections of the country, for the reason that we have very few reliable census figures of populations since the 1890 census, so that we do not know what the divisors should be as compared with the official returns in 1890.

When we come to operating expenses we find that in all cases, with very rare exceptions, the actual operating expenses have increased. The increase has not, however, been at such a rapid ratio as increase in gross receipts, and the consequence has been a reduction in the percentage of operating expenses to gross receipts, as seen in the diagrams. That reduction, however, is not only smaller than is generally supposed by those who have not looked thoroughly into street railway operations, but it is smaller than the figures will indicate; the reason for which I will presently explain.

In New York State the percentage of operating expenses which in 1885 was 73.9, in 1889, 79.4, was in 1896, 62.8, showing a very marked advantage in electric operation and one due almost entirely to electricity; but 62.8 is probably too low. In Massachusetts the horse railroads were operated at 82 per cent in 1885 and 1889, and 74.3 in 1896.

These figures are governed very largely by the extremely conservative, and yet, in some ways, not too conservative, policy adopted by one very large system in Massachusetts. In Pennsylvania the percentage has dropped from 65 and 68 to 55.5 under electricity. I am not able to tell how these extremely low operating figures for horse railway service in 1885-9 were obtained. I suspect they are quite delusive, and that the figures for electric railway operation are equally delusive. The Pennsylvania reports are not kept in the same way as the others, and allow more loopholes for differences in accounting methods than in the other two States mentioned.

The operating expenses per passenger have fallen somewhat, as may be inferred from the fact that with a uniform 5-cent fare, or practically so, the percentage of operating expenses to gross receipts has fallen. The operating expenses per car mile is a very delusive thing; it does not mean much of anything. It means something on any particular road when the results of one year are compared with another; it means almost nothing when different systems are compared with each other, the reason being that the expenses are, as I have already said, very much larger where a car can run only 80 miles per day, or at the rate of seven or eight miles per hour, than when run 150 or 175 miles per day, at the rate of fifteen miles per hour, since the "car service" portion of operating expenses forms a very large part of the total expenses. The cost per car mile is also governed by the length of cars, the carrying capacity, weight, etc., and therefore the cost of motormen and conductors per car unit, if we call a 16-foot car a unit. You can carry a hundred people with a thirty-five-foot car, with a single motorman and conductor, and the same number of people with a 16-foot car and two motormen and two conductors, the difference being very marked. The result is seen in such wide variations as 8 cents a car mile, and 27 or 28 cents a car mile, the fluctuations being usually within those figures. Such a road as the West End of Boston is operating at 25 cents a car mile, while a road with quite as great density of traffic, the Chicago City Railway, is operating at 14 or 15 cents a car mile. All these differences come in, and the car mile unit is a poor one to adopt.

I said a moment ago that the percentage of operating expenses to total receipts is delusive, as shown by the actual figures of a large proportion of roads, and in the totals of different States. That is due to this: In a correct financial system, as I defined it, you have to provide for the return of the principal to investors. Now when you start out with a new motive power about which you do not know anything, you should not pass to dividend account or to ordinary surplus account all the apparent net earnings of the first few years. Usually a large proportion of these apparent earnings represent depreciation of the new plant, and various contingencies, such as franchise life, etc. For example, a certain road commenced operation and after six months was able to present a profit and loss account showing operating expenses only 60 per cent. of the total receipts. Of these operating expenses, $2.94 only were for repairs and renewals.

That is, of course, ridiculous. We cannot hope that the life of the best roadbed put down to-day in our large cities, where the car traffic and wagon traffic is heavy, will exceed eight or ten years. In the heart of the business centers it may easily be not more than four or five years, particularly in the case of the special work. Now, during the ten years' life of the roadbed we must, if we are to maintain the capital unimpaired, not only pay the ordinary current repair bills for pushing up joints fixing the pavement and matters of that kind, but we must put aside enough money each year to provide a sum sufficient at the end of the life of the plant to replace it. It is an absolute necessity if we are going to maintain the capital intact. The same rule applies to cars, power station equipment, and every item of the installation. The cars, we hope, will last for twelve or fifteen years, although the electric service is pretty severe upon them. The motor trucks may last for ten years, but there is not a motor in operation to-day which is ten years old, I think; a great many have been discarded at the end of four or five years. The repair and renewal bills of electric railroads during the first six or eight years were something stupendous. The best apparatus known at the time was put in at the beginning of operation, but it was poor enough and had to be replaced. These replacements should properly be charged to operating expenses, but if that is done in any one year there is trouble at once. The best thing to do is to estimate the life of the various parts of equipment and provide for their depreciation.

When the people and newspapers see that a company is reporting expenses of 55 or 60 per cent. of the gross receipts and paying dividends of 6 or 8 per cent., it gives as a rule an incorrect idea as to the profits of street railroads. I believe street railroad managers are making a great mistake in not providing more largely than they are doing for inevitable depreciation, although it is true and sadly enough, in too many cases, that the interest charges alone take up a very large proportion of the apparent net profits, and there is little margin for proper accounting methods.

Now, we come to net earnings. The percentage of net earnings to total permanent investments will be seen also on these diagrams and will be found to be about the same to-day as they were under horse railroad operation in Massachusetts and New York, and very much less than they were in Pennsylvania. In other words, the enormous original investment, the cost of electric equipment and the cost of electric re-equipment and reconstruction of roads—all this experimental work added together has been large, and even though the net earnings have largely increased, the percentage on the investment has not increased, and it is more likely, I think, to slightly decrease than it is to increase in the future. I am inclined to think that the history of street railroading will be something like that of steam railroading, in that many of the companies will have to pass through reorganization periods in order to get down to a basis of fair earning capacity on the investment.

The net earnings per mile of track, as the result of the play of forces between the reduction in gross earnings per mile of track and reduction in percentage of operating expenses to gross receipts, is much the same to-day as under horse railroad operation. The curves in the diagrams show very little variation.

I wish now to speak very briefly of the probable conflict between electric railroads and steam railroads. We find that that conflict is much more likely to take place in the Eastern than in the Western sections of the country. In the Western section there is almost no interurban service and no conflict with steam railroads is likely except for a slight suburban business obtained by some railroads in a few cities. In the Eastern section, however, there are two networks, one of electric railway lines and the other of steam railway lines; and unless steam railways are more complaisant in the future than in the past, the conflict is going to be very severe. I think we will see electricity introduced on what are at present steam railroads to a very great extent in the States of Massachusetts, New York, Pennsylvania, New Jersey, Connecticut, and Rhode Island. I think that the solution of the problem which confronts steam railroads in the retention of their local business, which has always been a profitable one, lies in the adoption of electricity and the multiplication of stations.

PERFORMANCE OF THE COMPRESSED AIR CAR IN WASHINGTON.

MR. T. P. KANE, of Eckington, Washington, D. C., writes as follows to the Washington "Post" in regard to the compressed air car now on trial in that city:

The advocates of compressed air, who claim for it a dangerous rivalry of electricity, could have witnessed a practical demonstration of the superiority of the latter to the former had they been at the corner of R street and Eckington place on Tuesday evening of this week.

As the air car, now on trial on the Eckington line, was making its return trip on the evening stated, after its customary run of about a mile and three-quarters from the power house to the Treasury Department, it became hopelessly stranded in ascending the short grade of the half-square between Quincy and R streets and was unable to reach the top.

Under the skillful manipulation of the lever and brake by the expert in charge of the car every possible effort was made to force it up the grade, but without success. The car was backed and forwarded several times, but each attempt to reach the summit resulted only in its getting farther and farther down the hill. Finally in despair the receiver of the road, who was on the back platform of the stalled car, directed the conductor, sotto voce, to signal the trolley car, which was a short distance in the rear for assistance, and electricity, responding promptly to the call of its competitor in distress, came to the relief of compressed air and with perfect ease pushed its heavyweight rival up the hill and over the curve to the downward grade beyond.

I have been on this air car a number of times when it was barely able to reach the top of the grade at this point and had heard of several similar "hold-ups" which it had experienced at this same place, but I mention this particular instance simply because I happened to be present on the occasion stated and witnessed the occurrence above described.

The most noticeable peculiarities of this air car are its evident aversion to grades in general and a decided tendency to get winded when forced to climb a hill, all of which goes to support the doubt expressed in my recent criticism in the "Post" of the air motor experiment as to the ability of this car to make one round trip over the Eckington line. I mean by a round trip the course followed by the other cars on the line, from the power house to Brookland, from Brookland to the Pennsylvania Railroad depot, and back again to the power house, a distance of probably less than seven miles, and a trip which this car has never attempted to make.

SAFETY APPLIANCES ON RAILWAY GENERATORS.—SOME LIGHT ON THE MT. VERNON STATION FIRE IN PHILADELPHIA.

BY GEORGE MOFFAT.

Of the many fires which have lately destroyed power and lighting central stations, none have been investigated, that I am aware of, to find if the calamity could have been prevented, and, if so, how.

We find in the majority of stations now built a want of balance about the system; either the machinery may be the best money and labor can procure, while the building is simply a rude covering and the switchboard apparatus is of the crudest kind. Then, again, there are at least three stations in the East which have cost the owners considerably more than the machinery they contain. There is no serious objection to this, excepting one is generally done at the expense of the other, for buildings may be of brick and stone to be perfectly fireproof while the generator is left unprotected. There are others which have all the latest safety (?) devices and still the building itself is an invitation for the spark to complete destruction.

But let us look into the manner the machine itself is protected in our large stations. The last large central station fire—that of Mount Vernon station, Philadelphia Traction Company—will serve as an illustration.

When this station was built the first generator (400 kilowatt) had the circuit breakers put up on the negative side, which is the usual way. New machines (1,100 kilowatt) were installed in the fall of 1894, but as they flashed very badly the makers thought it advisable to break the positive side so as to stop excitation. Equalizer jaws were put on the breaker and it was also broken and the breaker taken off the negative side and from the switch, which leaves a complete negative cable from machine terminals to negative bus bar. The negative side of the machine was connected to the coil that releases this interesting (!) piece of mechanism. This can easily be understood by referring to Fig. 1.

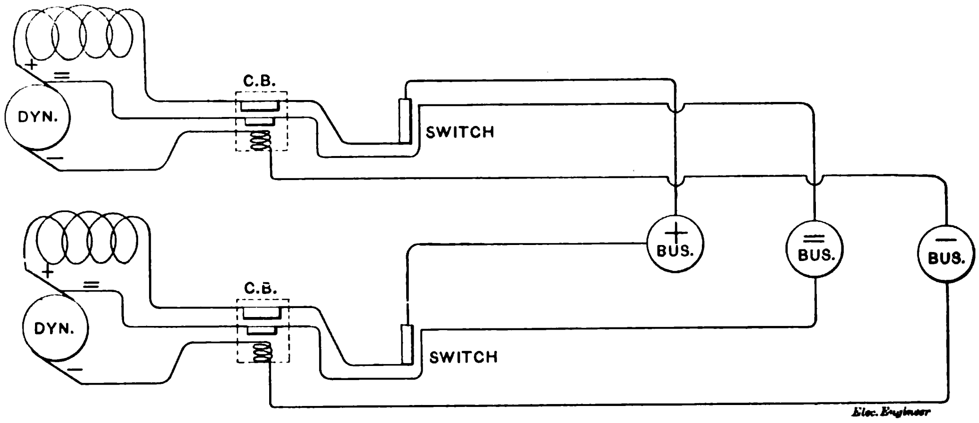


Fig. 1.

The evils of this combination were soon apparent. The author, who had charge of this station at that time, immediately put fuses on the negative side of the machine. Their utter unreliability in railroad work is too well known to be further discussed. It is sufficient to say that one fuse rated at 100 amperes was connected in series with a feeder circuit breaker loaded to 400 amperes and opened the breaker; and at another time the fuses on the machines (1,500 ampere fuses) melted at a load of 700 amperes. Accidents of this kind leave the machine disabled for a few minutes, overload the others and, the chances are, open the breakers and shut the station down. They were taken off soon after. Circuit breakers were next proposed and were to be fastened on the machine, but as the machines were not working well, it was decided to get entirely new ones and place the circuit breakers where they belonged—on the negative side.

The first of these new generators was in process of construction at the time of the fire, March 3, 1897. The fire itself was occasioned by a dangling crane chain short circuiting the positive to ground through the fly-wheel. The particles of molten metal thrown over a greasy floor soon accomplished the mischief.

Fig. 2 shows how the short circuit occurred, also the location of circuit breaker located on positive side, which no doubt opened, as the other machines would tend to open it, but still leave the unfortunate machine unprotected. Had the breaker been where it should have—on the negative side—this could not have happened, as it would have opened and the worst would have been an idle machine for two or three minutes.

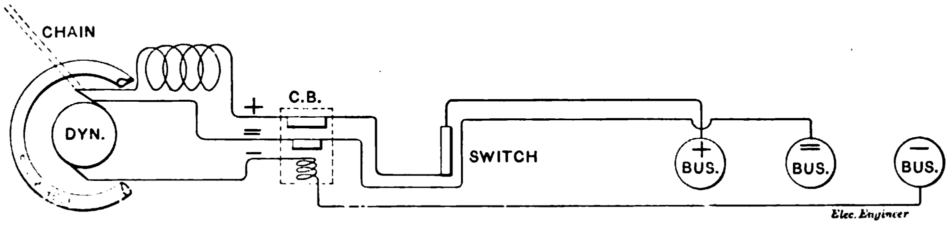


Fig. 2.

Added to this was a wooden floor (which has no right whatever in a central station), dangling chains and unprotected machine terminals—a pretty combination.

Another source of danger in many stations is grounded field magnets. There is not one good reason why field magnets should be grounded. In fact, all the arguments are against such a proceeding, and yet some makers of electrical apparatus are making them so. Possibly the cheapened cost of construction may have something to do with it. It is not enough that they should be put in position properly insulated, but they should be kept so. An insulation test with a voltmeter should be made at least once a week and all oil, dirt, dampness, etc., wiped off the base. This may prevent serious trouble should a field coil prove defective.

What is needed is not new safety appliances but the proper use of those we have, added to scrupulous care.

A SPOUTING TROLLEY POLE.

The spectacle of a sizzling fountain of water, springing geyser-like from the top of a trolley pole drew a crowd of wondering people at the corner of Michigan avenue and Third street yesterday. They looked on with almost as much amazement as the Israelites might have experienced when Moses worked his miracle with a rock and a walking stick. A gang of workmen set to work to discover the occasion of the phenomenon. In the course of time they came to a waterpipe, which ran beneath the pole. It had been eaten through with electrolysis, and the water burst through, entered the hollow trolley pole, and having nowhere else to go, came out at the top.—Detroit Evening News.

SUBURBAN ELECTRIC LINE FOR MONTREAL.

A big electric railway scheme is planned to connect Montreal with many near-by points across the river. The road will probably be called the Montreal and Southern Counties Railway. The idea is to connect Montreal and the south shore with the counties of Chambly, Vercheres, Ronville, St. Hyacinthe, Laprairie, Brown, Shefford, Stanstead, and Sherbrooke. From Montreal and Sherbrooke the main line and branches will form a system of 150 miles of track, and the road is to be constructed on the most approved methods. The trucks will be built in such a way that the cars run as fast as forty miles an hour. A. J. Corriveau, who is associated with a New York and Montreal syndicate, has the scheme in hand, and from present appearances there is said to be every prospect that it will go through. The capital of the company is $2,000,000.

MECHANICAL

THE WELLINGTON ENGINE.

BY IRVING A. TAYLOR.

I BEG to remark the fact that this engine, described in your issue of April 21, 1897, is merely a complex variation of the ordinary, every-day steam engine; and though I have not the time to go into a general analysis, a few words will be sufficient to make it evident that the efficiency is as low, if not lower, than usual.

For the first matter, that of non-originality. The boilers are the same as ordinary boilers and are not necessarily more efficient, while practically they would be less so when the inefficiency (due to loss of heat by radiation, chimney gases and other ordinary losses) of the prime boiler marked "Heater" is considered. The discharge into the "cooler" could just as well be into a river, while the feed from "cooler" could be from a river. The condensers would be called, if used for a non-condensing engine, feed water heaters.

Since the cases are parallel, does any one suppose it would be economical to keep a high pressure (40 lbs. absolute, for instance) in their combined condenser feed water heater, in order to obtain feed water at a high temperature? Or would it not be more economical to use the water from a river (the "cooler") for each condenser separately, thereby securing low back pressure, and heat the feed water to 288 degs. Fahr. by an economizer placed in the chimney of the furnace under the "heater"?

The use of a fluid with a low temperature of evaporation, i. e., a two-fluid engine, has been tried several times and found to be practically inefficient. (See Wood's "Thermo-dynamics.")

Now, looking at the matter of efficiency. The "heater" supplies, per pound of water passing through it, 500—288 = 212 H. U. The engines take 500—220 = 280 H. U., and deliver through condensers 288—50 = 238 H. U. They therefore use 280—238 = 42 H. U. The difference between 212 H. U., supplied by the "heater" and 42 H. U., used in the engines, i. e., 170 H. U., is the amount, 220—50 = 170 H. U., thrown away in the "cooler." The theoretical limit of efficiency of the engines is 42 ÷ 212 = .198 = 19.8 per cent. If the efficiency of the "heater," boilers, condensers, piping, and the mechanical efficiencies of the engines are taken into account, this figure would easily be reduced to 6 per cent., or less.

It may be laid down as a law, that, to be successful, any complicated apparatus must offer as an offset for its complexity, some great advantage, such as a very evident increase in efficiency.

The cost of coal per horse-power hour in a good condensing plant is not over 3-10 cent, while the attendance, interest, depreciation and repairs, brings the cost up to from 2 cents to 10 cents per horse-power hour, depending on the load factor and size of plant. It evidently will not pay, even for a 50 per cent. decrease in the coal consumption, to increase the other expenses by 10 per cent. In the case of 2 cents per horse-power hour, or 2 per cent. at the other limit of 10 cents per horse-power hour.

LETTERS TO THE EDITOR

CARELESS OVERHEAD WIRING.

AN instance of poor line work has come to our attention on one of the alternating systems now operating in Philadelphia. One day recently during a stormy day, a primary wire became crossed with the secondary, and either from poor insulation or through dampness 1,000 volts was sent through the secondary, and came near causing the death of a young man who was working in a store which the secondary supplied.

The young man went to the cellar and reached up to turn on the light; upon touching the brass part of the socket he received a shock which may cause the loss of three fingers. He lay in the cellar fully fifteen minutes unconscious. He was taken to the hospital and is now undergoing treatment.

The electric light company claimed that the accident was due to a ground, but upon a thorough test of the installation it was found to be clear of all grounds, and, what was more, after the test by one of their own employés, when the man went to slide up the canopy of the fixture he was knocked off the ladder.

A thorough search soon placed the blame where it belonged. One of the company's men got up the pole and found the cross not one foot from the converter, and yet the company claim they do good line work. Why does not the city make the companies having high tension lines do good work or hold them responsible for all accidents which may happen, due to their carelessness?

The large number of just such accidents should lead to the employment of competent and careful linemen, who would have some regard for the safety of the company's consumers and the public at large.

Thorough inspection of nearly all lines would probably reveal just such traps as these waiting for some unsuspecting person to walk into.

D. W. G.

MARRIED

CONOVER-GREENE.

The marriage of Miss Mary Richmond Greene to George Stevens Conover occurred on April 21 at St. George's Church. The ceremony was performed by the Rev. Henry Lubeck, rector of St. Timothy and Zion Church, New York, assisted by the Rev. J. Phillip B. Pendleton, D. D., rector of St. George's. The bridesmaids were Miss Downs of Philadelphia, Miss Conover of Princeton, N. J.; Miss Vincent of New York, Miss Page of Boston, and Miss Campbell and Miss Franchot of Schenectady. The best man was F. S. Conover, Jr., of Texas; the ushers, R. S. Conover of Hyde Park, N. Y.; E. F. Conover, A. B. Shepard, F. V. Blackwell, W. L. R. Emmett, J. W. Kirkland, George De B. Greene of Schenectady, and C. L. Perrine of Boston. The attendants upon the bride were four little cousins, Gertrude, Edith, Katherine and Eleanor Greene, daughters of Col. Greene of New York. The bride is a daughter of the late Capt. S. Dana Greene, United States Navy, who commanded the Monitor after Lieut. Worden was disabled, in her famous engagement with the Merrimac, and sister of Mr. S. D. Greene, general manager of the lighting department of the General Electric Company. The bridegroom is chief engineer of the construction department of the General Electric Company.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
120 Liberty Street, New York.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - -	per year.	$3.00
Four or more Copies in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, APRIL 28, 1897. No. 469.

Notice of Removal.

THE ELECTRICAL ENGINEER

is now occupying its handsome and commodious new suite of offices, entire south wing, eleventh floor, of the Beard Building, 120 Liberty street, New York City. It is not only thus most advantageously situated at the heart of the machinery and electrical district, but enjoys an increase of several hundred feet floor space. The offices are convenient to all railroads and ferries, and an invitation to visit them is cordially extended to all friends and patrons of the journal.

HIGH SPEED TELEGRAPHY.

THE telegraphic art, at least in the United States, has for a good many years been criticised on the score of non-progressiveness and it has been alleged that in the application of improved methods foreign nations for once have left us in the rear. This is not pleasing to contemplate and it seems worth while to consider a little more closely this state of affairs to determine if possible the causes to which the existing conditions may be ascribed. As a matter of fact, the telegraphic art has not been wholly at a standstill in America. This country was the first, we believe, to apply the dynamo as a substitute for the gravity cell, due to the enterprise of Mr. Stephen D. Field, and to-day America leads in the number of such installations. The quadruplex in its present form may also be claimed as ours, due to Mr. Edison; and other, by no means unimportant, improvements in methods and apparatus could be mentioned which have found their way into universal practice. But the fact remains that the Morse key and sounder still continue to be the ways and means of handling more than 99 per cent. of the country's telegraph business. Machine telegraphy can therefore hardly be said to have obtained a foothold here, in spite of the able inventors who have submitted their systems for public approval, among them Delany, Craig, and others. The newest comers are Messrs. Crehore and Squier, whose experiments in timing the flights of projectiles led them to the construction of their polarizing photo-chronograph out of which they have developed a decidedly ingenious system of telegraphic transmission by means of alternating currents. Their system as described by them before the American Institute of Electrical Engineers last week presents a most interesting study and though not yet beyond the experimental stage, is worthy of consideration. We may say, in passing, that the inventors have taken several leaves out of Mr. Delany's book, to whom, we are glad to note, however, they give full credit.

At the conclusion of their description of the apparatus employed by them Messrs. Crehore and Squier enter into a discussion of the place which a system of telegraphy capable of transmitting several thousand words a minute would have in the commercial world, in which they give a very instructive table showing the statistics of the United States mail service, the telegraph and the telephone. They bring these forward to show first how inexpensive the present mail is as compared with the telegraph and telephone and, on the other hand, how expensive the telephone is as compared with the telegraph. A high speed telegraph system, such as that elaborated by Mr. Delany and submitted to a Congressional committee some months ago, could, they believe, take largely the place of the post. It will be conceded even by the advocates of high speed telegraphy, that, however meritorious a system of high speed telegraphy may be, it will, of necessity, be limited to trunk line business, and that most of the way business will continue to be done by the Morse system.

This, however, is no argument against high speed telegraphy, but is only brought forward to emphasize the point that no system of high speed telegraphy has yet been exploited, applicable to all kinds of telegraph business. Nor is it the intention of the advocates of such systems to impose such conditions upon themselves, preferring, as they do, to cater for the most remunerative business. What has just been said is not intended in any way to convey the impression that high speed telegraphy is not worth striving for. On the contrary, we know of no more desirable goal to aim at in the art of transmitting intelligence, and any means brought forward to accomplish that end ought to be welcomed and encouraged. But before that end is reached, it seems to us that other hitherto neglected matters in telegraph work must be looked to, and principal among these is the line. Even the best constructed pole lines built, according to existing practice, are subject, one might say, to hourly disturbances of one kind or another, while not infrequently an entire system of wires is rendered absolutely useless by the destructive elements. Where a line fails temporarily as is frequently the case, the receiving operator's break at the other end informs the transmitting operator of the fact, and the unintelligible part is quickly rectified. But a line disturbance lasting for only five seconds, say, on a line handling 3,000 words a minute would mean a "break" of 250 words, and, what is worse, would not be discovered until perhaps thousands of words had been reeled off beyond it! The condition of affairs under such a régime can more easily be imagined than described. The first thing to be looked to in high speed transmission, it would seem, therefore, is the construction of a line which would be reasonably safe against interruptions of even the most temporary character. Such a line can be built but would, of course, require to be very much more substantial than the present types, and would probably run through a right of way not less than thirty feet wide and clear of all trees and other like disturbing environments. The cost of such a right of way would be to a considerable extent offset by the reduced number of wires demanded with high-speed telegraphy, and by the reduced cost of repairs. If a line such as here contemplated were in existence to-day we have no hesitation in saying that at least one of several high-speed systems would be immediately available. As to the effect of the inauguration of such a system on the present business of the telegraph and telephone companies, we have no hesitation in expressing our belief that it would be beneficial to both. We need only point to the business of the telegraph companies which has, after all is said and done, steadily increased since the advent of the telephone. Each service will command a distinct patronage and there will be room for all. It is to be hoped that private enterprise will take up this work and thus leave the government free to concentrate its efforts on the very defective mail service; but there is great danger that unless some move in this direction is made by existing or by new companies, the government may be forced to take up the matter in response to public demand. This would be highly regrettable.

ELECTRIC BURGLARY WITHOUT THE CURRENT.

THE public was recently alarmed by reports from Chicago of the easy manner in which the burglar of the future will use electric current as the means for penetrating into bank safes and vaults where valuables are kept. Our discussions of the subject have shown how little value need be attached to these sensational stories, and now comes an incident that tends to disprove some of the more subtle theories set afloat. It was urged, for example, that many burglars are expert mechanics and can easily acquire a knowledge of electricity or would graduate from the electrical ranks; so that they would utilize electric heat as readily as a fishmonger uses ice. Previous experience had gone to show, however, that when the burglar went a-burgling he preferred to have all the currents of electricity cut off, and the latest episode proves that this type of human leopard has not yet changed his spots. It appears that the foreman of an electric light plant in this State was discharged not long ago as a bad character, and that his dismissal was soon followed by sudden stoppages of the electric light, attended by a number of petty thefts. A detective was engaged, who soon trapped the man into an avowal of his ability to be bold and bad by engaging him to run a crooked pool and card room. The information was next volunteered by the ex-foreman that he had a plan of the local National Bank and knew how easily it could be "cracked." His plot involved the disabling of the electric light plant so as to leave the town in darkness; and he took the detective with him to the station and actually gave some whisky with "knock-out" drops in it to the night engineer. The drops took effect, and while the man was still under their influence the lighting circuits were thrown off. Next day the ex-foreman and his ally, a drug clerk, who had compounded the drops, were arrested for the offense of drugging, which carries with it a penalty of fifteen years' punishment. This is certainly a very interesting episode, but, as will be seen, every condition was favorable for just that burglarizing by means of electric heat we have heard so much about. Yet, it will be observed, this expert in electricity and crime did not want any electric heat in his scheme. His one idea was to get the current turned off, not to get more turned on; and even the preliminaries of opening the circuit have put him in peril of fifteen years' imprisonment.

THE ELECTRICAL CONTRACTORS' DINNER.

HARMONIOUS and successful in every way, the annual dinner last week of the New York Electrical Contractors' Association was something more than a mere occasion for feasting and oratory. It served to show how large and important a field of work had grown up within the past few years, and how great are the interests now engaged in the task of equipping a big modern city with electricity. Nothing has of late been more remarkable than the creation, not alone of the Greater but of the Newer city on the Island of Manhattan and its adjacent territory; and even the citizen who witnesses daily the work of rapid construction is impressed with the number, loftiness, size and beauty of the new buildings. The electrical contractor is entitled to the credit for much of the difficult work that has made these shining palaces possible, and the high standard always kept in mind was emphasized by the dinner and by the speakers. As President Hatzel pointed out, with labor troubles in the background, the association has important duties and objects none of which is more vital or laudable than that of setting up a high ideal of excellence and requiring all its members to maintain and advance it nearer to perfection. It is evident that the contracting business is expanding—still undergoing development, as suggested by Messrs. Johnson and Mailloux, on the one hand toward "bulk" contracting and on the other to a helpful supervision by the consulting engineer; in other words, an increase and a decrease of direct responsibility. Under such conditions and in view of the others still to arise, it is well that a strong and authoritative body should exist, whose efforts for unanimity on the right lines will do more good than all the multitudinous rules that are incessantly promulgated.

TELEPHONIC CONVERSATION AS EVIDENCE.

LAST week we made note of the fact that Judge Bundy, in Indiana, decided to admit a telephonic conversation as evidence, although he could find no precedent or authority in the books. A correspondent of the Sun, who writes apparently with some authority, asserts that there is authority and that the first admission of such evidence was in the famous Ferdinand Ward suits, when his "partner in crime," J. D. Fish, swore to instructions received by telephone as to the disposal of two checks for about $146,000. The evidence was admitted by Judge Barrett, as was also that given next day by a brother of the witness, to the effect that standing near the telephone he had heard Ward's voice distinctly. The lawyers for the defence of Ward objected, but a letter from Ward to Fish was put in evidence complaining that everybody in the room where that telephone hung could hear what was being said. Ward was found guilty of fraud, and Judge Barrett's decision in regard to the telephone message was sustained on the appeal. The Sun has quoted a precedent furnished three or four years ago in this city by Judge Benedict; so that here we have three authorities all accepting telephonic conversations as good evidence.

The telephone being thus established, the attempt to give a footing to the phonograph or graphophone may be noted. An action having been brought against the New York Central for damage from the noise caused in building its new viaduct uptown, three graphophone cylinders were produced in the court, alleged to bear record of the noises, so as to furnish the court with auricular evidence. Judge Truax ruled that he could not admit the evidence, at least at this stage. This would imply that it may manage to slip in later; and in the meantime this would appear to be the first time that an attempt has been made to secure acceptance by the courts of such testimony.

THE disastrous fire which destroyed the Mount Vernon street power house of the Philadelphia Traction Company a short while ago has attracted more than usual attention among railway men. The origin of the fire is primarily ascribed to the fouling of the crane chains with a generator, causing a short circuit; this was followed by the throwing of molten metal on the oil soaked floor, which did the rest. But the cause of the continued short circuit had not thus far been explained. Just how it came about is now shown in a communication, appearing in another column, which ought to prove of value to all railway power station superintendents.

THE Citizens' Street Railway Company of Indianapolis has come off signally victorious in its fight against the new three-cent fare law, noted by us last week. Judge Showalter in the United States Circuit Court at Chicago has declared the law to be unconstitutional because it is "special legislation," applying only to the city of Indianapolis and to no other part of the State of Indiana. The court holds further that where proceedings in effect destructive of vested property rights are threatened by a defendant in an official position under color of a void statute, a preliminary injunction ought to issue; and it has been granted. As a matter of fact, there are three injunctions: one preventing the company from receiving three-cent fares; one against the State Prosecutor forbidding him from any attempt to enforce the law, and one against the city to prevent its officers from trying to put the law in force. This is pretty complete in the way of choking off the unconstitutional legislation, and the company goes back at once to five-cent fares.

AN important "deal" that has been under negotiation for a long time past has just been brought to a successful issue. The Postal Telegraph Company has been without a Mexican connection and the Mexican National and Mexican Central railroads have been able only to send messages over their telegraphic lines to this country by way of the Western Union Cable between Vera Cruz and Galveston. These interests have therefore got together and have made a 25-year agreement to exchange business, and the Postal lines which have lately been pushed in Texas will now be carried through to Laredo and El Paso on the Mexican side. The Commercial Cable Company will naturally handle all the European business coming and going, and thus the line of communication will be complete. There will probably be no cutting of rates, as that is contrary to the policy of the competing companies, but the elimination of the cable may make a difference in favor of lower cost.

IT is stated that the creditor of a Western street railway sought to make the enforcement of his claim swift and emphatic by levying on all the motormen's switch handles, without which it would obviously be a very hard thing to run the cars. The upshot of the affair is not given, but it seems to us that aside from the meanness of the plan, it is wholly irregular and illegal. If it is improper for strikers to stop cars because they carry mails, it would appear even more improper to let anybody interfere in a suit for debt, with cars carrying not only mails but passengers, and subserving the necessities of a large population. There ought to be some better way out of the difficulty.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—VII.

BY JOSEPH APPLETON. (Copyright, 1897.)

INSTALLATION, CARE AND MAINTENANCE OF STORAGE BATTERIES. (Continued.)

THE value of this test in practical work, is to ascertain whether at the end of a discharge or charge, when the voltage of the cell has reached the limit, both plates are in similar condition or if one is behind.

It will be noticed, from the readings given, that at the end of a discharge the voltage between the cadmium and negative should read .23 to .33, according to the rate of discharge, the cadmium being negative; this requires very accurate measurement on account of the comparatively small difference in potential; therefore, the best way to make the test is as follows:

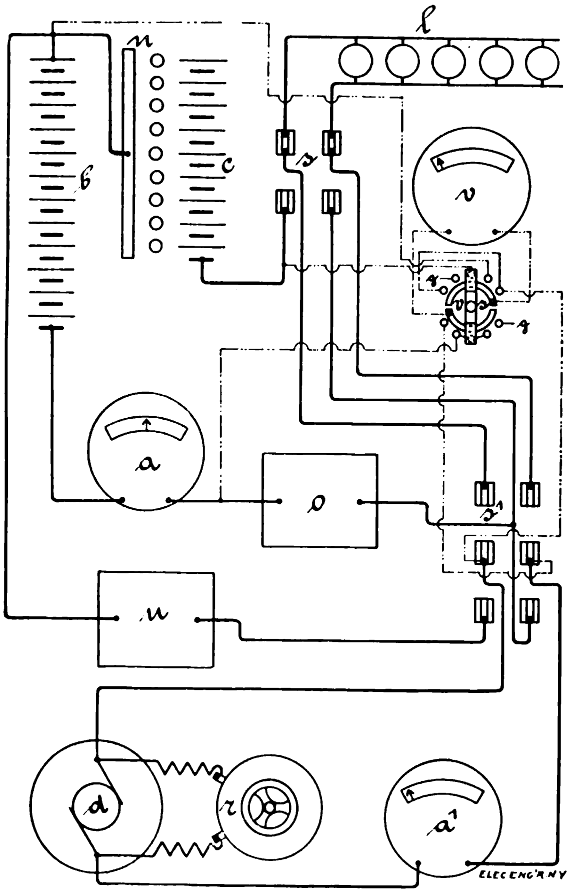


FIG. 21.—DIAGRAM OF CONNECTIONS FOR COUNTER CELL REGULATION.

a, a^1, Ammeters ; b, Battery ; c, Counter Cells ; d, Dynamo ; l, Lamp Circuit n, Counter Cell Switch ; o, Overload Switch ; u, Underload Switch ; s, s^1, Knife Switches ; v, Voltmeter ; v s, Voltmeter Switch ; r, Dynamo Field Rheostat.

At the end of the discharge when the voltage of the cell has dropped to the limit, measure the e. m. f. between the positive and negative plates, also between positive and cadmium.

The difference between these two readings will give the e. m. f. between cadmium and negative; for example:

E. m. f. of cell.	Cadmium and positive.
1.88	2.10

Subtract one from the other, .22, which shows the condition of the negative.

A negative plate should never be discharged beyond the point where the e. m. f. between the cadmium and negative reads .30, except at high rates of discharge, when .35 may be considered the limit.

If the voltage of the cell drops to the limit before the negative reaches this point it is the positive plate which is exhausted.

In the same way during charge this test will show if both plates are fully charged when the voltage of the cell reaches the proper point, which in ordinary work may be fixed when the reading between cadmium and negative is zero, or in other words, when the voltage of the cell, and the reading between the cadmium and positive agree.

During the early stages of storage battery work, when its use was considered more or less of an experiment, the manufacturers found it necessary, in order to sell them, not only to guarantee satisfactory operation, but also that the cost of keeping them in repair would not exceed a certain sum per annum. This custom, once established, became a recognized part of all storage battery contracts and in many cases was an injustice to the manufacturer, as the purchaser neglected the battery, feeling that he was protected under the maintenance contract.

In large central station plants, where the size of the battery is such that proper attention is given to it, the guaranteed maintenance is a fair and equitable arrangement, but in many isolated plants the battery is neglected and it becomes a question of guaranteeing the man in charge as well as the battery. No other class of electrical machinery calls for such a guarantee, in fact, such an arrangement would not be considered for an instant by the manufacturer. It is simply because the action of the storage battery is silent and invisible that the makers have to guarantee something, which in many cases is beyond their control.

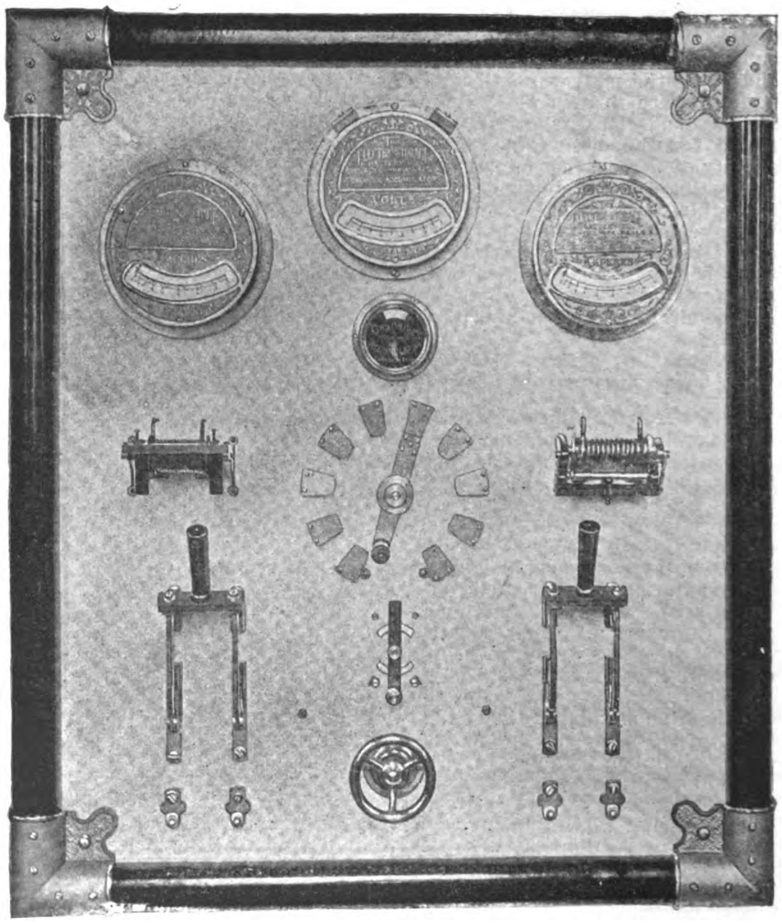


FIG. 22.—SWITCHBOARD FOR COUNTER CELL REGULATION.

With the modern storage battery and a reasonable amount of attention, the cost of maintenance is considerably less than that for which the manufacturer will enter into a contract, and these facts tend to discourage the adoption of such contracts except in large plants where the amount of money invested is considerable and the manufacturer has reason to know that proper attention will be given to the battery, and therefore is enabled to make a low maintenance contract.

In the majority of plants the owners could maintain the battery for a much smaller amount than the manufacturers charge, if they gave it proper attention, as the manufacturer has to allow for the possibility, if not the probability, of the plant being neglected. It is much better all round for the owner to maintain his own plant, if proper attention is given, as the battery is benefited by having regular attention; the owner saves money and the manufacturer is relieved of the responsibility.

APPLICATION OF STORAGE BATTERIES TO ISOLATED PLANTS.

In considering the application of storage batteries to isolated plants, we will divide the latter into two classes, and consider them separately.

1. When the isolated plant is installed in a private residence or similar situation, where convenience is of more importance than economy of service.
2. When the isolated plant is installed in an office building, or other business premises, where economy of operation is the chief point to be considered, the entire system being in competition with other methods of lighting and power.

In the first case, the storage battery is usually the principal feature of the system, all the light and power on ordinary occasions being obtained from it; the function of the generating plant being to charge the battery when necessary. This method of operation is simple and convenient, and eminently suited to the class of work, for it gives a continuous supply of electricity without the necessity of running the generating plant, except when the battery needs recharging.

The motive power in plants of this character is usually a gas or an oil engine, both of which are specially suited for intermittent running, and can be started up on very short notice. Steam engines are not so suitable for this purpose, as they require constant attention, and cannot be started up quickly; it is only where a large number of lamps have to be run for a considerable time that the conditions justify the regular attendance of an engineer.

A storage battery makes an electric light plant of this description possible, and even essential, for a private residence when it would be otherwise entirely unsatisfactory, as direct lighting from a gas or oil engine is impracticable except under special conditions.

The best arrangement of an isolated plant for this class of work is to have a battery capable of supplying one-half the lamps wired, for eight to ten hours on one charge. The average use is considerably less than one-half the lamps wired, therefore a battery of this size will take care of the ordinary requirements for two or three days on each charge.

The capacity of the engine and dynamo should be equal to that of the battery at the eight-hour discharge rate, so that on special occasions when all the lamps are required the battery and generating plant can be run together and supply all the lamps for a miximum of eight hours.

There are two or three ways of installing and operating a plant of this description, but it depends entirely upon the local conditions which will prove the most satisfactory. For installations up to a capacity of 200 16-candle power lamps the best arrangement is a plain shunt wound dynamo capable of generating up to 150 volts, the pressure required for charging a battery operating a 110-volt circuit.

When the engine is belted to a gas or oil engine it should be provided with a fly-wheel pulley to maintain a constant speed under the irregular running of the engine, due to the sudden impulse of the explosions; the engine should also carry as much fly-wheel as the design will permit. A battery of 58 or 60 cells is required for 110-volt lamps, so that the full voltage may be maintained until the end of the discharge.

The best method of regulation for a plant of this size, is by counter electromotive force cells, placed in the circuit between the battery and lamps. These counter electromotive force cells are composed of plain lead plates mounted in a containing cell in exactly the same manner as the positive and negative plates in an ordinary cell, and give a counter electromotive force when the battery is discharging through them, averaging from 2.2 to 2.5 volts, according to the amount of current passing.

It will readily be seen that by keeping the right number of these counter cells in circuit between the battery and lamps, the voltage of the lamps can be maintained at normal pressure irrespective of the voltage of the battery. Sufficient counter cells must be provided, so that if any lamps are being used when the battery is charging, and consequently has a higher voltage, the voltage on their circuit can be maintained at the normal. For example, if 110-volt lamps are used and the maximum voltage of the battery while charging is about 150 volts, the difference of 40 volts has to be absorbed by the counter cells. It is found in practice that 18 counter cells are sufficient for all purposes. When it is possible to avoid using lamps while the battery is being charged—and this is feasible in most private installations—the number of counter cells can be reduced to seven, these being sufficient to regulate the voltage during discharge.

Fig. 21 shows diagram of connections for a plant of this description, and Fig. 22 illustrates a convenient arrangement of switchboard for same. The necessary instruments and apparatus are as follows: Voltmeter with 5-point switch, arranged to read pressure of dynamo, battery and lamps, also to be used as a ground detector. Ammeter in dynamo circuit. Ammeter in battery circuit, reading current in both directions. Counter electromotive force cell switch. Knife switch for dynamo. Knife switch for battery. Automatic underload switch to open circuit when the charging current falls to zero, thus preventing the battery discharging back through the dynamo. Automatic overload switch to open battery circuit when the battery is discharging at too great a rate. Rheostat for shunt field of dynamo.

With the above arrangement of apparatus the plant can be operated and controlled as desired.

ALTERNATING CURRENT DYNAMOS IN PARALLEL.—I.

BY J. E. WOODBRIDGE.

THE advantages to be gained by the parellel running of alternating current dynamos are just beginning to be realized by electrical central station managers. The complications caused by the present prevailing system of running each machine on a separate circuit become very serious and annoying in the case of large stations where there are a large number of generators. The number of circuits increases necessarily with the number of machines, and the problem of properly distributing the loads on those circuits so that in the evening each generator shall do its full share of the work, and yet not be overloaded by some unanticipated addition, is a serious one. A compromise which results in poor economy always has to be made with loads which are subject to sudden changes that cannot be foreseen in the central station, such as theatre and church loads, etc.

Then constant attendance is necessary, as the load rises and falls through its daily range, to start up the fresh dynamos as they are needed, and switch on to them the different lines; and again, when the load falls off, to properly bunch the lines on certain dynamos, so as to keep the machines which are running always as near to their most efficient loads as possible. No little ingenuity is needed when the dynamos in the house are of various sizes and capacities. When the conditions are further complicated by the necessity of giving the longer feeders a higher voltage than the shorter ones, the increase in that voltage being proportioned roughly to the load, the switchboard man has no easy job. Added to that is the necessity of carrying over his circuits as nearly instantaneously as possible, to prevent too long a "wink" in the lights; and the risk of accidentally throwing two machines in multiple by a mistake in the manipulation of his switches.

The case is worse than the handling of a similar number of dynamos in parallel, as they are arranged, for example, in Edison stations; because in the latter case all the circuits being multipled, the various fluctuations of the different individual loads tend to even themselves up, and being small in comparison with the whole multipled load, give far less trouble. There is also but one load to watch, which, if the machines are well designed, automatically distributes itself evenly among them, while on the independent system there are a half dozen or a dozen different loads, each of which must be looked out for.

The winking of lights in switching is another disadvantage of the independent method of running alternators. To the critical customer engaged in reading his evening paper, the sudden darkness of two or three seconds' duration and the jumping of the lights, as the grouping of the switches is changed, are great nuisances, and are likely to cause some remarks concerning the comparative steadiness of the Welsbach gas burner.

These disadvantages are eliminated by running all the alternators in a station in multiple on one set of bus-bars, from which all the feeders are tapped off, either direct or, in the case of long feeders, through adjustable boosting converters. With such a system the number of feeders can in most cases be considerably reduced, which means increased economy, as, for example, two No. 0000 lines cost less and give less trouble than the same amount of copper in eight No. 3 lines. Less copper, even, may be used by cross connecting the feeders, so that they may help each other out when unequally loaded.

Only a few years ago it was considered impossible to run alternators in multiple arc, or, if possible, not commercially practicable. In the year 1889 the now classical experiments of Mr. Mordey proved the contrary. In these experiments he coupled together two large alternators without resistance or impedance coils:

(1) When running at the same speeds and voltage, but regardless of phase.

(2) When running at the same speeds, but generating 1,000 and 2,000 volts respectively.

(3) Generating 1,000 and 2,000 volts as before, but switched simultaneously together and on to a heavy load.

(4) Running at somewhat different speeds.

In all cases they instantly pulled each other into synchronous speeds, and into proper voltage and phase relations, and ran together on all loads; proving absolutely the ability of at least one type of alternating dynamo (the Mordey-Brush) to run multipled under more trying conditions than do direct current machines.

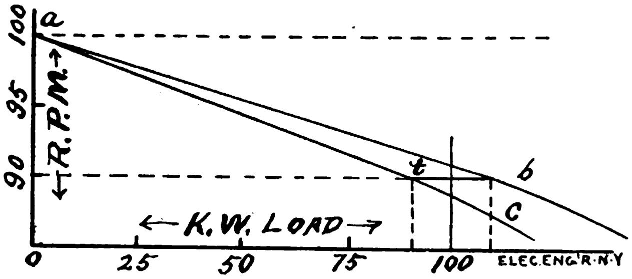


FIG. 1.

Since then the multiple method of running alternators has been generally adopted in Europe, machines of different makes and sizes being run together in some stations, and in one place (Deptford Station, London), high voltage machines being multipled with the secondaries of step-up transformers, the primaries of which are run from low voltage machines.

In this country the parallel working of alternate current machines has not as yet become prevalent. Large modern installations, such as that at Niagara, are arranged for parallel working; but the large majority of small stations work their machines entirely independently, constituting, to their own serious detriment, what Professor Fleming calls "a collection of little central stations, arranged for the sake of convenience under one roof."

The engineers of such plants have the idea that alternating dynamos must be specially made for multiple working. The best ready test of the ability of any two machines to work together is to run one of them as a synchronous motor from the other. If it holds up to speed under a complete range of loads without excessive current passing (and most good machines of the same frequency will do so) the two will run together as dynamos if properly driven. This condition as to the mode of driving is more exacting than with direct current machines; as two alternators, when switched together, must keep the same speed with as great a mathematical accuracy as though their armatures were keyed to the same shaft. Working with this premise and the nature of particular types of driving machinery, the writer has derived the treatments described below which seem to work well in practice.

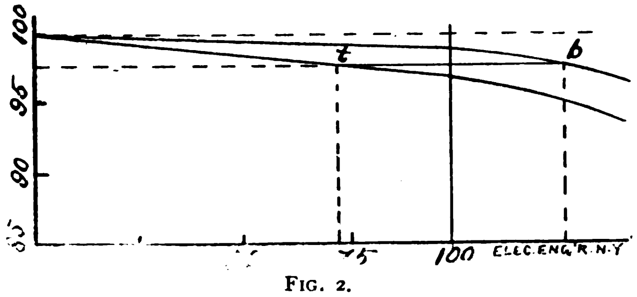


FIG. 2.

Three cases present themselves in common American usage, viz., multipling two machines:

(1) Where both are driven by the same engine or countershaft.

(2) Driven by separate engines, there being no other loads on either of those engines.

(3) Driven by separate engines, one or both of which supplies power to other loads.

In the last case no attempt had better be made to multiple the alternators, unless they constitute almost the entire engine loads, or unless the other loads on the two engines are also multipled, as for example two 500-volt generators running in parallel. The treatment becomes then the same as under case (2).

In the first case, that is where the two generators are driven from the same source of power by separate belts, the essential features for a proper division of the load are, first, such a diameter of the belt pulleys as to give both dynamos the same frequency when running light; and, second, such an arrangement that the slip of one belt shall be the same as that of the other at any load. If the condition does not comply with these requirements, the dynamo, the belt of which slips the more, will shirk its work as the load rises, making the other machine do more than its just share. In direct current working, differences in belt slip are very simply remedied by increasing the field excitation of the machine with the greater slip, thus making it take up its share of the load; but with the alternator this does no good, but makes things worse, if anything. If the two machines synchronize exactly when light, and one belt slips as much on fifty kilowatts as the other does on one hundred kilowatts, the first machine will take only one-half as much load as the second, when in parallel, no matter what tinkering is done with the fields, the armature circuits, or the load. If the fields of the shirking machine are strengthened, the machines are thrown out of phase with each other, though not out of synchronism. This generates idle currents in series through the two machines, which heat up the armatures and reduce their capacity for carrying external loads.

This running out of phase by means of idle currents makes the indications of the machine ammeters very deceiving, as under certain conditions the machine showing the greater current may be doing the lesser work, and a machine may be even motoring, that is, taking power from the other machine by wire and returning it via the belts, without showing it on the ammeter. For this reason an indicating (not a recording) wattmeter should be used on each machine in addition to the machine ammeter.

This description of the effect of the slip shows that a turn or two of the belt tighteners should have a much more beneficial effect in adjusting the relative loads between the machines than any amount of manipulation of the field rheostats; and shows also why a clean belt should be run with more slack than an oily one, etc., in multiple work. The same theory probably explains also why more success has been attained in Europe than here in such work, owing to the use there of rope driving; since rope drives with automatic tighteners are more like each other in their slippage than are belts, which vary with age, quality of leather, amount of oil, water, dressing, etc. By the same reasoning leather link belts should run better in such service than solid belting, because the comparative tension of two link belts can be more readily estimated by the eye than can that of two solid belts. Whether this is or is not the case is unknown to the writer.

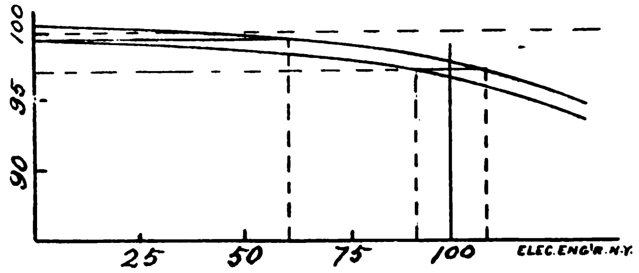


FIG. 3.

All that has been said about belts must be understood to apply only where the machines are driven from the same source of mechanical power. In the second case specified above, where separate prime movers drive the two generators, the treatment is quite different. Here the governors of the driving engines play a vitally important part. Not only must the engines drive the dynamos at the same frequency with great precision when light, but the drop in frequency must be the same in both dynamos at any load, that is, the drop due to the governing of one engine, plus the slip of its belt, must equal at any load the drop and slip of the other at the same load. If this is the case when the machines are independently run, they will divide the loads equally when run in parallel, whether of the same or different make, style and type. If this is not the case, the loads will not be equally divided, no matter what is done with the field rheostats or any other part of the electrical circuits.

It is true that the relative currents of the two machines may be varied by changing the field excitation; but the division of the load, as shown by indicating wattmeters, is not materially changed thereby, until the field excitations are unbalanced sufficiently to break the synchronism. This is owing to the fact that the relative loads depend solely on the relative cut-offs of the two units when running at the same speed.

In running two units of different sizes together, their governors should be so arranged as to slow them both down the same percentage at any proportional part of their respective rated loads. For example, in arranging a 100-kilowatt and a 500-kilowatt generator for parallel running, the governing drop in the first should be the same with a load of 25-kilowatt as in the second with 125-kilowatt, also as much in the first with 50-kilowatt as in the second with 250, and so on. Under this condition and only under this condition will the two units in multiple divide their loads properly. If the smaller unit is belt connected and the larger direct connected, the slip of the belt must be added to the governing drop of the former before the comparison is made.

Strange as it may seem, the more poorly the governors work, in the sense of slowing down as the load increases, the more uniform becomes the distribution of the loads. This may be realized by plotting together the speed regulation curves of two engines, assuming a small unavoidable difference in speed. Fig. 1 is such a diagram for a pair of direct connected alternating steam dynamos of the same size. It may be seen that they run at the same speed (100 revs.) when light, but regulate poorly and somewhat differently, a b being the curve of one machine and and a c that of the other. When the machines are independently loaded with 100 kilowatts each, the curves show that the first loses about 9 per cent. of its speed, and the second about 11 per cent.

Fig. 2 assumes the use of two governors with the same equality at zero load and the same difference at high loads, but shows better regulation for both governors; the drop of one with 100 kilowatts being 1 per cent. and that of the other 3 per cent.

Let us assume that the two machines represented in Fig. 1 are multipled with each other, also the pair in Fig. 2 with each other. Assume a load of 200 kilowatts to be applied to each pair of units. In the case of Fig. 1 it is apparent that the two machines run at the same speed (about 90 revs.) when carrying respectively about 90 and 110 kilowatts, the intersections (t and b) of the horizontal 90-rev. line being, respectively, at those loads. As the speeds of the machines must be exactly the same when in multiple, and as the kilowatt power exerted by either unit depends solely on the position of its governor, the 200 kilowatts will be divided between the generators in that proportion.

The action of a governor, as far as the relation of the point of cut-off to the speed is concerned, is of course the same, whether its dynamo is independent or multipled. In the case of Fig. 2, with better regulation, the diagram shows that the two engines run synchronously when delivering, respectively, about 70 and 130 kilowatts. This gives obviously a poorer distribution because of the better regulation. A little inspection of the figures will show that the multipling of one of the machines represented in Fig. 1, with either of those represented in Fig. 2 would give a much worse load division, the latter machine doing almost all the work at any load.

In Fig. 3 is shown the case of two governors that do not quite run together at any load, the regulation curves being similar but differing from each other for all loads by about one per ent. While the work will be divided fairly well at high loads, as is shown by a speed of 97 revolutions for 92 and 108 kilowatts, respectively, one engine will cut-off at the very beginning of the stroke while the other is carrying 60 kilowatts. The first engine then acts as a brake and its dynamo as a motor. If the internal losses of the engine and dynamo are 12 killowatts, the slower will absorb this amount from the faster and the output from the pair will be 48 kilowatts. With atmospheric exhaust and some valve mechanisms the engine cylinder becomes an air-pump as the cut-off approaches zero of the stroke, absorbing a large amount of power. This explains why, as has been found, some machines run well together when loaded, but get into trouble when light.

The phenomena illustrated in these figures are modified somewhat when belt driven units are used instead of direct connected units. The modification is caused by the slip of the belts, which, being approximately proportional to the load, virtually increases the downward inclination of the regulation curves, since these curves are intended to express the speed regulation at the dynamo shaft. In accordance with the theory given above, belt driven alternators should therefore multiple better than direct driven, other things remaining the same.

AMERICAN ELECTRICAL APPARATUS IN SIAM.

A dispatch of April 10 from Bangkok, Siam, says: The Siamese government granted to Mr. Bennett, an American citizen, one of the greatest concessions ever given by Siam, viz.: a franchise for the exclusive electric lighting of Bangkok. This is attributed to Minister Barrett's diplomatic settlement of the recent trouble, and is noteworthy as a further development of American interests in Asia.

SOCIETY & CLUB NOTES

FIFTH ANNUAL DINNER N. Y. ELECTRICAL CONTRACTORS' ASSOCIATION.

THE fifth annual dinner of the New York Electrical Contractors' Asso'n. was held on April 21, at 8 p. m., at the Hotel Flouret, Fifth avenue, New York City. The gathering was a large and representative one, at least 100 being present, while the arrangements were admirably carried out by the dinner committee, Messrs. C. L. Eidlitz, J. C. Hatzel and J. T. Hunt, and the reception committee, J. R. Strong, E. S. Keefer, P. H. Klein, Jr., J. P. Hall and W. W. Ames. The dinner was given in a handsomely decorated room and was well served. Mr. J. T. Hunt acted as toastmaster in a very easy and graceful manner, and made a forcible claim as to the value and importance of the work being done by contractors and their co-laborers in various parts of the electrical field. He called upon President J. C. Hatzel to respond to the toast of the association.

MR. HATZEL said: It seems fitting and appropriate on this occasion to give a brief résumé of the history of this association, and what it has accomplished. The majority of the gentlemen present are identified more or less directly with the electrical interests and incidentally with ours, in fact, to a great extent our interests are mutual. This mutual interest, in a financial way, naturally applies more directly to the gentlemen who furnish us our material and supplies, but it applies also, if only as a mere matter of sentiment to our friends, the consulting engineers, who share largely in the credit if their plans and specifications are carried out by the contractor to a satisfactory conclusion and who also share largely in the general condemnation if (so to speak) "things don't jibe."

It applies to the inspection departments of the Fire Underwriters and fire department, who can be saved considerable labor and stationery, in advising us of violations, if we consider our interests mutual. It applies to the illuminating companies, who benefit us by prompt and efficient service for our customers, and are benefited by us in turn, as by our zeal to secure business, we secure them new customers and in any controversy over bills, assure them of the correctness and infallibility of the meters. And last, but not least, it applies to the technical press. It would be superfluous if not arrogant to attempt to define this interest on our part, and we can only retaliate by stating that did not the electrical interests exist, there would be no necessity for the existence of the technical electrical press.

In the belief that your identity with the electrical interests may interest you in our association a brief history of its origin, past history and what it has accomplished may be of benefit to all. In the summer of 1892, directly after the great strike in the structural iron business, several members of this association now present received a communication from the United Building Trades (a council composed of delegates representing employers in the building industry), suggesting the advisability of forming an association of electrical contractors and having this association represented in this council. This suggestion was evidently due to the fact that ours was about the only industry in the building trades which had no organization, and the desire to have all trades organized and represented in the United Building Trades, to enable employers by united and concerted action to prevent strikes and adjust labor difficulties. Adopting the suggestion of this communication, this association was organized, and it is a pleasure to state, that the charter members, with one exception, are members to-day.

The first two years of our existence were devoted almost exclusively to the adjustment of labor difficulties, which were sufficiently numerous and harassing to prevent consideration of other objects for which the association was formed. In that time, however, the members had become thoroughly acquainted with one another and it is with pleasure and pride that I testify to the devotion of the members to one another in time of trouble, and to the self-sacrifice often made necessary by these labor troubles. Lifelong friendships were formed and the bitter personalities formerly indulged in and induced by keen competition were no longer heard. The belief of every individual contractor that he was the only competent and responsible party to successfully undertake and complete an installation was badly shaken, when by association he found he was not "the only pebble on the beach," but "that there were others."

While this association numerically and financially may represent a smaller percentage of the United Building Trades than a number of others, it has gained the admiration of all by its uncompromising, determined and united stand against all odds when positive it was in the right. This has been particularly noticeable in our labor troubles, when the trouble of one was the concern of all.

It may be stated without fear of contradiction, that this association represents about 85 per cent. of the work performed in our industry in the metropolitan district and naturally their action influences the trade generally. On this supposition we have endeavored in the past few years, during our respite from labor troubles to advance the profession, placing it on a higher plane and incidentally improve our finances. With this object in view we have endeavored with the able assistance of the consulting engineers to have proper provision made in buildings for the installation of our work, and architects generally now consider this in their plans, where formally no provision whatever was made and the electrical contractor was obliged to utilize every crack, crevice or corner that was left over after the autocratic plumber, steam, gas and water fitter got through.

We are recognized in the formulating of new rules pertaining to our work, and this is especially true of the fire department, to whom we are greatly indebted through the courtesy of the superintendent and chief inspector of the inspection department. We have established the most friendly relations with the illuminating companies. Our relations with the manufacturers are most cordial, and we hope in the near future to induce all of them to establish a trade price and a price for customers whom they sell direct. Ours appears to be the only trade where such a condition does not exist.

MR. E. H. JOHNSON replied to the toast of "Our Guests," after an enthusiastic reception, and went into an interesting and favorable review of American interior work as compared with much of that done abroad. He also pointed to the drift of the times in requiring an electrical contractor to do all the electrical work in any new building, with an undivided responsibility. This tendency was already pronounced and would dominate entirely in the next few years.

MR. A. HENDERSON replied to the toast of the Fire Department, as Chief Inspector of the Bureau of Electrical Inspection, and spoke of the good results of the one and a half years of work. Inspection carefully carried out now kept the work done in the New York district in the lead by a large majority. Mr. Henderson amused his auditors with some good stories.

MR. ANDERSON spoke in behalf of the New York Board of Fire Underwriters, and approved the co-operation of all interests to insure perfect construction. He knew that electrical work was sometimes defective but gas installation was more so, in spite of its long practice. Mr. Anderson was warmly received, but admitted he was out against the doctor's orders.

MR. J. W. LIEB, JR., responded for the "Illuminating Companies" and described vividly the crude conditions of early supply of current, from central stations, the first Edison plant in New York having neither voltmeter nor ammeter. With the advance in central station work had gone a higher standard of wiring construction with great advantage all around.

MR. C. O. MAILLOUX responded on behalf of "The Electrical Engineers," and elicited much laughter by complaining that he had not been furnished with plans and specifications for his speech. As a consulting engineer, he went on to enunciate some admirable ideas of the relation of that body of men to the contracting engineers, and particularly in regard to their responsibility to the purchaser of the apparatus and installation.

MR. T. C. MARTIN replied for "The Technical Press." He said that a short time ago a boy had applied at one of the city free libraries for a book on "How to Get Educated and How to Stay So." The electrical contractors had no doubt educated themselves thoroughly by reading all the books available on the subject of electricity, but he ventured to think they could not stay educated unless they studied with painstaking regularity the pages of the electrical press.

MR. J. W. GODFREY brought the oratory of the evening to a bright and happy close by treating the toast of "Our Creditors" in a very cheerful manner, indicative of the high esteem had by wire makers and other dealers in apparatus of all kinds for the general solvency and solid financial repute of the electrical contractors as a body. He concluded with a poetic tribute of admiration, which brought down the house, and which told how the contractor coming into this world naked and bare, worried through it in such a way as to earn the love of everybody and a cool place in the future life.

After Mr. Godfrey's poetical fireworks had shot off their last sprays of color and sparkle, a small stage at one end of the hall was occupied by a number of artists engaged for the occasion, including such celebrities as "Press" Eldridge, Tom Ballantine, Horace Golden and Messrs. Cooper, Miller and Le Monier. Somewhere between 2:30 and 4:30 the company separated, and saluted in parting the brilliant monogram of the association in frosted lamps over the portals of the hotel. Some of the guests on invitation of Mr. Blizard took a ride in the electric horseless vehicles, which, owing to the clearness of the streets were able to "let themselves loose."

THE OMAHA TECHNICAL CLUB.

On April 8 there was organized at Omaha, Neb., the Technical Club of Omaha, 69 engineers, architects and others interested in engineering work, having for its object the advancement of the profession in general. The following officers were elected: George H. Pegram, M. Am. Soc. C. E., chief engineer Union Pacific Railway system, president; George T. Prince, M. Am. Soc. C. E., chief engineer Omaha Water Company, vice-president; Harry Lawrie, architect, secretary; Curtis C. Turner, C. E., treasurer; Andrew Rosewater, M. Am. Soc. C. E., director for two years; Edward F. Schurig, electrical engineer, city electrician, director for three years.

Thirty-five persons were present and sixty-five have signified their intention to join the club. Meetings will be held on the third Monday of each month, except July and August.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Secretary George F. Porter, who has just returned from a consultation at Niagara Falls with President Nicholls, informs us that arrangements have been made with the management of the International Hotel and Cataract House, Niagara Falls, to take care of members and delegates of the National Electric Light Association attending their twentieth convention, June 8, 9, 10. Rates range from $3 to $5 per day, American plan.

The headquarters and convention hall will be at the International Hotel. Floor plans of both houses can be seen at headquarters of the association, 136 Liberty street, New York, where reservation of rooms can be made. Mr. Porter says that there are signs of an extraordinarily large attendance and that the interest in the convention is very general.

MUNICIPAL PLANTS.

At the University of Wisconsin, Madison, Wis., on April 3, the Engineers' Association had a discussion with the U. W. Engineers' Club on the question whether it is desirable for the city of Madison to have its own electric light plant. The question was decided in the negative.

EDUCATIONAL

UNIVERSITY OF NEBRASKA.

At the University of Nebraska, Lincoln, Neb., Mr. E. G. Willyoung, of Philadelphia, will begin on April 26 a course of lectures on "Electrical Measuring Instruments," being part of the series lately organized by Prof. R. B. Owens for bringing his students in touch with the practical side of things.

The Nebraska Legislature, before adjourning, gave the University $30,000 for the wing of a new engineering building. The edifice will be laid out for extensions, and on a plan involving a total final expenditure of about $80,000.

PERSONAL

MR. H. C. GUNTON and Mr. H. Lomas, two English electrical engineers from Manchester, have recently been making an extensive trip through the country as far West as Chicago, examining electric light and electric railway work. They left for England by the Campania on Saturday last, well pleased with their trip and with what they had seen.

MR. W. R. CARSON has become superintendent of the Eddy Electric Motor Company's factory at Windsor, Conn., vice Mr. G. T. Briggs, who is to take charge of the Briggs Manufacturing Company, at Voluntown. Mr. L. L. Rivers becomes assistant superintendent. Both of them have been some time with the Eddy Company.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 20, 1897.

Alarms and Signals:—

FIRE-ALARM SYSTEM. C. E. Buell, North Plainfield, N. J., 580,927. Filed April 29, 1894.

Comprises a circuit controller that is held to close a circuit by a fusible substance, and when acted upon by heat opens the circuit and then closes it.

SWITCH AND SIGNAL APPARATUS. C. A. Geissenhainer, Pittsburg, Pa, 580,973. Filed May 25, 1896.

Comprises a longitudinally movable rod, and electric motor for operating the rod, a sliding trigger, a pendant arm engaged by the trigger, and electrical connections between the trigger and motor.

Batteries, Secondary:

CONSTRUCTION OF BATTERIES. E. N. Dickerson, New York, 581,104. Filed March 28, 1892.

A caseless battery, the elements with the aid of gaskets forming the cells.

Connectors, Conduits and Insulators:—

SECTION INSULATOR FOR ELECTRIC RAILWAYS. S. L. Foster, San Francisco, Cal., 581,023. Filed December 23, 1896.

Details of construction.

JUNCTION BOX COUPLING FOR ELECTRIC WIRE CONDUITS. J. P. Cochlin, Worcester, Mass., 581,064. Filed February 8, 1897.

Embodies a coupling for attaching the conduit thereto, consisting of a hollow coupling bushing exteriorly screw-threaded, and interiorly smooth.

ELECTRIC WIRE INSULATOR. J. E. Sharpe, Oneida, N. Y., 581,088. Filed February 8, 1897.

Consists of a block of non-conducting material provided with parallel wire-receiving grooves, respectively, in its top and bottom, and with channels at opposite sides of and at right angles to the grooves, for the reception of fastening devices.

ERECTING AERIAL ELECTRIC CABLES. F. S. Viele, Pittsburg, Pa., 581,242. Filed November 12, 1896.

Employs a curved rail and clamps adapted to secure the ends of the rail in line with the messenger wire.

Dynamos and Motors:—

ARMATURE FOR DYNAMO ELECTRIC MACHINES. A. L. Parcelle, Boston, Mass., 580,889. Filed October 9, 1893.

Comprises a laminated core, a supporting frame provided with arms which engage the periphery of the core, and enter grooves therein to keep the core permanent, and means for keeping the laminæ of the core in place.

SECTIONAL ARMATURE FOR DYNAMO AND ELECTRIC MOTORS. G. L. Jeck, Nashville, Tenn., 580,977. Filed January 9, 1897.

Comprises a series of interchangeable shuttle sections, wound with wire of different gauge and resistance, so that by removing one series of sections and replacing another series the machine may be changed from a dynamo to a motor.

DYNAMO ELECTRIC MACHINE. M. O. Southworth, Indianapolis, Ind., 581,089. Filed September 22, 1896.

A casting embodying a set of shoes for dynamo electric machines, united by webs and provided with lugs whereby they may be secured to the face plate of a turning machine and be finished altogether before separation.

Electro-Metallurgy:—

APPARATUS FOR SEPARATING PRECIOUS METALS FROM METALLIC ORES. C. F. Pike, Philadelphia, Pa., 581,032. Filed April 6, 1894.

Employs a body of mercury upon which ore is placed, an intermittently acting electro magnet above the body of mercury, and electric circuits in which the magnets are situated.

PROCESS OF AND APPARATUS FOR SEPARATING PRECIOUS METALS FROM MAGNETIC ORES. C. F. Pike, Philadelphia, Pa., 581,034. Filed October 21, 1896.

Means for the separation of gold from what is known as "black sand," a comminuted magnetic ore in which fine particles of gold are loosely held.

MAGNET. G. G. Brown, Brooklyn, N. Y., 581,101. Filed April 7, 1896.

Adapted for use in ore separators.

PROCESS OF TREATING ORES CONTAINING SILVER AND GOLD. H. Hirsching, Salt Lake City, Utah, 581,160. Filed August 9, 1895.

Consists in subjecting copper in the presence of moisture to the action of ammonia and a nitrate, and then decomposing the resulting solution to separately recover therefrom the metal and the ammonia.

Electro Therapeutics:

ELECTRO-MEDICAL APPARATUS. R. H. Wappler, New York, 581,091. Filed February 5, 1897.

Means to regulate the current.

Lamps and Appurtenances:—

OSCILLATING INTERRUPTER. D. McF. Moore, Newark, N. J., 580,987. Filed December 3, 1895.

The combination of an oscillating member capable of vibration in different planes, of a ring or encircling contact member. Intended for vacuum tube lighting.

INTERRUPTER. D. McF. Moore, Newark, N. J., 580,998. Filed December 3, 1895.

Consists in operating the interrupter by an electro-magnet traversed by an alternating current passing over a circuit independent of that controlled by that of the interrupter contacts.

ELECTRIC LIGHT AND HEAD GEAR FOR SURGICAL USE. L. Woolf, New York, 581,052. Filed December 30, 1896.

Details of construction.

ELECTRIC ARC LAMP. W. L. Preece, Derby, Eng., 581,136. Filed July 7, 1896.

A frictional grip which allows a sliding rod to be freely moved in one direction, but holds it firmly when strained in the opposite direction unless it be released.

Miscellaneous:—

ELECTRIC SELLING DEVICE. A. Davidson, New York, and C. G. Armstrong, Chicago, Ill., 580,931. Filed January 25, 1896.

A device to permit of the sale of reserved seat tickets, at a number of different stations in such a manner as to prevent the sale of the same ticket at two different stations.

APPARATUS FOR BLEACHING BY ELECTROLYSIS. A. E. Woolf, New York, 581,052. Filed Dec. 30, 1896.

For bleaching textile fabric thread, wood-pulp, or other material by the electrolysis of a saline solution or a solution of a chlorid of salt.

ELECTRICAL RESISTANCE COIL. J. Nebel, London, Eng., 581,170. Filed June 12, 1895.

Comprises casing of heat conducting material, a resistance coil supported therein, and insulating granular material within the tube and surrounding the coil.

APPARATUS FOR UTILIZING ROENTGEN RAYS. C. F. Easton, Wallace, Idaho, 581,199. Filed June 1, 1896.

Consists of a case which is opaque to X-rays, a Crookes tube, arranged within it, a vertically adjustable arm supporting the tube, and means for adjusting the arm horizontally and laterally.

ELECTRIC PUMP. B. Heftye, Tuxpan, Mexico, 581,204. Filed October 10, 1896.

The pump, cylinders and pistons constitute an electro-magnetic engine.

METHOD OF AND APPARATUS FOR DISINFECTING AND DEODORIZING. A. E. Woolf, New York, 580,919. Filed April 19, 1894.

Consists in discharging or injecting into a stream of infected water or sewage, an electrolyzed solution of salt water.

Switches, Cut-Outs, Etc.:—

INTERLOCKING SWITCH FOR THEATRE DIMMERS. G. L. Colgate, Westfield, N. J., 580,929. Filed November 16, 1896.

Means for the regulation of lights of different parts of a theatre.

AUTOMATIC CUT-OUT. C. A. Rolfe, Chicago, Ill., 580,957. Filed July 16, 1896.

Means to shunt the cut-out when the current becomes greater than the safety of the instrument will warrant.

Telegraphs:—

TELEGRAPH KEY. M. M. Porter, Malone, N. Y., 581,135. Filed May 13, 1896.

Means for automatically closing the circuit through the instrument after the key shall have been released by an operator.

Telephones:—

MAGNETO TELEPHONE. L. E. Dye, Morris, Minn., 580,851. Filed May 27, 1896.

Details of construction.

TELEPHONE SWITCHBOARD. C. E. Egan, Chicago, Ill., 580,853. Filed December 5, 1896.

Comprises a stationary jack, a pair of movable arms with their front ends projecting in front of the board in proximity to the jack, and contact points in the path of the arms, one contact point being in the circuit of the signaling apparatus, and the other in the telephone circuit.

ANNUNCIATOR SIGNAL FOR TELEPHONE SYSTEMS. W. F. Smith, San Francisco, Cal., 581,044. Filed August 4, 1894.

Means for signaling the operator and registering at the station switchboard the number of the telephone with which the subscriber desires to connect his telephone.

COMBINED TELEPHONE AND ELECTRIC LIGHTING SYSTEM. C. E. Buell, North Plainfield, N. J., 581,246. Filed July 27, 1896.

Means whereby a system of lines that are used for electric lighting, can be utilized for the transmission of conversation.

REPORTS OF COMPANIES

STANDARD AIR-BRAKE CO.

The annual meeting of the stockholders of the Standard Air-Brake Company was held at the company's office, 100 Broadway, New York, Wednesday the 21st. The following directors were elected to serve for the ensuing year: Henry Seligman, Edward J. Wessels, Albert Strauss, Leopold Wallach, Theodore Seligman and D. F. Meyer.

The engineering staff of the Standard Air-Brake Company has been increased by the addition of Mr. Edward H. Dewson, Jr., with whom General Manager Wessels lately closed a contract for a term of years. Mr. Dewson brings to the company a ripe experience. He entered upon his new field April 26. Mr. Dewson has been long and favorably known in connection with his work while with the General Electric Company in their engineering department and in connection with locomotive practice and the superintendency of one of the Western lines. He has for some time filled the position of master mechanic for the Pratt & Letchworth Company, of Buffalo. Mr. Dewson is thoroughly posted on the mechanical arts and will find full scope for his ability in his new field.

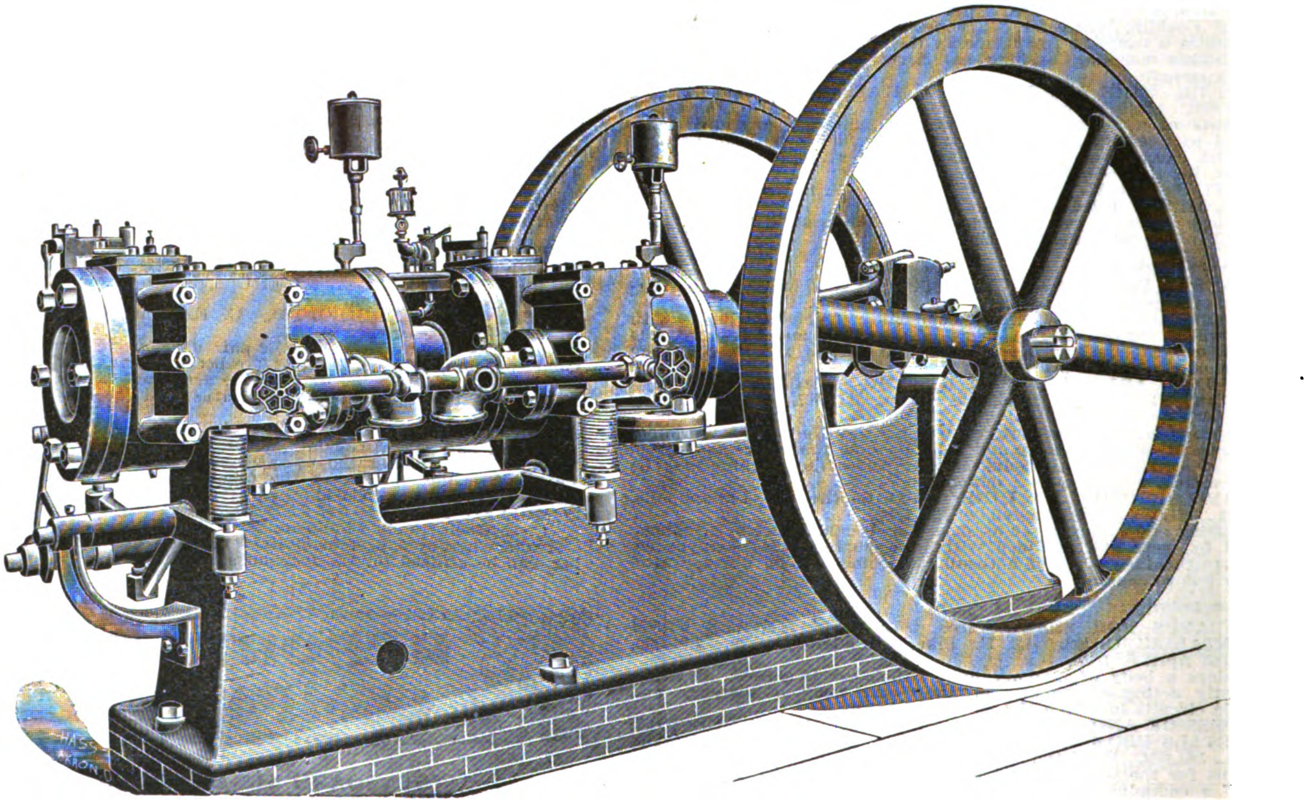
THE NEW YORK HEAT, LIGHT AND POWER COMPANY is now controlled under lease by Messrs. Oscar T. Crosby and C. A. Lieb.

TRADE NOTES & NOVELTIES

THE HICKS SELF-STARTING GAS AND GASOLINE ENGINES FOR ELECTRIC LIGHTING.

It is well known that a given amount of illuminating gas or gasoline burned in the cylinder of a gas engine will produce nearly twice as much illumination in candle power than when burned in gas burners. Hence we find the gas engine making rapid strides in isolated plant lighting and for the charging of storage batteries. When to this is added the absence of boiler, with its attendant nuisance of hauling coal and and ashes, the convenience of a gas engine which can be started up at a moment's notice, becomes aparent.

In seeking to utilize these advantages the Yaryan Company, 142 Times Building, New York, have placed on the market the Hicks self-starting gas and gasoline engine, a view of which is given in the accompanying engraving. In this engine two cylinders set in line are employed to work alternately, their pistons being on one piston rod, to which an effective impulse is imparted for every revolution of the crank, doubling the power of the engine while adding only the weight of one cylinder and piston, a very small percentage of the whole weight of the engine. By this doubling the number of effective strokes of the piston a very much steadier motion is attained.



The Hicks Self-Starting Gas and Gasolene Engine.

The operation of the engine is as follows: Under 15 horse power, which are not self-starting, the gas throttle valve being opened, the fly-wheel is turned by hand once or twice, and the engine starts in full operation. At the first outward movement of the piston the explosive compound is drawn into one of the cylinders, say the end one, through the valves, which then close and prevent its flowing back into the pipe as the pistons make their back stroke. While the compound in the end cylinder is being compressed in the end of the cylinder, the crank shaft passes its in-center, the charge in the end cylinder is exploded and the expanding air and gases drive the piston out rapidly and start the engine. When the piston has completed its outward movement and starts back, the escape valve is opened and the burnt gases in the cylinder allowed to escape. On its next outward movement, the piston again draws in a fresh charge of the compound which is compressed and exploded as before. When the pistons are on the outward stroke under the impulse of the explosion in the end cylinder, the front cylinder is drawing in its charge of the compound to be compressed and exploded, while the end cylinder is being cleared of the burnt gases and recharged, the two cylinders thus working alternately.

It will be seen that many advantages arise from this construction and arrangement of the parts. Every out stroke of the piston delivers power to the shaft so that the engine is twice as powerful as one in which every other out stroke, only, is a power stroke; and further, all the power of the piston tends to force the shaft on to the solid parts of its bearing, and thus relieves the cap entirely of wear. In fact, the cap might be entirely removed and the engine would run, consequently there will be no jumping or pounding of the shaft in any of the bearings. The valves admitting the compound to the cylinders are direct acting vertical poppet valves, and being always closed on their seats when combustion is going on, they remain perfectly clean and require no attention or occasional scraping. The governor regulates the engine to a nicety as with steam. The engine is so well balanced that it can be run at full speed without being fastened down to the floor or foundation.

FESSENDEN MFG. CO.

The Fessenden Manufacturing Company is organized under the laws of the State of Pennsylvania. The capital stock of the company is $100,000, and the directors are D. N. Seely, F. H. Seely, J. G. Wainwright, J. F. Tener, N. L. Tener. The company has been formed for the purpose of manufacturing under the patents of Prof. Reginald A. Fessenden, and the apparatus which it now has ready for the market are the Shadowless Arc Lamp and X-Ray outfit. The latter apparatus was illustrated and described by us last week. The arc lamp is striking in that it casts absolutely no shadow, and that it is only 12 inches long when furnished with the shortest style of globe. The lamp can be entirely enclosed within the holophane, and many handsome and peculiar forms of globe can be used. The life without inner mantle is 50 hours, and with the mantle from 100 to 150 hours. Mr. J. F. Tener is manager of the new company, which has headquarters at Pittsburg, with branch offices at room No. 307, Electrical Exchange, New York, and room 780 Monon Building, Chicago.

THE EDDY ELECTRIC MANUFACTURING COMPANY, Windsor, Conn., are now represented on the Pacific coast by the California Electrical Works, San Francisco.

NEW C. & C. IRON CLAD MOTOR.

THE C & C Electric Motor Company, of New York, have just brought out a series of ironclad motors of the type shown in the accompanying engravings, which possess a number of very desirable features.

The frame consists of a soft steel shell with radial poles projecting inwardly; the shell is capped at each end with a circular end plate, which carries the bearings and also the rocker arm support.

The machine has four poles and magnet coils, and the coils may be readily removed after taking out the armature, and are interchangeable.

The armature, of drum type, is built up of thin laminae of soft iron, well insulated to provide against Foucault currents, and having the conductors laid in slots, the coils being wound on forms.

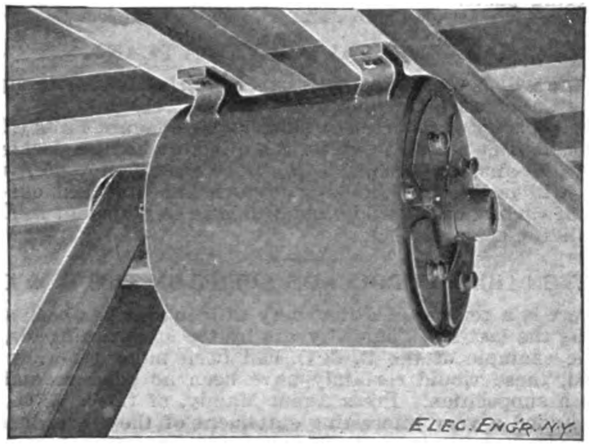


Fig. 1.—C & C Iron Clad Motor.

The commutator is of generous proportions with ample brush surface, and the brush pin support is designed to secure mechanical rigidity and to avoid humming noises.

The brush holders are of the well-known C. & C. reaction type, securing a flexible and even pressure of the brushes with a minimum wear, and of such design that the brushes maintain a constant relative position on the commutator, thereby providing against the necessity of shifting the brushes forward when they have been shortened by wear.

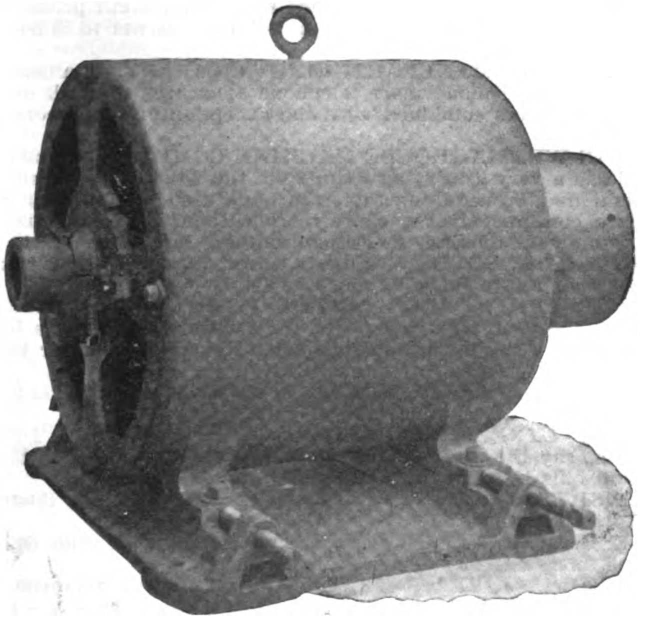


Fig. 2.—C & C Iron Clad Motor.

The bearings are self-oiling, with oil wells of large capacity, thus providing an ample quantity of clear oil for lubricating purposes. The shaft is of best steel and of such proportions as to insure rigidity and ample driving capacity.

The cylindrical form of the machine makes it well adapted to all cases of direct connection, either through gears or otherwise. The gear shaft boxes can be placed on the shell at any convenient position, as the distance from the shaft to the outside of the shell is always the same. The machine itself can be placed in any horizontal position, thus making it well adapted to run as a ceiling motor, or attached at any angle to an "A" frame, or to bolt on the bed plate of any machine or tool with which it may be combined; the circular form of the end plates allowing them to be bolted on always with the oil wells in the proper position.

The ironclad magnetic field is ideal in its compactness, its circuits of minimum length and its freedom from external field or magnetic leakage; all of which qualities effect a saving in magnetic force, and consequently a gain in efficiency. While improving on the ordinary type by providing an ironclad type of field, the outer shell also forms a protection to the motor, making it especially valuable where dust or dirt or dampness are apt to occur, and, in fact, anywhere where employés are liable to be careless with the motor. It will also be noted that the commutator is inside of the shell, thereby gaining full protection. Indeed none of the moving parts, except the pulley, pinion or coupling, are outside of the shell, which secures safety not only to the operator, but also to the armature of the machine.

As the shell is of steel ⅝ inch or more thick, it may be tapped into wherever desirable, as in a case of direct application to machine tools or other classes of machinery, providing iron bolts are used, thus making the motor form part of the frame work as well as the driving power.

The construction of the armature, while making it a beautiful winding, has also the mechanical advantage that it can be handled without danger to the winding, the conductors being below the surface of the armature.

The efficiency of the C & C ironclad motors ranges from 85 to 92 per cent., depending on the size of the motor.

The construction of these motors is such that they can be belted, back-geared, direct connected or furnished with change gears to drive at a range of speeds.

G. E. MAGNETIC BLOWOUT LIGHTING ARRESTER FOR RAILWAY CIRCUITS.

IN order that lightning arresters may be effective in conducting away high potential discharges generated in overhead lines by atmospheric disturbance, they must have less resistance across the spark gaps than the apparatus to be protected. Railway armatures are usually constructed with insulation that will stand a high potential test of approximately 3,000 volts, and very often lightning arresters are used that require from 8,000 to 10,000 volts for the current to pass across the gap spaces in them. It is easily seen that arresters having long gap spaces are likely to fail to protect electrical machinery.

In the new arrester for 500 volts continuous current work, known as type M-D, recently designed by the General Electric Company, and illustrated in the accompanying engravings, the spark gap which separates the overhead line connection from the ground connection is only one thirty-second of an inch and 2,000 volts only are required for the electric current to bridge this gap. After the passage of the high voltage current, if there were no means of rupturing the arc, a short circuit would be maintained and the lightning arrester would be completely destroyed. In this arrester, the gap is placed in a strong magnetic field, which tends to force the arc from the field and ruptures the current. It is the same principle em-

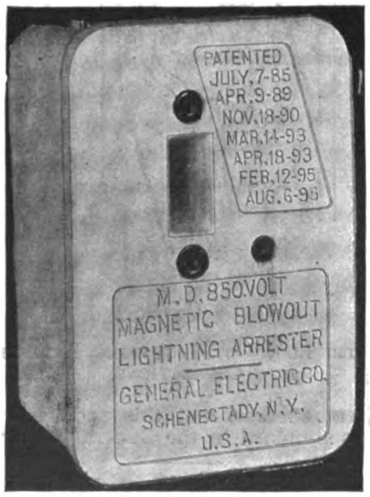


Fig. 1.—Magnetic Blow-Out Lightning Arrester, Closed.

ployed for rupturing arcs in circuit breakers and car controllers.

In order to limit the current, a low non-inductive resistance is placed in circuit. The spark gaps are mounted on the cover and may be easily removed from the circuit for inspection and adjustment. In the station type all the metal parts are contained within a substantial porcelain box. For line use, the arrester is placed in an iron case or wooden box.

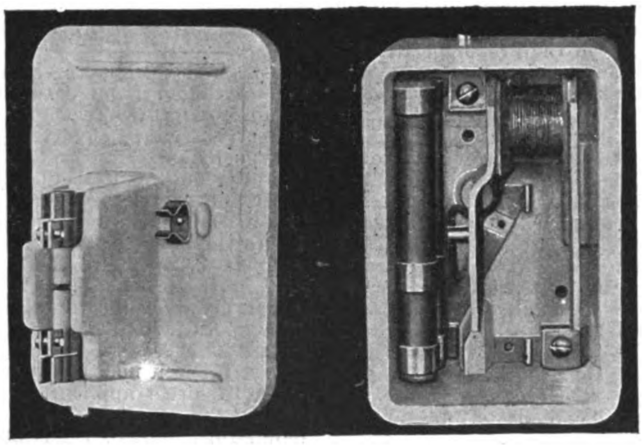


FIG. 2.—MAGNETIC BLOW-OUT LIGHTNING ARRESTER, OPEN.

Arresters of similar type have been used for the past two years with great success, and this perfected type has now been adopted as standard by the General Electric Company.

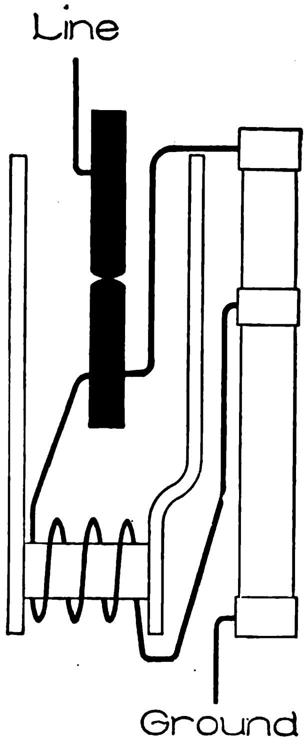


FIG. 3.—MAGNETIC BLOW-OUT LIGHTNING ARRESTER, DIAGRAM OF CONNECTIONS.

HIGHLAND INSULATING SOLDERING PASTE.

Soldering fluid made from zinc cut with muriatic acid, as is well known, is harmful to insulation. The zinc chloride it contains will not only decompose the insulation, but will continue indefinitely to absorb moisture. Again, the fluid being thin, the workman invariably uses an excess, which runs down into the commutator, or between the wires of the armature or other apparatus, and often causes a ground or short circuit.

To meet this want of a safe and rapid soldering compound, the Highland Electro Chemical Manufacturing Company, of Connellsville, Pa., are manufacturing the "Highland" insulating soldering paste.

The material itself is an insulator; it can be more quickly applied and is cleaner than a fluid. It contains absolutely no acid; being in a paste form it cannot be spilt or splashed on the work. In a deep joint as on a commutator, a small amount will run at once, when the iron is applied, into every crevice of the joint. In soldering copper wire a streak of it like a grease mark will do the work. It will not run where it is not wanted, as the cold part of the commutator, for example, will chill an excess. If it is not used in excess, no fumes will be given off. It is also claimed to be the cheapest compound to use. It is concentrated, and a little goes a long way, as it cannot be spilt or wasted.

The company have many valuable letters from leading electrical manufacturers attesting the merits of the Highland soldering paste.

CANADIAN CARBORUNDUM PLANT.

Work will be begun at once by the Carborundum Company on its Canadian plant across the river.

The capacity of the present plant in the Niagara Falls (N. Y.) power district will be doubled, the directors having decided to make the amount 2,000 e. h. p., twice the amount used now. This will enable the company to turn out four and one-half tons of carborundum a day and will give employment to about 25 additional men.

SEVEN MILLION DOLLARS SPENT ON THE B. & O.

There is a general idea that very little money has been spent during the last few "panic" years by the steam railroads, but if the example of the B. & O. had been more generally followed, there would certainly have been no good ground for such a supposition. Press Agent Maddy, of the B. & O., has just issued a very interesting statement of the work done on the road since February, 1896. The expenditure figures up $7,000,000, and this amount does not include the outlay for 58,000 tons of 85-pound steel rail just ordered, costing about $1,000,000 more. Probably the B. & O. was never in better physical condition than to-day or better able to compete for local and through traffic wherever its lines run.

ADVERTISERS' HINTS

WARD-LEONARD ELECTRIC COMPANY, Hoboken, N. J., are offering ventilating fan speed regulators at cut prices for all sizes and kinds of motors from 1-12 horse-power to 25 horse-power.

VIADUCT MANUFACTURING COMPANY, Baltimore, claim to have made more telephone apparatus than all other manufacturers combined with the exception of the American Bell Co.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, publish a very gratifying letter from the Bristol (Pa.) Electric Light and Power Company, who have used one of their engines continuously for eight years without its costing them anything for repairs. They have nothing but praise for it.

HENRY F. NOYES, 56 Liberty street, New York, advertises "How to Apply for a Patent," at $1.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., have an iron roof which they will dispose of at a bargain. It is admirably adapted for a machine shop, car barn or general manufacturing purposes.

NATIONAL TUBE WORKS COMPANY advertise trolley poles.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., say they can save customers 25 to 50 per cent. on their lamp bills by renewing burned-out lamps.

FISHER & CRAMPHORN, Congress and A streets, Boston, show another style of their station switches.

E. G. BERNARD COMPANY, Troy, N. Y., have some dynamos for sale at prices worth investigating.

SCHIFF, JORDAN & CO., New York, have removed to larger quarters at 232 Greenwich street, where they are better than ever able to make prompt shipments of carbons for all kinds of arc lamps.

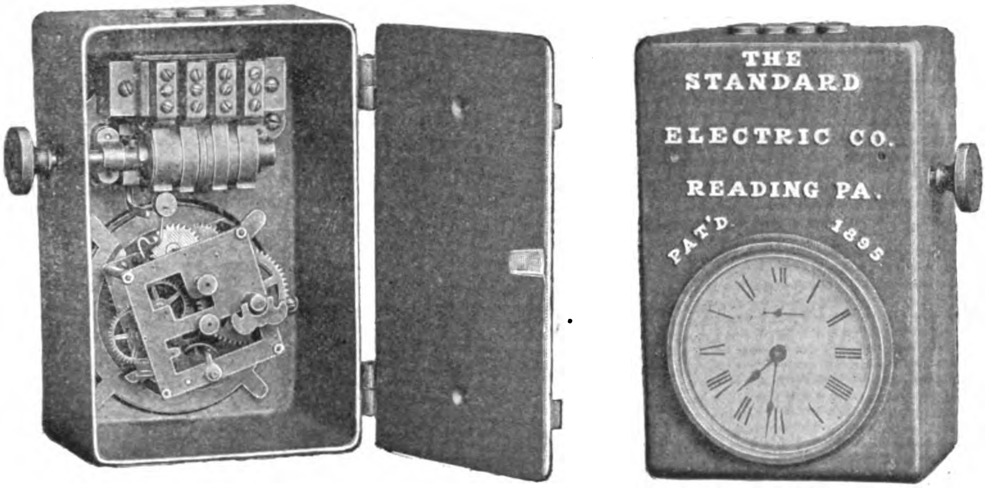
HART & HEGEMAN, Hartford, Conn., illustrate their "ad" with a cut of their No. 2 box for iron armored conduit with gang of two switches which they furnish with any number of outlets desired.

MR. A. C. DARRAGH, general manager of the Purity Filter Company, 211 Water street, Pittsburg, Pa., has issued for 1897 a neat little brochure with catechism on oil filtration and giving a number of testimonials. He says: "We are well satisfied that we fly the pennant as to sales and satisfaction."

THE STANDARD AUTOMATIC TIME CUT-OUT.

EVER since the introduction of incandescent lamps devices have been constructed for cutting off current automatically. In most cases this was accomplished by the use of magnets, which in course of time proved unreliable and caused their abandonment.

The Standard automatic time cut-out, illustrated in the accompanying engravings, is a device purely mechanical and well calculated to meet all requirements and any demand made upon it up to its carrying capacity. For display windows the merchant will find it invaluable as a saver of current and most convenient for cutting off current at any given time.



THE STANDARD AUTOMATIC TIME CUT OUT.

By means of this switch the consumer is saved the annoyance and inconvenience of going himself or sending another person to the point of consumption in order to break the circuit. On account of the inconvenience of this proceeding, it is seldom done, and the consumer who has his lamps longer in circuit than he needs them, is saved this unnecessary expense.

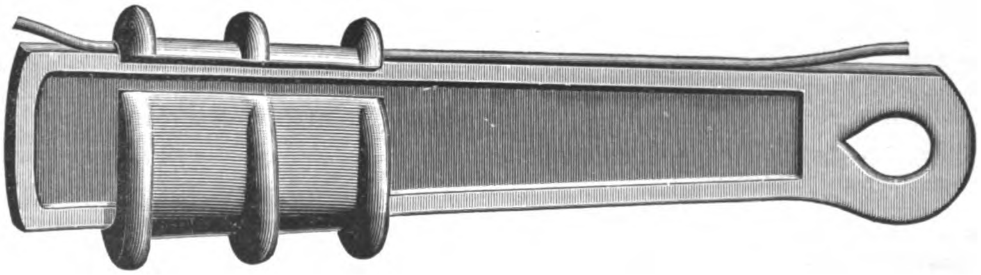
With the Standard automatic time switch in circuit, the consumer has merely to wind the clock work and to set the "let-off" mechanism, so that it will be released at the desired time; he can then turn on the switch and leave the device to operate automatically. If, however, it is desired to switch off the current before the time determined upon, and perhaps to again complete the circuit, or if it be found desirable to turn on the switch and to turn it off again after the time switch has operated automatically, all this can be done without any interference with the automatic mechanism employed in the switch.

The Standard cut-out has been approved by the Fire Underwriters for currents up to 40 amperes and 220 volts. It is made double-pole, but can be wired so as to make it a single pole device as well.

The Standard automatic cut-out is manufactured by the Standard Electric Company, of Reading, Pa., for whom Mr. R. E. Difenderfer, of 20 North Fifth street, Philadelphia, is general agent.

THE CLEVELAND "COME ALONG" WIRE STRETCHER.

WE illustrate herewith a quite novel wire stretcher or "come-along," which will be of interest to every construction man. It is called the "Cleveland" come-along, and consists of only two pieces of malleable iron. It does away with all springs, screws, eccentrics, etc., yet is claimed to be the most positive in clamping and easiest to release of any clamp heretofore introduced. It is made in two sizes, the No. 1 for wires of a larger gauge than No. 8, and the No. 2 for No. 8 wire or smaller wires. The illustration shows the No. 2, but the principle is the same in both sizes.



THE CLEVELAND "COME ALONG" WIRE STRETCHER.

The "come-along" consists of a wedge-shaped piece having an eye at its smaller end for attaching the rope. This wedge-shaped piece slides in a flattened tapering sleeve, having an opening to one side to admit the wire; the edge of the wedge-shaped piece next the opening in sleeve, is grooved to fit the wire and is parallel to the adjacent wall of sleeve so that as the wedged-shaped piece is drawn towards the small end of the tapering sleeve the wire is clamped the whole length of the sleeve and held positively as long as the tension is maintained. On releasing the tension and giving the sleeve a slight blow at the small end the clamp is instantly released.

These come-alongs are made with copper faces for use with hard drawn copper lines. Messrs. J. H. Bunnell & Co., 76 Cortlandt street, New York, are the sole agents.

NEW YORK NOTES.

GENERAL ELECTRIC COMPANY have received an order for several hundred alternating current induction motors, to be used to operate the Tuerk ceiling fan, manufactured by the Hunter Fan and Motor Company, of Fulton, N. Y. This is a high indorsement of the alternating current induction motor, inasmuch as hundreds of these motors were used last year for operating Tuerk ceiling fans, to the entire satisfaction of the Hunter Company.

MIDLAND ELECTRIC COMPANY, of 281 Pearl street, New York City, manufacturers of electric batteries, have gone into the hands of the sheriff. The company had a capital stock of $10,000. It has ceased to do business for a month past. The effects will be sold Thursday, April 29.

SCHIFF, JORDAN & CO., of Vienna and New York, owing to the increased demand for their well-known brand of high grade imported carbons, have taken larger and more commodious quarters at 232 Greenwich street. At this address the company will have not only its offices but a capacious warehouse in which will be stored a full line of all sizes of high grade imported carbons. Mr. Ralph Straschnow will continue the management of the company's affairs and will be pleased to see all his friends at his new address.

THE STANDARD PAINT COMPANY, F. S. De Ronde, general sales agent, 81-83 John street, New York City, inform us that they have just arranged with the Electric Appliance Company, of Chicago, to handle their P. & B. products extensively. That concern will carry a large stock at all times, and their store will be known as the Western Depot fór the P. & B. insulating compound, armature varnish, tape, etc. They are prepared to fill large orders promptly direct from stock. This method will enable Western purchasers to get their wants supplied in a speedy and convenient manner.

MICANITE IMPROVEMENTS.—The Mica Insulator Company's plant at Schenectady has been again increased by some very fine machinery for the purpose of milling their Micanite plates to more accurate thicknesses. Their insulating commutator segments are steadily gaining ground. The difficulty they at first experienced from the cement oozing out when the commutator became too hot while running has been entirely overcome. They report business greatly improved, and during the past year of depression have prepared themselves for a much larger business. At the present moment their factory in the machine department is already putting in some overtime. There is no doubt that Micanite is playing a very important part in electrical machine design and has a very bright future before it.

THE GARVIN MACHINE COMPANY, Spring and Yarick streets, New York City, have just issued a very neat and most useful illustrated catalogue and price list. It shows a bewildering variety of labor-saving machinery of latest style and construction at the lowest price consistent with good workmanship and durability.

MR. MAX OSTERBERG, of the firm of Osterberg & Sutton, succeeded recently in locating a bullet very near the spinal column of a patient in the Smith Infirmary on Staten Island. The case was one of peculiar difficulty as but a couple of small storage batteries were on hand, and the exposure had to be quick since the man was on the point of death. The negative showed not only the exact lócation of the bullet, but also the outline of the wound and that had been washed out with iodoform. The cord and the vertabrae were also plainly discernible.

MR. SAMUEL RUSSELL, JR., who has been connected with the Crocker-Wheeler Electric Company for some time past, at the Ampere factory, has now taken up their representation at the Philadelphia office, 14 South Broad street. He is thoroughly familiar with this standard apparatus, and there is no doubt that a large market exists in the territory he is now covering in conjunction with Mr. H. S. Smith.

WESTERN NOTES

MR. J. E. ELLIOTT, general manager of the National Electric Company, reports business brisk in repair line. The National Electric Company is a new concern and starts out with good prospects. Mr. Elliott is a man of long experience in electrical field and all his friends wish him well in this new enterprise.

MAXSTADT ELECTRIC FUSE COMPANY has been formed in Chicago to make electrical appliances and supplies, with a capital stock of $2,500. The incorporators are F. G. Jones, S. W. Norton, C. D. Stillwell, C. S. French and S. A. French.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, has been given the agency for the Thompson-Brown arc light hanger board. This is one of the best hanger boards on the market, is neat, well built, of good mechanical construction, and a good seller; filling all the requirements of the underwriters, and one that will meet the approval of the best electricians.

THE C. H. LEVER MFG. CO., makers of wooden specialties for electrical and other purposes, have moved their quarters from 16 North Canal street to 19-21 North Jefferson street, Chicago.

TOLEDO, O.—The Saddler automatic switch and electric signal system is to be built for electric roads by the Saddler Electric Switch and Signal Company, of Toledo, whose factory and salesroom are at 809 Monroe street, that city. Mr. C. W. Munson is secretary and treasurer.

PHILADELPHIA NOTES

MR. L. R. SCHULTZ, formerly with the Penn Electric Engineering Company, has opened offices as consulting engineer at 1001 Chestnut street. Mr. Schultz is acting as engineer for the Girard Estate, who are putting up extensive buildings on Eleventh street; and he has also several large contracts on hand.

READING, PA.—The firm of Clymer & Heilman, manufacturing electricians, has been dissolved by mutual consent, Mr. E. S. Clymer having fallen heir to a controlling interest in the East Saginaw (Mich.) Electric Light Company, to which plant he will devote his personal attention, while Mr. D. B. Heilman has accepted a position as general superintendent for the Standard Electric Company, of Reading, who are manufacturing time cut-outs, fan motors, quick break switches and other electrical apparatus.

THE CATHOLIC PROTECTORY, Valley Forge, Pa., for whom Wilson Bros., Drexel Building, Philadelphia, are the architects and engineers, will be entirely equipped with electric motive power for the propulsion of machinery intended for use by 2,000 boys, who will be engaged in learning shoemaking, printing, book-binding, blacksmithing and tailoring under instructions from technical experts employed by the order of Christian Brothers.

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The Electrical Engineer.

Vol. XXIII. MAY 5, 1897. No. 470.

POWER TRANSMISSION

ELECTRICITY IN COAL MINING.

BY HARRY N. GARDNER.

A GOOD example of the economical results of applying electricity to mining purposes is to be found in the anthracite mines of the New York and Scranton Coal Company, located at Peckville, Pa., about eight miles from the city of Scranton.

The two mines of this company, the Ontario and Sturges, are located well up on the mountain side above the town. They are about three-quarters of a mile apart, the Ontario being what is termed a "slope" or tunnel mine, while the Sturges is entered by a shaft about two hundred feet in depth. There is but one breaker, located some distance below the entrance to the Ontario.

A double inclined cable road is used to lower the coal from the Ontario mine to the head of the breaker, a loaded trip of cars in its descent always pulling back a trip of "empties" upon the other track. Two donkey engines are used in the transportation of coal from the Sturgess shaft to the breaker, and to handle the culm upon the dump.

AN ANTHRACITE COAL BREAKER.

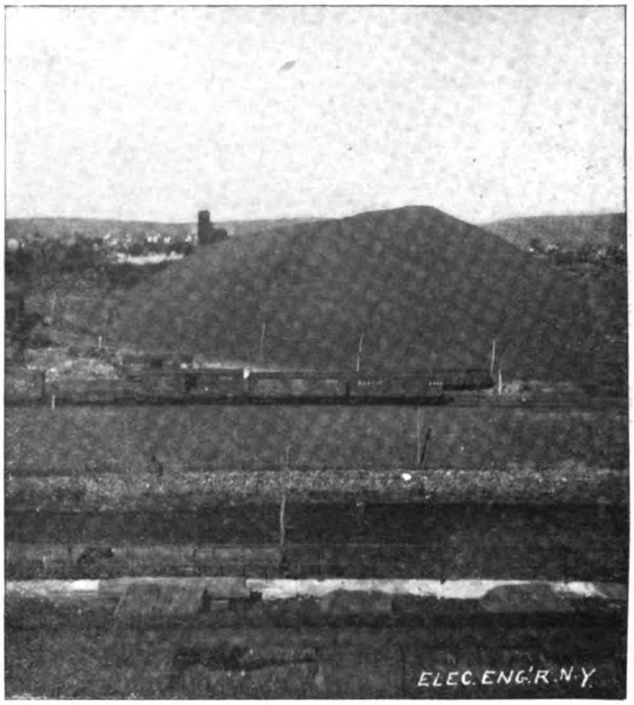
Two electrical plants assist in the operation of these mines. The generating machinery for the Sturges mine is in the building at the head of the shaft which contains the engines and drums for operating the shaft carriages. One building is also used near the entrance to the Ontario mine to contain the electrical generating machinery and the engines and cable drum for the gravity cable way. Thus one engineer at each place can look after the entire plant.

For the electrical plant at the Sturges shaft a 60-horse-power Ball & Wood engine is used. The engine is belt-connected to an old type bipolar 40-kilowatt C & C generator, operating at 250 volts.

The No. 0000 cable leads are carried beneath the floor to the skeleton oak switchboard, standing a few feet from the dynamo. The switchboard contains the regular instruments, ampere and voltmeters, a G. E. blow-out circuit breaker, large main switch, rheostat and lamps.

Both sides of the circuit lead from the switchboard and out of the building to the head of the shaft a few feet distant. No. 0000 solid wire is used, and the mains are carried down the side of the shaft upon glass insulators, the wooden bracket supports being fastened to the shaft timbers. A lightning arrester protects the line at its exit from the power house, and another arrester is placed in the mine at the foot of the shaft.

Besides the branch circuit taken off for the power house lights, another branch circuit leads from the switchboard to a smaller switchboard in an adjoining room. In this room is a four-pole General Electric 7½-horse-power dynamo, which is used to furnish power for the pump line when the large generator is not running. This dynamo is driven from the main shaft that operates the ventilating fan. When the large generator is running, power for the pump line is taken from the main circuit. But it is sometimes unnecessary to run the large dynamo, because it frequently happens that the mines are in operation but three or four days a week. The pump, however, must be kept running; and when the large generator is idle the small one is started and switched onto the pump circuit.



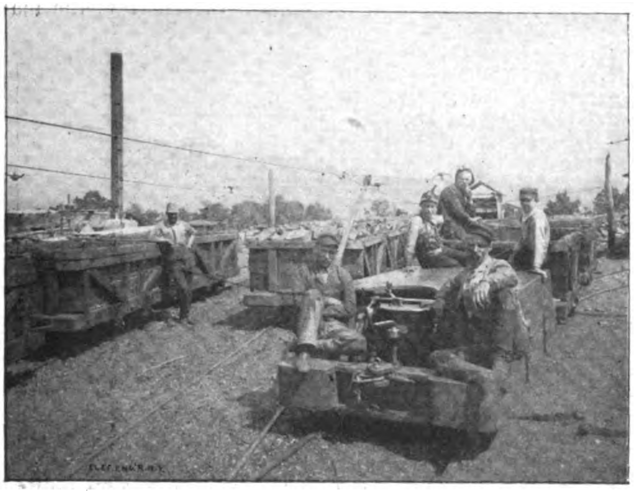
AN ANTHRACITE CULM DUMP.

ELEC.ENG'R.N.Y.

ELECTRIC DRILL IN COAL MINE.

At the foot of the shaft one side of the circuit is attached to the rails, and wherever the locomotive is used in the mine, the rails are bonded with a single bond of No. 0 copper wire.

The No. 0000 feeder runs from the foot of the shaft some distance into the mine, being supported at the side of the mine upon wooden brackets and glass insulators. The feeder is tapped into the trolley line at three points, a single pole switch being used to cut in the current at these places. As the three sections of trolley are insulated from each other, it is thus possible to cut out any section if desired for any purpose.



Electric Motor at Ontario Tunnel, Scranton, Pa.

The trolley wire is No. 0 hard drawn copper, and is supported by wooden blocks bolted to the roof of the mine. To fasten these blocks, holes are drilled in the roof, into which the bolts holding them are secured by means of split pipe wedges. The old type of General Electric clamping ears and hangers are used to support the wires and insulate them from the blocks. Instead of being placed overhead midway between the tracks, where it would be in the way of the men and mules, the trolley wire is suspended at one side at a point about six inches outside the rail.

As the hangers are attached directly to the blocks upon the roof, and the mine varies from five to eight feet in height, the trolley pole spring is kept in operation more constantly than upon street railroads. On account of the angle at which the trolley pole stands to the wire, and because of the varying height of the wire, an ordinary trolley wheel attachment could not be kept upon the wire if any speed was maintained. The trolley wheel for mine use is therefore connected to the pole with a swivel attachment. On account of the location of the wire, the trolley pole is, of course, attached to one corner instead of the center of the locomotive.

The locomotive used is a regular General Electric 6½-ton mine locomotive, driven by two W. P. 30 motors. As these locomotives are only three feet in height, it is possible to operate them in low roof mines where it would be impossible to use mules for haulage without going to the expense of blowing down part of the rock roof for headway.

The locomotive is used only in the main tunnels, mules still being used to draw the cars from the chambers and the main gangway. At present the locomotive runs from the shaft to a point about 4,000 feet distant. At the farther end of the trolley line a grade of three per cent. against the load extends for some distance. Up this it would tax two mules to draw a loaded car. In order that the locomotive may not be overloaded because of the voltage drop at the end of the line, only two loaded cars are handled by it on this grade. This load is increased to eight or ten cars upon the more level stretches nearer the foot of the shaft, where the voltage drop is less.

Not only does the locomotive handle from two to three times the load which a team of mules would draw, but it handles it from two to three times as fast. There are no mules to get in the way of one another, nor any conflict of loaded trips going out and "empties" coming in. It is therefore found that one locomotive with two men to operate it, can perform the work of from ten to fourteen mules and the necessary driver boys.

When the locomotive is not in use it is housed in a side chamber near the foot of the shaft. This chamber contains a repair pit, so that the under part of the motor can be conveniently gotten at.

The wires for the pump circuit run down the shaft the same as the trolley feeders, two No. 6 wires being used for this purpose. From the foot of the shaft the wires are conducted to the point where the pump is now located, about 4,200 feet distant, upon porcelain knobs, placed upon the side of the mine near the roof. To fasten these knobs, holes were simply "drilled and plugged" in the mine wall, the knobs being screwed fast to the plugs. If a steam pump were used in such a place the steam piping would be more expensive than the wire, it would require more work to change the location of the pump, and more care would be necessary to attend to its operation.

The mine was not in operation the day when it was recently visited; but Mr. W. M. Price, the efficient electrician for the company, descended the shaft, and gave the writer an underground trolley ride. When the end of the line was reached, there was the five horse-power bipolar C & C motor working away energetically at its pump. There it works day in and day out, the only attention it requires being to start it and an occasional oiling. A 5 by 6 inch vertical triplex pump is used; and the motor and pump are mounted upon a truck so that they can be easily moved from place to place.

At the foot of the shaft, and at important points along the main gangway, incandescent lights are tapped off from the trolley circuit. All the underground lights, as well as those in the power house are run three in series.

The plant at the Ontario tunnel consists of a 12 by 16-inch McEwen engine, which develops 90 horse-power, belt connected to a General Electric 55 kilowatt four-pole, steel frame generator. Weston volt and amperemeters, Carpenter rheostat, blowout circuit breaker, and the switches, mounted upon a skeleton switchboard complete the station equipment.

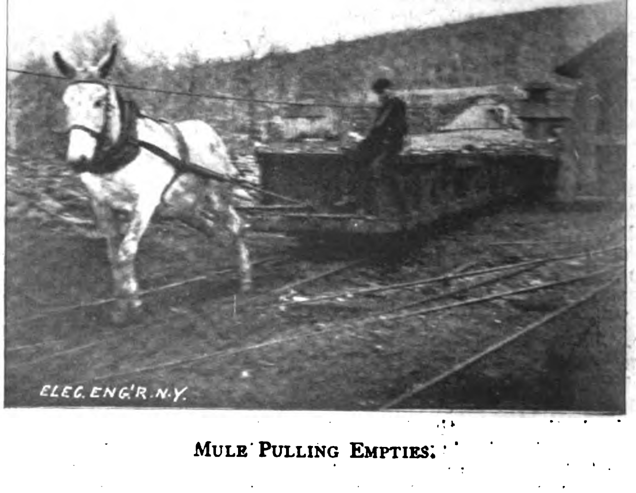
But one lightning arrester is used, that at the exit of the lines from the power house. The same voltage is used as in the Sturges mine.

As the locomotive in this case draws the cars to the tunnel's mouth, it is also used outside of the mine to do the necessary switching. When not in use it is housed in a small building a short distance from the tunnel. The locomotive is similar to one in the other mine, and the same trolley construction is used; but as it enters less than half as far as in the other mine, no feeder wire enters the tunnel.

A drill circuit of No. 6 wire is tapped off from the trolley some distance in the tunnel, and from there it is led through a side chamber to another part of the mine. Two drills are used. Each of these, with their motor, which will develop 3 horse-power for short periods, weighs but 121 pounds. The motors are entirely inclosed; thus the drills will stand the rough handling to which they are subjected in being dragged from one part of the mine to another. Current is taken from the stationary wires to whatever part of a chamber a drill happens to be working in by means of a flexible cable. The motor runs at 1,600 revolutions, and a nine to one reducing gear is used for the drill.

With one of these drills two men can drive a six-foot hole, changing drills in the operation, in five minutes; while three or four times that, and much harder labor would be required to drive the same hole by hand.

No better idea of the financial side of these electric plants can be given than to quote from a paper read before the Anthracite Coal Operators' Association in January of this year, by Frederick J. Platt, the engineer who installed these plants.



Mule Pulling Empties.

In one part of his paper he said:

"I will now take up two electric haulage plants at the mines of the New York & Scranton Coal Company, at Peckville, Pa., based on the expenses of the year 1896.

"Sturges shaft plant consists of an engine and dynamo, one 6½ ton locomotive and 4,500 feet of trolley wire. Cost, $6,103. Five per cent. depreciation per year would amount to $305.15, or for 200 working days, $1.52 per day.

"Cost of operating is as follows:

Motorman	$1.75
Helper	1.25
Electrician	.78
Repairs	1.03
Depreciation	1.52
Oil	.24
Total	$6.57

showing a cost by electric haulage for 250 tons of 2.62 cents per ton.

"By mule power the cost would be:

14 mules @ 50 cents	$7.00
7 boys @ $1.35	9.45
Total	$16.45

"or a cost for 250 tons of 6.58 cents per ton. Thus showing a saving of 3.96 cents per ton, or for 250 tons, about $9.90 per day. Taking 200 working days in the year, there is a saving of $1,980. The locomotive travels about 32 miles per day and has run about 7,800 miles, with a cost for repairs of 2.7 cents per mile.

"This company has also an electric haulage plant at its tunnel opening, where the cost is as follows:

Cost of plant $7,039.00
5 per cent. depreciation .... $351.95, or $1.75 per day

Cost of electric haulage:

Motorman	$1.75
Helper	1.25
Electrician	.78
Repairs	.65
5 per cent. depreciation	1.75
Oil	.24
Total	$6.42

Cost of electric haulage for 600 tons, 1.7 cents.

Cost of mule haulage:

12 mules @ 50 cents	$6.00
6 boys @ $1.35	8.10
Total	$14.10

"Cost of mule haulage for 600 tons, 2.35 cents, or a saving of 1.28 cents per ton.

"Saving on 600 tons, $7.68 per day.

"Saving in year of 200 working days, $1,536."

Of the electric pump in the Sturges mine he said:

"Comparing it with a steam pump for the same work, we find that it is saving the cost of two men or boys, who would be required to look after a steam pump, from the fact that the pump is first running on water and then on air, and a steam pump under these conditions would require close watching.

"Had a steam pump been used in this place it would have been necessary to put down a bore hole for the exhaust steam, or use a surface condenser, as the roof in a return airway is very poor, and would not permit the exhaust steam being turned into it.

"This pump and the wiring cost $625, which was less than a steam pump with the piping. The repairs during 1896, including wire used in changing its location, amounted to $159.55 for 365 days and nights.

"The cost of operating per day of 24 hours, for the past year, has been as follows:

Repairs	$0.43
Oil	.10
Electrician	.41
Total	$.94

"Cost of operating a steam pump would have been at least two boys @ $1.25—$2.50, without taking into account the oil and repairs. The saving therefore has been at least $1.56. It has run for 970 days, which shows a total saving of $1,513.

"The fact that the pump is drawing water through 700 feet of suction pipe is one of the strong points in favor of electric over steam pumps for such work as pumping out dips and slopes which are being driven, as it only becomes necessary to change the location of an electric pump every few months, instead of every few weeks, as would be necessary were a steam pump used."

In speaking of electric drills he referred to one of those in the Ontario mine when he said:

"The New York & Scranton Coal Co. is using one of these drills for driving a heading and airway through a poor piece of coal. The vein averages 7 feet 5 inches in height and contains 46 inches of coal and 43 inches of rock. It is driving this at a cost of $2.85 per yard, as against $5 per yard, hand work. In the month of September it drove 109 yards; 58 yards in the heading and 51 yards in the airway, which was a decidedly good showing for an electric drill as compared to what could have been done by hand power, both as regards to cost and number of feet driven.

"In all of the above figures you are probably aware that no charge has been made for steam used by the generating plant. This is due to the fact that in none of the above mentioned cases has it been necessary to add to the boiler plant, and the fuel used practically costs the company nothing."

In regard to the economy of electric haulage in coal mining, the superintendent of the Hillside Coal and Iron Company, which at Forest City, Pa., operate the largest electric mining plant in the United States, recently said that he had kept an account of the cost of operating one part of a certain mine with mules and another part of the same mine with an electric locomotive. He had figured his mules as costing only 25 cents a day each; but he admitted that he had given the mules the benefit of every doubt.

With mule haulage he found that it cost 5.86 cents per ton, while the electric locomotive did the work for 5.04 cents a ton. "This looks like a rather small saving, only .82 of a cent a ton, or only 14 per cent. in the cost of haulage," said the superintendent, "but it is only fair to explain that the electric locomotive worked in a part of the mine where mules could not be used on account of the steepness of the grade against the load, while the slight grade in the part of the mine operated by mules, is in favor of the load."

ELECTRIC LIGHTING

ARC LIGHTING IN AMERICA AND EUROPE.[1]

BY C. WILER.

In America arc lighting was considered a necessity while it was a luxury in Europe. It is no wonder then that the streets of American cities and towns have been glittering in the splendor of the electric light while Europeans were still content with gas and oil and thus too it became possible that the keen foresight and genius developed in our country a system which allowed of an economical distribution over a large area and left nothing to be desired as regards simplicity.

Series arc lighting with constant current dynamos of varying electromotive force found its birthplace, its application and its perfection in America. Up to date it has hardly gained a foothold on the European continent. It was adopted in England at the time that the Brush and Thomson-Houston machines made their first appearance and although the plants are still running and a few have been added, the system has been nearly entirely abandoned. The desire to supply arc and incandescent light as well as the motive power from one and the same generator, the once low efficiency of arc dynamos, the use of small high-speed units, the consequently inferior arrangement of the steam plant, and, last, but not least, the high pressure for interior lighting are the objections made abroad against high tension series arc lighting. Some of these objections have of late years been overcome in our land since larger units were built. The speed of arc dynamos has been decreased and hand in hand therewith their efficiency has been increased, so that to-day the commercial efficiency of a 60-light dynamo reaches 82 to 83 per cent. and of a 100-light about 86 per cent. Since, however, the speed has been decreased to about 800 revolutions per minute for 60-light dynamos, and to about 500 to 600 r. p. m. for 100-light dynamos, it has been made possible to escape that labyrinth of countershafts, belts, pulleys, clutches and bearings which for many years was characteristic of an arc plant. This enabled an economical arrangement of the steam plant. The countershaft can be avoided, as arc dynamos can be direct connected with the steam engine.

Series arc lighting predominates in America. Arc lighting by constant potential circuits was developed much later than in Europe. It has come into extensive use here since 1891, especially in large cities for private lighting. Most of the large direct current supply stations for light and motive power here and abroad use the three-wire system with 220 volts across the outers, in Germany in conjunction with storage batteries. Plants, which serve mainly for arc lighting on the European continent, use the two-wire system with a pressure from 110 to 650 volts. The turning on or off of public street lamps, which are connected with constantly supplied circuits is mostly done by hand when the area covered is small. When the supply extends over a large area, street lamps are turned on or off from the station or the distribution point. Each circuit with from 2 to 12 lamps in series is controlled from the station switchboard or from the distribution center, where the necessary measuring instruments for each circuit (ammeter, voltmeter, polarity indicator) and rheostats are placed.

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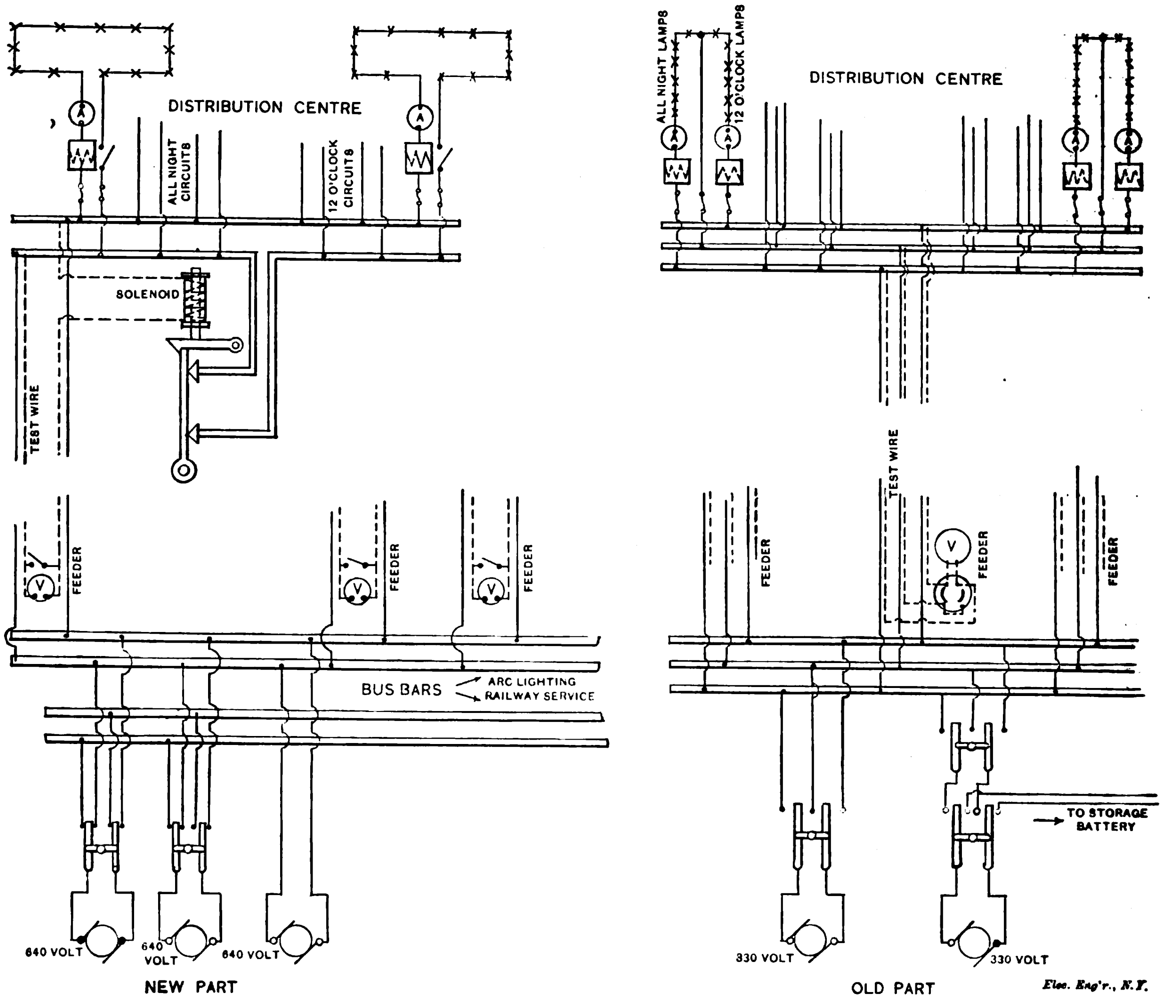
[1] Abstract of a paper read before the Chicago Elec. Assn., April 16.

Figs. 1, 2, 3 and 4 (modified from the Elektrotechnische Zeitschrift) show the arrangement made in the combined arc and railway plants of the city of Munich. The voltage of the generators is 640, 12 lamps are connected in series in one circuit. The feeders are run to well designed distribution centers which are located on the street and resemble patrol boxes in their exterior appearance. From here the arc circuits branch out. The all-night circuits are connected with the same side of the bus bars in the distribution center as the incoming feeder, while the 12 o'clock circuits are connected with the other side. Both sides can be disconnected by an automatic cut-out, the fine wire winding of which is connected with a test wire which indicates in the station the voltage of the feeder end. But short-circuiting the voltmeter in the station the current rises sufficiently to operate the automatic cut-out, which disconnects the desired circuits.



Elec. Eng'r., N.Y.

FIGS. 1, 2, 3 AND 4.—COMBINED ARC AND RAILWAY POWER CIRCUIT ARRANGEMENTS, MUNICH, GERMANY.

In the old part of the plant the three-wire system is used for the feeders as well as for the arc circuits. The all-night lamps are placed on one side of the neutral, the midnight lights on the other. The three-wire system is changed into a two-wire system after midnight; the disconnected dynamo can be used for the charging of a storage battery during the rest of the night.

Thus far only direct current distribution systems have been considered. Alternating arc lighting has been kept in the background both here and abroad. Only within a few years has it come into a more extensive use, especially in the European continental countries, where it is no longer regarded as much inferior to direct current lighting. The success is to some extent due to moderate frequencies, to the use of the very best proper size, and even special carbons and to the prevailing tendency of using lamps with a very fine adjustment and slow feed.

Alternating street lamps are connected in America with an individual transformer, the secondary voltage of which is 30 to 40, the primary mostly 1,000 or 2,000. This does not require a great amount of wire, allows an economical distribution over a large area, makes the lamps independent of each other and avoids a complicated lamp mechanism. It has the drawback of requiring a special transformer for each lamp. When alternating arc lamps are connected with incandescent circuits the lamp voltage is obtained either by the introduction of sufficient resistance, by a transformer or by a choking coil, usually called an economy coil. The coils are wound either for 50 volt circuits for the connection of one or two lamps or for 100 to 110 volt circuits for the connection of one to three lamps. Some are arranged so that the lamps can be turned on or off independently of each other.

Since the Frankfort exposition in 1891 a large number of alternating current stations have been built on the European continent. Some of the older ones, as Cologne and Amsterdam, supply each consumer with an individual transformer, the secondary voltage is 72. An intermediate terminal on the transformer allows of the use of single lamps at 36 volts. Most of the stations built later connect the lamps with a network of secondary mains fed from a transformer substation. The voltage is 110 or 120, so that three lamps can be connected in series with a suitable choking coil, which takes the place of the ohmic resistance of the direct current lamp. Quite recently the Avenue de l'Opera in Paris has been again lighted with alternating current lamps. The first attempt was made in 1878 with Jablochkoff candles, but since 1882 the street had been lighted with gas. The primary current is stepped down to 220 volts. Two transformers are used, each supplying five circuits. Five lamps are connected in series on one circuit, requiring $5 \times 36 = 180$ volts, the choking coil for five lamps requires 20 volts; a drop of 20 volts in the line is allowed, which makes a total of 220. After midnight the illumination is reduced by disconnecting the transformer from the 12 o'clock circuits.

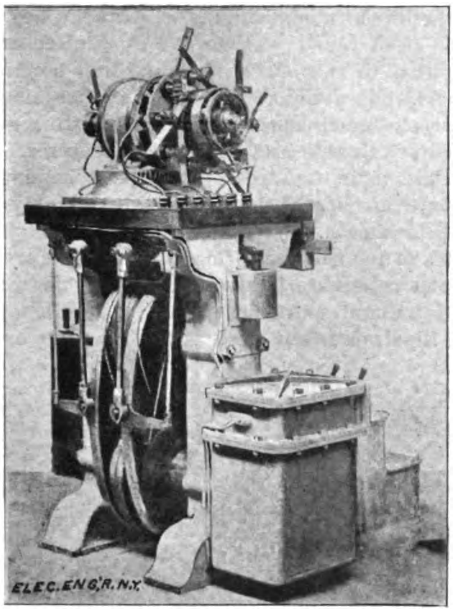


Fig. 5.—Ferranti Rectifier for Arc Light Current.

These examples serve to show that alternating arc lighting is in vogue on the European continent. Various attempts have been made to run a large number of alternating arc lamps in series from a constant current dynamo with varying voltage or they have been connected with a constant current transformer; other methods for alternating series arc lighting have been proposed and tried, none, however, have come into extensive use. The difficulties in high series alternating lighting arise in the lamps which are not yet satisfactory. They have been overcome in England by rectifying the negative waves of the alternating current. The current from the constant potential alternator is led to a constant current transformer. This consists of moveable primary coils and fixed secondaries; the force of repulsion between primary and secondary is balanced by adjustable weights. The regulation is dependent upon the leakage in the transformer. The current is brought from the converter to the rectifier proper, which is a revolving commutator driven by a synchronous motor. The pulsating direct current is sent from here into the line. The crater is formed at the positive carbon, the light is consequently thrown downwards, just as in a direct current lamp.

A rectifier set requires but small floor space and very little attendance. The wear of the brushes on the commutator is said to be not worse than on arc machines. The efficiency of a 40-light set is about 81 per cent. The rectifier system fills a long-felt want in England as is amply demonstrated by its rapid introduction. Fig. 5 shows the latest type of Ferranti rectifier; it has a capacity of 50 12-ampere lamps. These are the systems which at present are used in America and Europe for the distribution of electrical energy for arc lighting.

In taking up the final conversion into light we will compare European with American lamps. Gravity feed is nowadays used everywhere, the mechanical means for accomplishing the feed, however, differ greatly from one another. The clutch and rod is the American standard, the clutch or brake wheel in connection with a gear and a rack rod, the English. The rack, the chain or ribbon in connection with a train of wheels is the standard on the continent of Europe. The arc in American lamps is mostly traveling. The interior of the globe, the lower carbon holder and the lamp rod are not protected against the weather. With these concessions a greater simplicity has been obtained than in foreign lamps which are mostly of the focusing type and encased.

English lamps are very simple in construction, those of the other European countires, however, show strongly the hand of the clockmaker. They are often fitted with contrivances which are easily put out of order and are very delicate. For simplicity, ability to stand wear and tear, quick carboning and and cleaning, ease of inspection and repair, quick handling and connecting, the American clutch lamp has not been surpassed.

In England the electrical regulation of the lamp is mostly mechanically differential, while in Germany as well as in many other countries, the shunt lamp—filled with a shunt magnet, which strikes, regulates and feeds the arc—has displaced the differential type to a great extent. Of late, high tension series arc lamps have come into use in our country, which are focusing, encased, of the clutch type, short length, ornamental in their outer appearance and fitted with a single pair of carbons for all-night lighting. Double carbon lamps are very seldom used at present in new installations, single carbon lamps with ⅝-inch carbons and the necessary length for all-night lighting take their place. Double carbon focusing lamps are used in England; ⅝-inch or 11-16-inch carbons are used for all-night lighting elsewhere in Europe.

Very little need be said about the European solid and cored carbons. They are used extensively here and are well known. The purpose of the core is to anchor the arc and keep it from wandering about, which results when the section of the carbon is too large in proportion to the current. The core decreases the resistance of the arc by the higher conductivity of the vapored material and allows a lower lamp voltage. Coated carbons are unknown abroad and at present are used here less than heretofore. Their use was justified in the earlier days,

DATA RELATING TO VARIOUS PUBLIC ARC LIGHTING PLANTS. COMPILED BY A. E. BLONDEL, PARIS, 1895.

Towns.	Nature of Current.	Nature of Globe.	Current.	Average Width of the Streets in Feet	Average Distance Apart in Feet.	Average Height of Posts in Feet.	Total Number of Arcs Used.
Paris { Grand Boulevards	Continuous.	Opaline.	10	115	130 to 200	19.5	313
Paris { Avenue de Clichy				80	165	14.5 and 16	
Toulouse	"	"	10	45 to 50	165 to 230	23	222
St. Petersburg	"	Roughened.	11 to 12	165 to 200	130 to 230	34	84
Hamburg	"	Opaline.	8	50	80 to 100	26	68
Berlin { Unter den Linden	"	"	14 to 15		134–2 rows. 197–1 row.	26	320
Berlin { Leipzigerstrasse			14 to 15		197–1 row.		
Milan	"	"	4.5, 6, 10, 15–20	26 to 98	130 to 195	30	341
Berne	"	"	12	50 to 65	200 to 260	29.5	42
Munich	"	"	5 and 10	50 to 80	165	26 to 33	780
London—City	"	Small Opaline Globe in Clear Lantern.	10		230 to 590	21 25	479 City 340
Londonderry	"	Opaline.	10	50 to 80	130 to 280	17	170
Glasgow	"	"	10				101
New York { Avenues	"	Clear.	10 to 11	100	255	20	2,621
New York { Crossroads			10 to 11	60	290		
Chicago	"	"	9.6 to 10	65, 75, 80, 100	195 to 330	18	1,486
Atlanta	"	"	10	30 to 100	75 to 100	25 to 39	416
Havre	Alternate.	Opaline.	12 to 15	100 to 150	230 to 260	15, 28, 25	77
Clermont Ferrand	"	"	15 to 20		115	20	15
Zurich	"	"	18	100 to 130	196	23	53
Cologne	"	"	10	23 to 33	150 to 200	23	13
Blackpool	Continuous and Rectified.	"	10 and 10.5	80	150 to 165	25	185
Bristol	Conti uous and Alternate.	"	10 13	50 to 100	130 to 165	22, 12	97
Yarmouth	"	"	10 15			22	60
Portsmouth	Rectified.	"	12		262	25	109

when the resistance of the carbons was high and their life short. The thin coat of copper which surrounds the lower part of the peak of the negative carbon where the temperature is not high enough to melt it very readily, intercepts a good deal of the light. The molten globules of copper which drop on the glass globe and adhere to it account to some degree for the breakage of the thus disfigured globes. It is just as important to use good carbons and of the proper size as it is to employ efficient machinery. Else the advantages gained by one are offset by the disadvantages of the other.

To the progress in the manufacture of carbons in due the perfection of the long-burning arc lamps with enclosed arc. The arc in these lamps is surrounded with a small glass globe which is closed airtight at the bottom. At the top it is closed in such a manner as to allow the passing through of the positive carbon, the escapement of the products of combustion and the entering of fresh air. The oxygen of the air combines with the free carbon to CO_2 and CO and prevents its deposit and blackening of the globe. The lamp, which has become standard in the United States—abroad it is hardly in use at present—consumes 4.5 to 5 amperes at a pressure of 110 volts. The arc voltage is about 80. The remainder is taken up in a resistance which serves for the steadying of the arc. Aside from the great saving in carbons and attendance these lamps have the advantage, that they can be connected singly with a 110-volt circuit, whereas thus far constant potential arc lamps had to be run in pairs on 110 volt circuits. Long life arc lamps require when run singly, only a simple mechanism, with a main circuit magnet; they are perfect spark arresters. The double globes, with which the lamps are fitted, diffuse the light very evenly when properly selected.

Clear glass globes for street lighting are solely used in America, while abroad diffusing (opalescent, opaline, alabastrine) globes are used. European critics who usually describe these clear globes as a mere protection against the weather have often made them the target of their sarcastic remarks and have blamed the American public for the poor protection they afford the eye. Of late, however, opalescent globes have come into use. Different attempts have been made to reduce the loss in light produced by the use of the diffusing globes in outside service and to gain a better distribution. Although these attempts are old it is only since a short time that they have reappeared again greatly improved and modified in France in the holophane or entirely luminous globes. The outer surface of these clear, transparent globes is covered with a large number of very small horizontal ribs and groovings (prisms). They have two faces, one reflecting and the other refracting, and spread the light vertically. The shape of these prisms is different according to their relative position to the light. The inner surface of the globe is covered with a large number of vertical flutings, which spread the light horizontally. The flutings are concave at the bottom and separated by narrow ribs. The loss in light is very small compared with other diffusing globes, and the light is better distributed. Holophane globes are expensive at present, are difficult to clean, are split in two halves, and require special fittings for their support.

Two part globes are sometimes used in France where for street lighting the harp and hood is in very extensive use for the rigid support of lamps on posts. Quite sharply marked from this is the German method which supports street lamps in a so-called bishop's crook, a straight ornamental stem with a crook at the end—in such a manner that they can be lowered for the trimming. This avoids the use of a ladder or of steps on the post, but the line wires hang flopping about, which does not add to the beauty of the post or to the insulation resistance of the net. Where high voltages are used lamps are rigidly supported on the post and carefully insulated from the ground. The American hood with its wooden hangerboard and post answers these requirements. Since the voltage on arc circuits has in late years been nearly doubled, the hangerboard and hood have been discarded; with the outside exposed binding posts of the lamp located in the inside, the weather-proof lamp is insulated suspended on the post.

Arc lighting is by far not in as general use abroad as it is here. Public street lighting (see Prof. Blondel's table above) is very often confined to the main thoroughfares. The conditions under which arc lighting developed in America and Europe differ greatly, as shown, and the results are a consequence of these varying conditions.

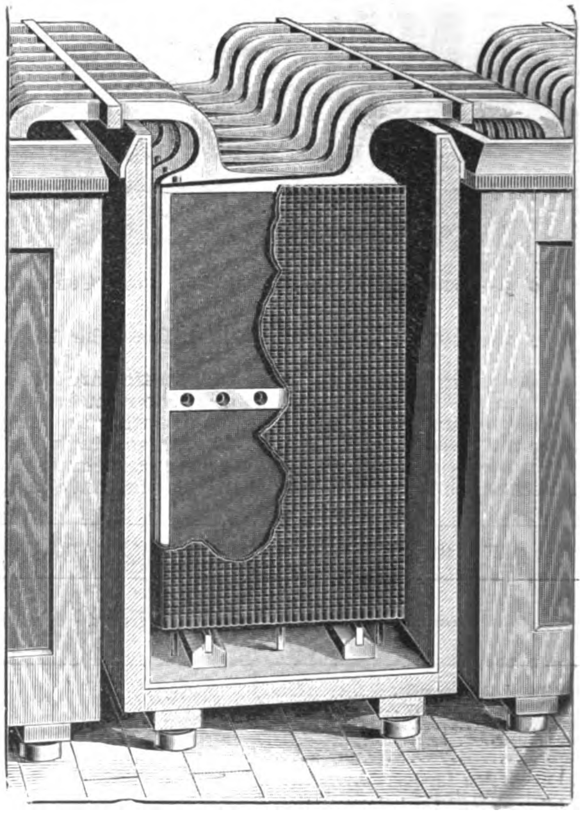
ELECTRIC LIGHTS vs. CRIME.

"There has been a remarkable decrease in crime," remarked Justic Potts to a Jersey City, N. J., "Journal" reporter. "I used to have an average of twenty to thirty cases daily, but now the average is down to single figures. I attribute it to the improvement made in the lighting of streets. The decrease began when the electric lighting system was extended. Criminals shun the light; they operate in the dark. It proves that the lights are a great protection to the community."

THE WILLARD CENTRAL STATION STORAGE BATTERY.

Owing to the rapidly increasing field for the use of storage batteries in central station work, trolley regulation, etc., it has been found necessary for manufacturers to pay more attention to this class of work than heretofore. The accompanying engraving represents one of the large Willard station cells designed especially for the above services. This cell possesses valuable and interesting features. It will be seen that the main feature is its perfect insulation. Each positive plate is encased in a corrugated highly perforated rubber cell or sheath.

The plates of the cell are formed by a special process which only occupies a period of three hours; They are made of pure rolled lead without joints or solder. The size of the plate in the cell illustrated is 16 in. x 34 in. No paste or pellets are used, the active material cannot possibly fall out, and the plate is claimed to be practically indestructible.


THE WILLARD CENTRAL STATION STORAGE BATTERY.

The supporting perforated cell is made of pure hard rubber and perforated so highly that there is a perfectly free action of the electrolyte. The internal resistance of this cell is very low. In a recent test of one of these cells the voltage remained practically constant in an eight hour discharge until the last fifteen minutes, dropping from 1.9 volts to 1 volt almost instantly.

The manufacturers of this battery, the Willard Electric & Battery Company, of Cleveland, O., are in position to furnish plants of any size up to 20,000 amperes.

Among the many plants of this type of battery installed by the Willard Company, is that of Mr. J. D. Rockefeller at his summer residence at Forest Hill.

LIGHTS PUT OUT BY EELS.

Ten eels caused trouble at the electric power station of the Attleboro street and commercial lighting systems recently. The station uses water power and steam, and while the water wheel was doing its work 10 large eels became tangled in the wheel. The wheel stopped and lights about the town went out. Next day the wheel was taken apart and the eels were found. They measured, on the average, three feet in length and from two to three inches in diameter.

ELECTRIC TRANSPORTATION

REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.[1]—I.

BY HAYWARD COCHRANE AND E. J. SWARTOUT.

IN presenting this paper we have tried to bring out what seem to be some of the most practical conclusions of the best authorities, to condense these into practical form and to suggest some outlines of what we consider to be the best results obtainable from the use of electrical machinery as it is now manufactured.

Mr. William Baxter, Jr., in a series of articles in The Electrical Engineer of 1896, gave data to prove that there would be a marked economy in coal consumption by the adoption of electric traction on roads now operated by steam. He showed that the cost of coal on trunk line steam railroads was about 10 per cent. of the total operating expense; that the substitution of electricity would reduce this item to about 4½ per cent. of the operating expense. If such a saving as this could be effected on roads where the stops were few, a much greater saving ought to be made where the stops are frequent. Steam locomotives when starting trains are working at a very low economy, whereas an electric motor would consume energy more nearly in proportion to the work to be done.

	Total Weight of Engine and Tender.	Weight of Engine.	Weight on Drivers.	Weight on Truck.	Weight of Tender Loaded.	Weight of Tender Empty.	Diameter of Drivers.	Size of Cylinder.	Steam Pressure.	Mean Effective Pressure in Cylinder.	Theoretical Tractive Power.	10% Off for Friction.	Ratio of Adhesive to Tractive Power, Approximate.	Dead Wt. per Lb. of Tractive Power.	Type of Engine.	Class of Service.	H.P. of Elec. Loco. of same Wt. on Driv'rs	Approx. Useful Wt. for Total Engine.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	"	"	Lbs	Lbs.	Lbs.	Lbs.						%
C. R. I. & P.	203,000	125,000	83,000	42,000	78,000	28,667	78	19½×26	190	161½	20,470	18,423	1—1	4—1	8-wheeler	Express.	758	40
St. Clair Tunnel	195,000	195,000	195,000	....	....	....	50	22×28	160	136	36,861	33,175	1.2—1	..	10 "	Tunnel.	1,365	100
C. R. I. & P.	194,700	126,700	107,000	19,700	68,000	....	63¾	18×24	160	136	16,588	15,929	1.6—1	3—1	6-coupled	Suburban	614	54
C. C. C. & St. L. (Schen.)	216,000	126,000	83,000	43,000	90,000	40,000	72	19×24	200	170	19,433	17,490	1—1	5—1	8-wheeler	Express.	719	38
L. S. & M. S. (Schen.)	205,133	118,000	90,000	28,000	87,133	40,800	68	18×24	190	161½	18,468	16,621	1.25—1	4—1	10 "	"	684	43
B. & O. Tunnel	192,000	192,000	192,000	....	....	....	62	......	..	....	....	38,880	1.1—1	..	8 "	Tunnel.	1,440	100
B. C. R. & N. (Brooks)	221,000	137,000	108,000	29,000	84,000	37,667	69	18×26	180	151	18,435	16,591	1.5—1	4—1	10 "	"	682	48
C. & E. I. (Schen.)	171,000	109,000	95,000	14,000	62,000	....	63	18×24	150	127½	15,737	14,163	1.5—1	3—1	6-coupled	Suburban	582	56
" "	121,000	75,400	61,700	13,700	45,600	....	57	17×24	150	127½	15,514	13,963	1—1	2—1	4 "	"	574	50
Vandalia (Pittsburg)	223,400	142,000	127,000	15,000	81,400	34,067	62	20×26	185	157¼	26,393	23,754	1.2—1	2—1	Mogul.	......	977	56
Metropolitan Elevated (Elec.) 2 motors	63,000	....	35,000	....	....	....	33	......	..	....	....	5,400	1.4—1	5—1	......	......	200	55
Metropolitan Elevated (Elec.) 4 motors	70,000	....	70,000	....	....	....	33	......	..	....	....	10,800	1.4—1	..	......	......	400	100

Mr. O. T. Crosby ("Limits of Steam and Electricity in Transportation") states that the repair bill for electric railway motors would not exceed 30 per cent. of that for steam locomotives. Electricity would therefore effect a marked reduction in operating expenses over steam in repairs alone. The elevated roads in Chicago use motor cars equipped with two General Electric motors of 100 horse power nominal capacity, and a drawbar pull of 2,000 pounds each at about 30 miles per hour with 33-inch driving wheels, or 2,700 pounds each at about 20 miles per hour. The series-parallel method of control is used. A few motor cars were equipped with four 100 horse power motors and were tested with two coaches, the loaded motor car weighing 70,000 pounds and each coach loaded to 42,000 pounds, making a total train weight of 154,000 pounds, or 77 tons. This train, we are informed, was run at a speed of 30 miles per hour on a level track. The weights of cars empty were as follows: Motor car, 60,000 pounds; coaches, 32,000 pounds. In case of the two-motor equipment, the motor car with two coaches, which is an ordinary train, gives a total train weight loaded of about 147,000 pounds, or 73½ tons, assuming 10,000 pounds per car as full load and an empty motor car as weighing 53,000 pounds, with a maximum two-motor elevated train of one motor car and three coaches of 42,000 pounds loaded (which is a rush hour train). This gives a total train weight of 159,000 pounds, or 94½ tons.

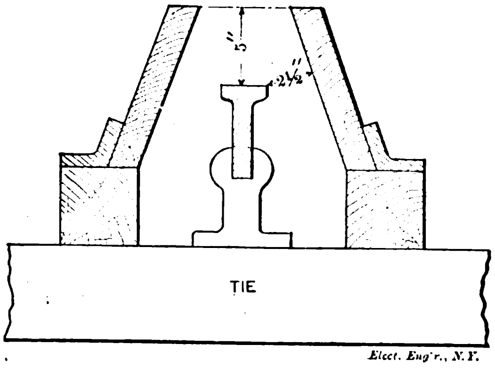


FIG. 1.

We give in the table data regarding some of the standard makes of steam locomotives, also data of a B. and O. electric locomotive used in the tunnel at Baltimore, also data of the electric motor cars on the Metropolitan Elevated Railroad in Chicago. The approximate ratio of adhesive to tractive power is given, the adhesive power being calculated on a basis of 450 pounds per ton of weight of drivers, but the steam locomotives are supplied with sand boxes to use in case the wheels slip, which probably increases the adhesive power to 600 or 650 pounds per ton. The electric motor cars or locomotives, should also have sand boxes, and these might be electrically operated.

We will now estimate the tractive power and the adhesive power of the two-motor and four-motor equipped motor cars in comparison with those of a Chicago, Rock Island and Pacific suburban steam locomotive.

Assume 12 coaches as the maximum train hauled by this locomotive and 7 coaches as an average train, and speeds of 30 miles per hour. Total weight of engine and tender, 194,700 pounds; weight on drivers, 107,000 pounds; 12 coaches loaded at 58,400 pounds, 700,800 pounds; total train weight, 895,000 pounds, or 447¾ tons. With a 7-coach train at 58,400 pounds each, the total is 408,800 pounds, plus engine and tender, 194,700 pounds, 603,500 pounds, or 301¾ tons.

The formula used by Mr. G. F. Wilson, superintendent of motive power for the Rock Island Road, for obtaining the tractive power of locomotives is,

$$T=\frac{D^2\times P\times S}{W}\text{ lbs.}$$

where D is diameter of steam cylinders in inches; P is mean effective steam pressure, 85 per cent. of boiler pressure; S is length of stroke in inches; W is diameter of drivers. For the above suburban engine, $D=18''$; $P=(160\times.85)=136$; $S=24''$; $W=63.75''$. Substituting, we have

$$T=\frac{18^2\times 136\times 24}{63.75}=16{,}588\text{ lbs.}$$

Allowing 10 per cent. for friction losses, $T=14{,}929$ pounds.

The adhesive power of the locomotive upon ordinary rails must greatly exceed the tractive power, because the rails may be wet or slippery at times. An English rule for obtaining the adhesive power of a locomotive is as follows: With dry rails, allow 600 pounds per ton of weight on drivers; with very wet rails, allow 550 pounds; with ordinary rails, 450 pounds; with misty weather, rails greasy, 300 pounds, and with rails frosty or snowy, 200 pounds. Assuming 450 pounds per ton, the above suburban locomotive would have an adhesive power, $A=(107{,}000\div 2{,}000)\times 450=24{,}075$ pounds, or about 61 per cent. greater than the tractive power.

Assuming that each loaded coach of a Chicago, Rock Island and Pacific suburban train weighs 58,400 pounds and twelve coaches to be the largest train, the total train weight would be, including locomotive and tender, 895,000 pounds, or 447¾ tons. The tractive power being 14,929 pounds, there is a tractive power per ton of train of 33.3 pounds. For a 7-coach train weighing complete 301¾ tons, the tractive power per ton is 49.4 pounds. With an elevated railway train of two coaches and one motor car equipped with four motors equal to a total weight of 77 tons, where the motor car loaded weighs 70,000 pounds, or 35 tons, the adhesive power is 35x450 = 15,700 pounds, but the tractive power of each motor at a speed of 20 miles per hour is about 2,700 pounds, or for four motors 10,800 pounds. The adhesive power is therefore about 45 per cent. above the tractive power, which is lower than for the Rock Island suburban engine. The tractive power per ton of train is 140 pounds, or greatly in excess of that for the Rock Island trains.

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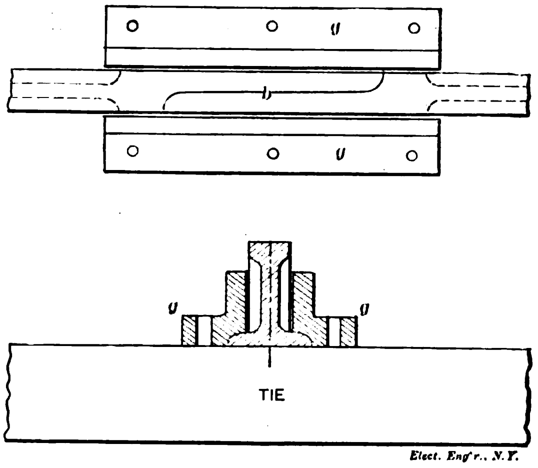
[1] Read before the Chicago Electrical Association.

For an elevated railway two-motor equipment, assuming a loaded motor car to weigh 63,000 pounds with two loaded coaches each of 42,000 pounds, or a total train weight of 147,000 pounds, or 73½ tons, the tractive power would be that of two motors of 100 horse-power each of 2,700 pounds drawbar pull, or 5,400 pounds. Assuming the weight of motor car on drivers to be 35,000 pounds, we have the adhesive power equal to (35,000 ÷ 2,000)x450 = 7,875 pounds or about 45 per cent. more than the tractive power. The tractive power per ton of train is 73.4 pounds. For an elevated train of one motor car, loaded, equipped with two motors, and three loaded coaches of 42,000 pounds each, the total train weight would be 189,000 pounds, or 94½ tons. The tractive power would be 5,400 pounds. and the adhesive power 7,875 pounds. The tractive power per ton of train would be about 57 pounds, which is low for a service where the stops are so frequent.

The adhesive and tractive power per ton of train should be much greater for frequent stopping than for a suburban service like that of the Rock Island road, where there are but four or five stops in 8 miles. The motors used on suburban railways should be linked to both axles so that the whole weight of the motor car would be effective in giving adhesive power. The motors moreover should be designed for a much greater weight per horse-power since the trucks are crowded with them as they are now built; larger drivers as well as slightly longer trucks would probably be required. If the motors were designed with a greater weight per horse-power, they would be less likely to heat seriously when run continuously under full load. It would be advisable, moreover, to have upon the motors a commuted field winding for use in connection with the series-parallel method of control such that a greater number of safe and fairly economical running speeds could be had in place of the two running points of the present series-parallel controller. Running in series may give too slow a speed, while running in parallel may give too fast. If, however, the motorman can have the option of about six running speeds, it would be much easier for him to keep on schedule time. By having heavier motors per horse-power and more running points, the acceleration and running of trains would be accomplished far more economically and satisfactorily than at present. The passenger coaches and trucks need not be any heavier than now built, and might be considerably lighter. The double spring suspension of motors should be adapted, as tending to prolong the life of rolling stock, and of rails not cast welded.



Elect. Eng'r., N.Y.

FIG. 2.

The third rail, wherever used, should be protected by guards so that trackmen would be comparatively safe while discharging their duties. Fig. 1 shows a form of trolley rail which we think would be better than the present form for using with high guards. This rail could be easily supported by insulating brackets at intervals and would be less likely to cause lodging of snow in winter. The top of the guards should be raised at least five inches above the top of rail, and there should be 2½" or more between the rail and either guard at the sides. For the sake of obtaining easy riding trains and saving to rolling stock, it would be advisable to cast-weld the rails together and to have expansion joints (Fig. 2) at such intervals as might be found necessary to prevent too great a movement of rails at the joints. At the take-up joints (b), Fig. 2, the rails could be specially designed, with each half equal in cross section to the main cross section of the standard form, there being no web, but the width at top being retained down to foot of rail with guides g g at the sides to keep the rails in place.

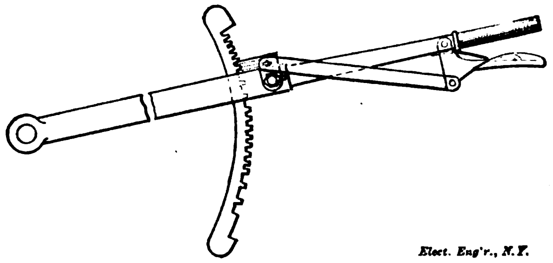

Elect. Eng'r., N.Y.

FIG. 3.

The motorman's cab should be arranged as follows: His seat should be from 4 to 6 feet back from the front window (this distance being easier for his eyes) and at the right hand side of the cab. A sliding window should be placed by his seat to enable him to look out easily upon the track or the train whenever necessary. The painting of the cab should be dark so as to relieve the motorman's eyes from all glare. The controller should be operated by a horizontal lever (Fig. 3) instead of a crank, the lever being arranged with a dog engaging in notches which give the required speed combinations.

AMERICAN STREET RAILWAY FINANCE.—IV.

BY E. E. HIGGINS.

THE question of power station is physically at the root of the whole operating plant of an electric railway, but commercially it is not, because the cost of power is so small a proportion of the whole expense. The power station, however, is usually the pet of the street railway managers, and it is given more attention perhaps than is really due to it from some points of view. In the original power stations a 150 kilowatt machine was a monster, a subject for admiration, and was only put in after considerable experience with 50, 60 and 80 kilowatt machines had demonstrated that they could be replaced easily by larger ones and to advantage. Since that time we have gone by successive leaps to 500, 1,000 and 1,500 kilowatts, or 2,000 horse-power units. We have passed from belted machines, high speed engines, to direct connected engines and generators, the engine speeds going up, and the dynamo speeds coming down to meet each other, until now we have engines which are run up pretty nearly to the limit of speed and dynamos which could easily be run at greater speeds for great output, but have to be run less economically as far as interest on investment is concerned in order to be direct connected to the engines. We find coincidentally with this that the areas of the power stations are coming down to very moderate limits, and that the cost of real estate is therefore becoming a less marked feature of street railway investment. I imagine it would be surprising to make a comparative estimate of the cost of real estate and buildings necessary for operating an electric railway plant with those of the buildings necessary for operating a horse railway plant of the same size. I think the figures for the horse road would be several times those for the electric road.

The boilers used in street railroad work at the present time are, almost without exception, of the water tube type, although there are quite a number of horizontal tubular boilers in use. The principal advantage claimed for a water tube boiler is the quickness with which it answers to the many calls for power which are put instantly, a thousand times a day, on the steam space. The more sluggish horizontal tubular boilers sometimes have pretty dangerous conditions developed through their inability to quickly respond to these calls, particularly if the surplus of water is small.

As far as the ordinary features of the boiler house are concerned, these are known to all and may be passed over briefly with the statement that there are self-feeding grates, grates for using small coal—buckwheat and slack—and a good deal of care is taken latterly to prevent the formation of smoke in the furnace and chimney, by providing more perfect combustion. It is generally conceded that smoke consuming devices do not reach the root of the difficulty and you must go further back and get at the heart of the problem in securing perfect combustion of gases in the furnace. The engines which were originally of the high speed type run with belts, are now, as I said before, of much lower speeds, and Corliss valves are used in a large proportion of the engines. There are other valves which have given excellent service, and there are medium speed machines which some people swear by, but as a rule I think no one would hesitate to-day to put in direct connected generators in any plant of 500 kilowatts capacity.

As an illustration of the difference between American and foreign engineering a curious thing came to my attention recently. A road serving a German city of about 175,000 people is actually building seven power stations, each having a capacity of about 300 kilowatts, to operate the comparatively small system of only sixty or seventy miles of track. It seems a rather strange thing to increase stations in this manner and to multiply the original and operating costs. The idea in this country is concentration, although I believe the idea of concentration can be carried too far and has been in some cases. I think we are coming to a point where the burden of copper is going to be too much to be stood and some relief must be found.

The efficiency of our dynamos is so high that it seems difficult to improve them. I imagine that this is perhaps the most stable part of a street railway plant as far as efficiency and intrinsic economy are concerned, but, of course, improvements may come even here, though in directions other than efficiency. Switchboard appliances are all quite perfect. As to the methods of power station distribution there is nothing special to be said, except that I believe that the power coming out of a station should be metered, and it is not metered generally enough at the present time. The true basis for the determination of comparative power station economy between systems, and from year to year on the same system is found in the kilowatt hour unit.

Water power is used in a good many places and with considerable success, the form of regulation varying according to the amount of power. Where the power is ample for all requirements and the surplus cannot be sold there seems to be no material objection to regulating the power as is done in one case by the introduction of rheostats, to take up the surplus power, the rheostats being switched in automatically as the current consumption of the outside circuits goes down. It is an extremely wasteful means of regulation, and if you did not have Niagara Falls behind you, you could hardly use it. There have been devised excellent automatic regulating gates so that the output is not difficult to govern and fluctuations of electromotive force and current can be taken care of with only moderate variations of electromotive force.

I am inclined to think that on the present lines of power station development there is little to be expected in the future. Steam engineering in its present state has been the result of so many years of development and study and investigation that we can hardly get above the present economy in such engines and boilers as we have to-day, and, as I have already said, the efficiency of dynamos is so great that the consumption of coal per kilowatt output is about as low as we may expect to find it with any of the present lines of engineering. There are two possibilities of the future, however, which must not be lost sight of in providing against contingencies. One of them is the much longed for direct conversion of coal into electricity. There is here an opportunity for saving perhaps eighty-five per cent. of the operating cost. The actual saving may be only fifteen to twenty per cent. of the total energy of coal and still it would double the present economy. There is another field which is nearer than that perhaps, and that is the use of turbines instead of engines. This improvement leads less to economy in operating cost than to heavy reduction in the investment cost. The economy of turbines is likely to be slightly in excess of engines, while the first cost of engine-dynamo and units may be only one-tenth or one-twentieth as much. I think we are nearer the turbine era to-day than ever before, and I am inclined to think it is only a short time away.

I have examined the operating figures of 69 railway power stations in New York and Massachusetts for 1896, as to the cost of electromotive power. The costs in Massachusetts include the repairs and renewals of power house apparatus, but this is not included in New York State. Of the 69 roads there are only 4 which are operated at less than $.01 per car mile; 12 at from $.01 to $.015; 16 from $.015 to $.02; 20 from $.02 to $.03; 9 from $.03 to $.04, and 6 from $.04 to $.05. These figures show that in the larger cities the cost of operation is usually smaller, but there are exceptions in all these cases.

The distribution circuit is always an interesting part of a street railway plant. There has not so far been any material variation in the practice of adopting a direct current, constant potential system of distribution, at a pressure of 500 volts. Experiments with less voltage were early given up and the higher voltage is used. The series system has much to commend it theoretically but has not proved a success and there are very great difficulties in the way of success on any large system. The alternating system we hope will soon come to perfection and will solve many problems that are now troubling us.

One most important thing wanted is a solution of the copper problem. It is not a pleasant thing to have to put a whole copper mine in a city, and there is certainly a chance for great reduction in that item of cost by the alternating current. There is a still greater opportunity for it in the direction of doing away with motor commutators and all the commutator difficulties which, as we know, are a large proportion of the motor difficulties in toto.

The three-wire system has been thought of in connection with street railroad work, and experiments have been made with it, but it has not been considered feasible for various reasons, among them, the difficulty of crossing wires at branches with 500 volts difference of potential between them. This is a serious and in some cases a prohibitory matter. The heavy cost of feeders in the distribution system is a serious burden on the roads and is constantly growing heavier with the increase of the number of cars called for by population increase and extensions. It is customary to divide the overhead circuit into a larger or smaller number of sections and to have the feeders run to the station from those sections. Originally there was a little different arrangement of feeders by which the sections of the trolley wire were made smaller and tapped into the same feed wire with fuses or some automatic cut-out arrangement so that if a section 1,000 feet in length gave out, it would disconnect the section from the continuous feeder but would not blow any cut-out at the station. It has the disadvantages that when there is trouble on the line, you have to get a repair wagon out as quickly as possible to locate the trouble and put in a fuse. The trouble may simply have been a ground on the motor, and cars had to be stopped till the fuse was put in. This system has been almost entirely discarded in this country, but I see by the Board of Trade regulations in foreign countries it is now used quite generally abroad. I think they will soon discover that changes are necessary.

Various methods of reducing the burden of copper have been devised, among them the "booster" system. This is a very ingenious and pretty system. Its operation is very generally known and it will hardly be necessary for me to describe it here. I think nothing need be said about the overhead construction except that in general it is very good. Iron poles are used almost universally now in our principal cities and can be made ornamental and will last longer, probably, than wooden poles will, although we have no actual knowledge on that point from experience. The span wire construction is light and strong. Altogether we seem to have gone pretty nearly as far as we can go in perfecting the overhead construction. There is a possibility of doing away with frogs and switches, and quite a little of the special work in that way, by the adoption of a trolley other than the wheel trolley. At present such trolleys are in quite general use abroad and to some extent in this country. There is also another means of doing away with some of the disadvantages on a single track, and that is by running two trolley wires along the track, branching out at turnouts so as to make it unnecessary for the trolley to leave the wire at any time. The copper for two trolley wires is usually necessary on the line, and there is no reason why this should not be an excellent form of construction.

THE COMPRESSED AIR MOTOR IN NEW YORK.

"And things are not what they seem" is an appropriate quotation sometimes. The subjoined has just been printed on the editorial page of the New York "Sun." We are sorry for that paper and for Mr. Elias:

New York, March 31, 1897.

E. A. Willard, Esq., American Air Power Company.

Dear Sir: Your cars, operated by compressed air, have been steadily operated on the 125th street line of Third Avenue Railroad Company since the 3d of August last.

They have been easily handled, started, stopped and reversed, the last-named quality being a very desirable feature, reducing the liability to accidents.

Of course, the advantage of a motor that operates independently of connection with any subterranean motive power is apparent.

I have not been able accurately and definitely to determine relative cost of this compared with other motors, but am quite sure that it is not greater, and am of the impression that it is less than animal and probably less than cable traction.

The motors are capable of attaining high speed and overcoming considerable gradients. Very truly yours,

A. J. ELIAS, President.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—VIII.

BY JOSEPH APPLETON. (Copyright, 1897.)

FIG. 23 illustrates an automatic underload switch and Fig. 24 an automatic overload switch.

An additional feature, which is sometimes of great service, is an arrangement whereby the gas or oil engine can be started by running the dynamo as a motor supplied by current from the battery; this requires simply an ordinary motor starting box with short circuiting device to be used when the plant is running under normal conditions. This feature is very convenient and relieves the attendant of the trouble of pulling round the engine by hand until the explosions commence.

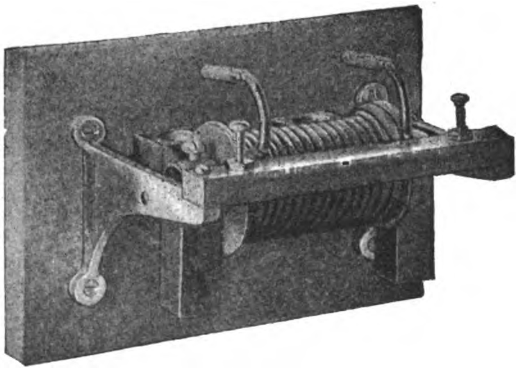


FIG. 23. AUTOMATIC UNDERLOAD SWITCH.

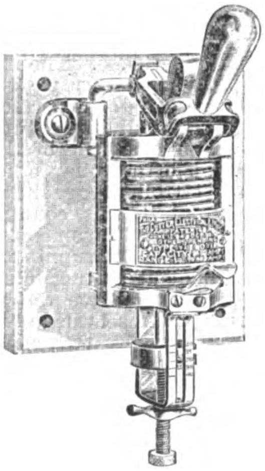


FIG. 24.—AUTOMATIC OVERLOAD SWITCH.

Another method of regulation is by means of switches which cut in and out the end cells of the battery as required, to maintain the voltage on the lamps at normal pressure. This method obviates the use of counter cells and the consequent loss of energy, but has the disadvantage of discharging the end cells of the battery unevenly, some of them being in circuit longer than others; this necessitates more attention during charge to see that the end cells are switched out of circuit when they are fully charged.

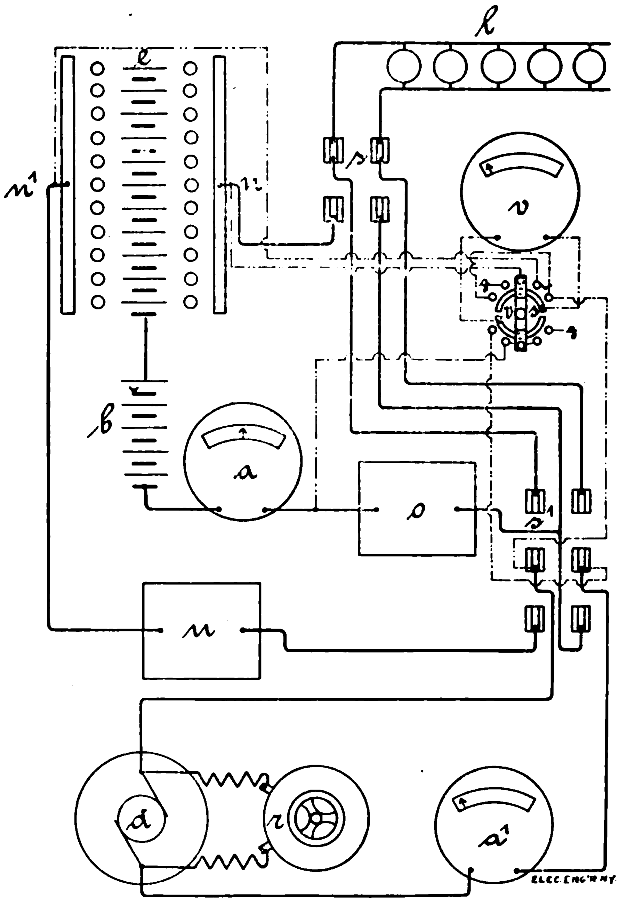


FIG. 25.—DIAGRAM OF CONNECTIONS, END CELL REGULATION.

a, a^1, Ammeters, b, Main Battery; e, End Cells; d, Dynamo; l, Lamp Circuit; n, n^1, End Cell Switches; o, Overload Switch; u, Underload Switch; s, s^1, Knife Switches; v, Voltmeter; v, s, Voltmeter Switch; r, Dynamo Field Rheostat.

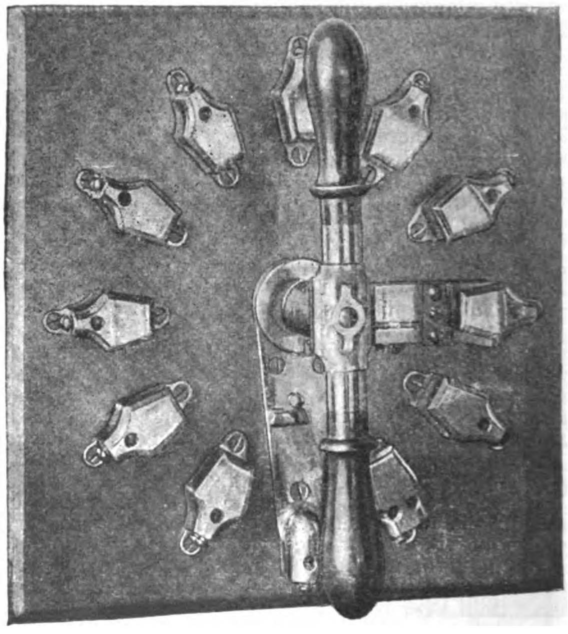


FIG. 27.—END CELL SWITCH.

The connections for this method vary somewhat from the arrangement used with counter cells; two end cell switches are required, one for controlling the number of cells in circuit during charge, and the other for regulating the number of cells in circuit on the discharge side. The number of cells which have to be controlled in this way varies from 10 to 18, according to the conditions. Fig. 25 shows diagram of connection for this method of operation, and Fig. 26 illustrates a switchboard for same which the writer installed for a large country residence; Fig. 27 illustrates an end cell switch for controlling cells as described above.

A special feature in the construction of this switch is the divided lever or contact arm; with an ordinary multiple contact switch. In switching from one contact to another, the cell connected between the two contacts would be short circuited if the contact arm made contact with one block before breaking with the other or would interrupt the circuit entirely if the contact arm broke circuit with the one block before making with the other. In order to overcome this difficulty, the contact arm is divided, a resistance being inserted between the two sections, so that in moving from one block to another, the intervening cell is not short circuited, neither is the circuit broken.

This method of regulation is generally used in very large installations where an engineer is in constant attendance, as it gives the best economy, if properly controlled; but in private installations for residences where simplicity of operation, and the smallest amount of attention are the chief considerations, the counter cell method is preferable.

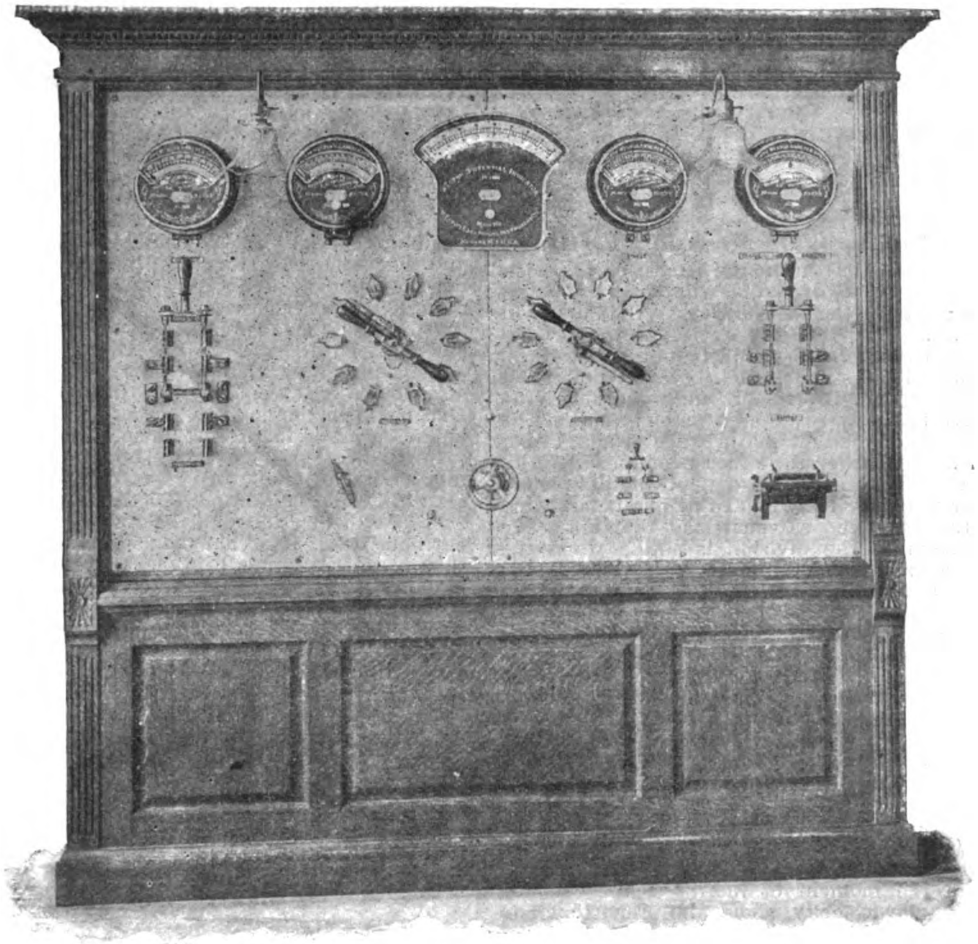


FIG. 26.—SWITCHBOARD FOR END CELL REGULATION.

A properly designed plant of this description can be satisfactorily operated by the class of help usually employed to take care of heater furnaces, if once properly instructed, and does not require a skilled mechanic. The writer has installed many such installations in all kinds of residences where they are run entirely by the gardener, coachman or handy man, requiring only a few hours' attention and giving the greatest satisfaction.

The cost of lighting a residence by means of an electric light plant of this description is very reasonable and will compare favorably with the cost of lighting by current taken from an electric light company, even where the same is available; although in the majority of cases where these plants are installed, there is no public lighting system, and the choice lies between gas, oil lamps and a private installation. Another advantage derived from the use of this system of lighting is the operation of electric motors for power purposes and ventilating.

The following figures as to cost of installation and operation are taken from a plant installed by the writer in a residence containing about 300 16-candle-power incandescent lamps.

The plant consists of a 20-horse-power gas engine, 200-light dynamo and storage battery having a capacity of 100 lamps for eight hours. The cost of installing such a plant exclusive of house wiring and fixtures is about $5,500. The cost of operation per annum is as follows:

Interest at 5 per cent. per annum	$ 275.00
Depreciation at 7½ per cent per annum	412.50
305,000 cubic feet gas	305.00
Proportion of man's time, 12 hours per week	125.00
Lamp renewals	49.00
Oil, waste and sundries	40.00
	$1,206.50

The number of lamps supplied for above cost averages 80 lamps for five hours per day throughout the year, or a total of 146,000 lamp hours for the year.

This gives a cost per lamp hour of .802 cent.; as a matter of fact, the actual cost to the owner is not so much as stated above as the man's time would be paid for whether he looked after the plant or not, and again the depreciation during the three years the plant has been in operation has not reached anything like the amount allowed, which is most liberal, considering that the generating plant is not run on an average throughout the year more than three times a week.

The cost per lamp hour for a similar residence taking current from an electric light company would be one cent., thus showing a considerable margin in favor of the private installation. Where gas is not available for the engine and gasoline is used, the cost of power would be somewhat less.

DUBUQUE, IA.—City Electrician Osborn in his annual report advocates that all interior wiring for light and power should be done under the supervision of the city, as a measure of public safety.

ALTERNATING CURRENT DYNAMOS IN PARALLEL.—II.

(Concluded.)

BY J. E. WOODBRIDGE.

ANOTHER factor that affects operation of such combinations is the relative promptness of response of the governors. If one governor responds more promptly than the other to a change of load, it will overrun, then when the other governor operates, the former will have to reverse its action, and a series of governor oscillations will be thus set up, which may cause disagreeable fluctuations in the lamps. These oscillations will be the more violent as the governors approach ideal synchronous action, as may be realized by imaging one or both of the curves in each of the figures to oscillate irregularly up and down and noticing how the horizontal or load difference between them varies with these speed oscillations. It may be readily seen that the variations in the length of the horizontal line t b between the two curves will be greater and more violent for a given vertical oscillation of the curves in Fig. 2, than in Fig. 1.

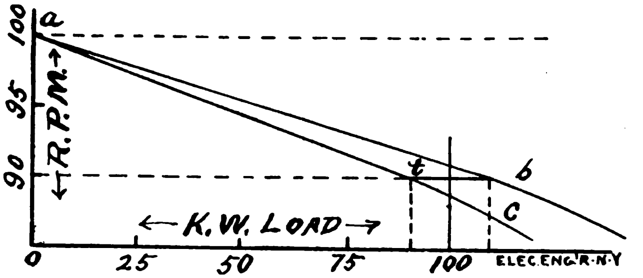


FIG. 1.

Perfect or isochronous governors would be out of the question for direct connected units in parallel, because, unless set at precisely the same speed, the faster one would take the whole load and drive the slower one as a motor; and even if set at the same speed, any slight disturbance would throw the whole of the load on one or the other machine. The division of the load would be in a state of neutral equilibrium, and either generator might be fully loaded at one instant and motoring heavily the next, the external load remaining the same. The equilibrium of the division is stable when the curves fall as the load rises, and the more rapid that fall the more stable is that equilibrium, although the regulation is poorer. Other interesting complications arise when the curves are non-similar, cross each other, or rise with the load; but are too numerous for the limits of this article.

Still another factor that has a theoretical influence on the action is the inertia of the units. When abrupt changes of load come on any engine, no matter how perfect, the speed changes somewhat before the governor acts. The inertia of each unit should be of such a value as to make these changes of speed take place simultaneously and at the same rate. That necessitates for units of different sizes or speeds that the first differential co-efficient of the inertia with respect to the angular velocity of the different units should be proportional to the rated loads of the respective units. This requires that the respective products of the moment of inertia of the rotating parts, times their angular velocity, should be proportional to the respective rated loads. This requirement is probably of no great consequence, but its application to direct connected units of widely different sizes carrying fluctuating loads might be of value.

The problem of running on a single set of bus-bars two or more groups of alternators, the dynamos of each group being belted to a separate prime mover, is solved by first mutually adjusting the dynamos in each group according to the rules laid down above for case (1), and then obtaining proper full range load distribution between the independent groups by properly adjusting the governors of their prime movers as defined above for case (2). In this second operation each independently driven group should be considered the equivalent of one dynamo of the same capacity, and treated as such. The attempt should not be made to vary the number of the dynamos on any one such engine without properly readjusting the engine governor at the same time. For example, if one of two dynamos, driven by any one such engine, is shut down, the engine, unless re-regulated, will attempt to carry through the remaining single dynamo the same proportion of the whole station load that it formerly carried through both, which will compel the remaining dynamo to carry double its due share of the load.

It is now plain also why alternators driven by engines carrying other independent loads should not be multipled. The variations in these independent loads would tend to disturb the equality of speeds between the engines, which would vary the distribution of the alternating loads. The special case of multipling two alternators coupled to the same shaft is, of course, solved by keying the armatures in such an angular position that they are in phase with each other. The fields of such a set should preferably be run in multiple arc from the same field rheostat.

In starting up a fresh unit, and switching it on to the bus-bars with a group of loaded units, the following difficulty arises. If the regulation curves are all the same (like the lower curve in Fig. 2, for example), the fresh dynamo before it is switched in will be running, say, three per cent. faster than the loaded machines. To synchronize the new machine with the others, it has been customary in European stations to provide a great bank of lamps on the station wall sufficient to load a dynamo, or some equivalent non-inductive load. The fresh generator would be loaded with these lamps as heavily as the working machines at the time, which would bring it to a synchronous speed with them; and when the phase indicator showed that the fresh machine was in phase with the others, it would be switched on to the bus-bars, after which the starting resistance would be removed gradually. Of course this accomplishes its purpose and gives absolutely no disturbance to the lamp voltage in switching, but it seems a rather unscientific method.

A better arrangement would be to provide in connection with the engine governors a hand adjusting device, by which each governor could be adjusted, while running, to any desired speed within a certain range. In starting such a machine the attendant could adjust the governor until it would run light at the same speed as that at which the working machines were running. Then with the voltage brought to the same point, and the phase indicator dark, the switch could be closed without the slightest disturbance and the machine gradually loaded up by adjusting the governor to a higher speed. By reducing the speed of any unit, it could be unloaded and switched out when light.

Such an arrangement would be, however, more valuable in affording a ready means of adjusting the distribution of the load between the engines. If any unit shirked, its load could be increased by increasing its speed, and vice versa. The wattmeter indications of a group of units could be made to harmonize by adjusting the governors, and then the ammeter readings could be brought to a minimum by adjusting the field rheostats; when it would be known that there were no idle currents being interchanged between the machines, and that they were therefore all in phase with each other and working together as though all keyed to the same shaft.

All that has been said applies equally to single phase and multiphase machines. The multiphase machine allows the application of the Siemens-Halske synchronizing device, in which a spot of light revolves one way when the fresh machine is running too slow, the other way when too fast, and remains fixed when the machines are at the same speed, its position indicating whether they are in or out of phase. The ordinary phase indicator, although it tells when a fresh machine synchronizes with the others, gives no indication as to which machine is running the faster, without some rather uncertain experimenting with the speed. A pair of resonant "humming" coils would tell the tale to an attendant with a musical ear, but all attendants are not gifted that way. A small split-phase motor arrangement, constructed as follows, will always indicate that information with single-phase generators. Let the stationary inductor of this motor be of the ordinary split-phase type, and connected to the bus bars. Let the motor be also wound with a split-phase winding connected to collecting rings with the same number of poles as the stator, and arranged for magnetic rotation in the same direction, and let it be connected to the fresh dynamo. Then the rotor will turn forward or backward, according as the fresh generator is running faster or slower than the loaded ones. Its speed will be propor-

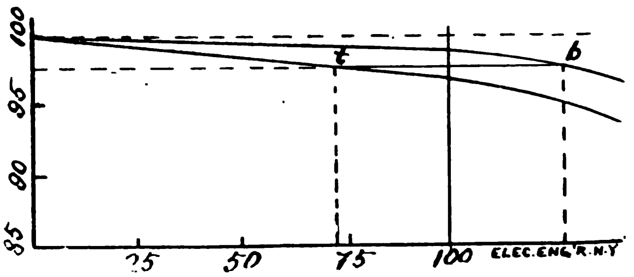


FIG. 2.

tional to the difference in speed between the fresh and the loaded generators, and its stopping will indicate synchronism. Its angular position will also indicate the phase relation.

The ideal governing arrangement (and an easily attainable ideal) for a set of engines, or turbines, each driving one of a multipled set of alternators, is a single governor controlling, through connected mechanism, the point of cut-off, gate opening or gas admission, as the case might be, of all the power units. Such a mechanism would, for example, keep the cut-off in each of a group of engines at the same point. All engines of the same size in the group would then be exerting at any load the same power, and engines of different sizes would be exerting powers proportional to the sizes of their cylinders. A special runaway governor would be necessary on each engine, to provide for any accidental opening of the circuit of that unit. This runaway governor could be a centrifugal trigger throttling arrangement, arranged to trip the valve and shut down the engine whenever the speed reached any predetermined unsafe amount.

The operating governor could be connected to the cylinders of the different engines as are the governors of multiple cylinder Corliss engines, or better by a pneumatic, hydraulic, or electric controlling mechanism; the governor itself being an accurate, sensitive instrument, placed out of harm's way, perhaps in a glass case, and driven by a synchronous motor connected to the bus-bars. The principle could be carried further, if found desirable, and a clock work or chronometric governor used, in which case the generators would make a certain number of revolutions per day, regardless of loads, and clocks could be used, driven by minute synchronous motors tapped from the lighting wires anywhere. This clock service would require no special lines, no winding devices, no batteries, and the instruments would be of the simplest. Such a plan is quite visionary, however, and is only given as an interesting possibility.

A prominent engine building house in this country has lately designed and started to build a line of marine type engines intended for direct connection to alternators, in which every element, down to such details as the width of the valves and the size of the exhaust steam pipe has been proportioned, in the different sizes, to the rated capacity of the engine. The idea was to obtain by that means proper load distribution between different sized units when running in multiple. Such extreme care for details may be valuable to their advertising and sales agents; but it is a safe prophecy that the loads will distribute themselves properly if the governors give the same speed regulation to the different sizes, and improperly if the speed regulation differs, whether the size of the steam pipes and weight of connecting rods are directly or inversely proportioned to the size of the engine.

MECHANICAL

THE WELLINGTON ENGINE AND MODERN STEAM ENGINE EFFICIENCY COMPARED.

BY HENRY E. LONGWELL.

I HAVE read with much interest the article on the Wellington series engine, appearing in your issue of April 21, and your editorial comments on the same.

This work of the late Mr. Wellington, representing as it does, such a vast amount of study and research by a man of unquestioned ability, is for this reason, if for no other, deserving of the most respectful consideration. Unfortunately however, this work is so voluminous, and of a nature so far removed from the lines along which the average engineer is accustomed to thinking, that it seems almost hopeless that a reasonably busy man should be able to fully acquaint himself with it in all its details.

Assuming that your article is a fair exposition of Mr. Wellington's theory, and that the numerical quantities, given in the illustration,—Fig.2, page 421—are from Mr. Wellington's own calculations, it is difficult to see, without throwing over all of what we are pleased to regard as knowledge of thermodynamics,—how such a system can promise, even theoretically, results equal to those actually obtained in the best modern steam engine practice.

In the first place, we may as well neglect any consideration of the efficiency of boiler and furnace, and consider only the action of the heat in the circulating fluid in the case of the Wellington engine, and the heat in the steam, in the case of the steam engine. There is no reason to suppose that the circulating fluid coming from the heater of the Wellington engine would carry any larger percentage of the heat in the fuel than the steam coming from a first-class boiler plant. The products of combustion, in the case of the Wellington engine must escape at a temperature not lower than that of the incoming circulating fluid, 288 degrees, and there are numerous examples of boiler plants fitted with economizers, which discharge the products of combustion at an equally low temperature, and which, consequently work with equal efficiency.

The measure of the efficiency of any heat engine is represented by the ratio of the amount of heat converted into mechanical work, to the total amount of heat supplied. The heat converted into mechanical work is equal to the total heat supplied, less the heat rejected.

Referring now to the illustration in your article, and supposing, for ease in calculation, that the circulating fluid is a substance of which the specific heat is unity, it will be noted that each pound of the circulating fluid in passing through the heater has its temperature raised from 288 degrees to 500 degrees, and consequently absorbs 212 British thermal units. In passing through the cooler, the temperature is reduced from 220 degrees to 50 degrees, and each pound of the circulating fluid rejects 170 British thermal units. With no intermediate losses the total amount of heat available for conversion into mechanical work would be 212—170 = 42 British thermal units per pound of fluid circulated.—Consequently the maximum possible efficiency would be $\frac{42}{212} = 19.81$ per cent.

Examining the operation from another standpoint, it will be observed that each pound of the circulating fluid in passing through the system gives up in each of the five boilers 56 thermal units, 47.6 of which are returned to it in each of the condensers, leaving 8.4 thermal units converted into work in each engine, or a total of 8.4 x 5 = 42 thermal units per pound of fluid circulated, which gives us the same result as the previous calculation.

There are a very considerable number of modern steam engines in operation which have shown actual efficiencies of 15 per cent., and over, when running under conditions of pressure and temperature much less favorable than those proposed for the Wellington engine. As a single instance might be mentioned the Leavitt compound pumping engine at Louisville, Ky., a test of which, reported to the American Society of Mechanical Engineers in 1894, by Mr. F. W. Dean, of Boston, showed a duty of 12.156 pounds of steam per indicated horse-power per hour, with an average boiler pressure of 151.6 pounds absolute, and an average vacuum of 27.75 inches. At this pressure, and with feed water at 100 degrees, the expenditure of heat would be 1,123.5 thermal units per pound of steam, 13,656.8 thermal units per horse-power per hour, or 227.6 per horse-power per minute. The heat equivalent of one horse-power being 42.75 British thermal units per minute, the actual efficiency of the engine was $\frac{42.75}{227.6} = 18.7$ per cent.

If with this comparatively low boiler pressure we can obtain an actual efficiency of nearly 19 per cent., there can be no reasonable doubt that with steam at 355 pounds, as proposed for the Wellington engine, a suitably designed condensing steam engine would give an actual efficiency far in excess of what appears to be the ultimate theoretical efficiency of the Wellington engine.

Exception must also be taken to the statement that with water and its vapor used as the working substance in all the engines of the series, operating under the conditions set forth in the example cited, the engines toward the right will do a much larger amount of work than those toward the left. If each pound of the fluid circulated gives up to each of the five boilers 56 thermal units, and receives back from each of the five condensers 47.6 thermal units, each of the five engines will have done exactly the same amount of work per pound of fluid circulated, that is, the equivalent of 8.4 British thermal units.

The volume of steam generated in boiler E would be many times greater than that generated in boiler A, and consequently the cylinder capacity of engine E would have to be correspondingly larger than that of engine A. By the use of ether or ammonia in boiler E, we might be able to obtain pressures which would admit of less cylinder capacity in engine E, but it is hard to see how the use of any working fluid can make the mechanical equivalent of 8.4 British thermal units any more or any less than 6484.8 foot pounds.

Pittsburg, Pa.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico	per year.	$3.00
Four or more Copies in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies		.10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, MAY 5, 1897. No. 470

THE GENERAL ELECTRIC REPORT.

WE publish this week the full text of the General Electric report, anticipatory figures from which had already been given out and have appeared in our columns. On the whole, the report is much better than might have been expected, and shows, if not an advancing business, at least a material gain in the relations of income and outgo, and in the value of the assets to the capital liabilities. It may be seriously doubted whether prices of electrical apparatus can ever again attain their former level, but the sales of $12,540,000 if taken at the prices prevalent before the panic of 1893, would represent about $25,000,000, with a corresponding, if not larger, margin of profit, for the General Electric Company is to-day doing business on a basis of economy that might fairly be called parsimonious. With that policy, however, stockholders will not complain, provided the results shall presently bring back the days of dividend and a rising market for the stock. So far nothing has been done, and nothing is hinted at in the report, as to provision for dividend resumption, but the company has, without increasing its obligations, enlarged its plant, and has also retired $750,000 of its debenture bonds. There is also reason to believe that such of the stocks and bonds as remain in the possession of the company, now of a par of $15,427,259 and carried as an asset worth $8,545,795 are likely to appreciate in value materially, in the bulk.

As to the "monopoly" of the company, it is perhaps less a fact and possibility than ever, but the relations entered into by the company with several other concerns, and not yet carried out in all the directions feasible, must be regarded as having in some measure solidified its position. There are probably more companies than ever making lamps, motors, dynamos, converters and general supplies, for lighting, railway and power work, and the tendency is to their gradual increase. But the factors making for the pre-eminence of the company, in any event, are numerous and obvious; and our conviction is that worse things might happen to the whole industry than to have the General Electric Company earning and paying good dividends by reason of its large bulk of product and the return to living prices.

THE STORAGE BATTERY OUTLOOK.

SIGNS are not wanting that the storage battery is gradually but surely looming up as a practical factor in American electric central station practice. If no other indication of this were at hand, we would be fully convinced of the fact by the letters which we have received from station managers since the publication of Mr. Joseph Appleton's series of articles on "Storage Battery Engineering Practice," in the columns of The Engineer. These communications voice the unanimous opinion of the writers as to the timeliness and value of these articles and manifest the deep interest of our correspondents in a class of work which must sooner or later be taken up by the majority of them. The letter which we publish in another column presents a typical case, in which many station operators will find a reflection of their own experience. It tells the story of a station operating at full load for less than one-half the running time and greatly underloaded during the remainder of the run. Can the storage battery remedy this state of affairs and will it pay a profit on the investment? While no answer covering every case can be given to these questions, since much will depend on local conditions, we firmly believe that the investment can be made to pay in a large majority of cases. Besides the greater economy of operating at full load, the storage battery in connection with the large majority of alternating stations would mean an increased revenue and would enable those stations shut down during the daytime to supply current during the whole twenty-four hours, which would attract not only lighting but more particularly power customers. The location of the storage batteries will probably in most cases be outside the central station as well as in it, in substations as at Buda Pest, where such an installation on a large scale has been in successful operation for several years. The manner of converting from alternating to direct current for battery charging will probably for some time yet be carried on by moving apparatus, although the static converter for this class of work has long been heralded as about ready. The rectifier, driven by a synchronous motor, has been used with success in some stations abroad, but for heavy work the rotary converter seems to be preferred in this country. The efficiency of both types of apparatus is high, so that no difficulties are encountered on that score.

What has been said regarding electric lighting service is equally, if not more, applicable to electric railway work. Already many companies are confronted with the enormous and increasing cost of feeders demanded for their heavy traffic and as lines are extended, it becomes a serious question as to the proper limits of economic operation of electric railway stations. As Mr. E. E. Higgins suggests in his paper on American Street Railway Finance, may it not be that the matter of concentration of railway power service in single stations has been somewhat overdone? Here again the storage battery, situated at the farther end of existing feeders constitutes a valuable aid to maintaining potential on the trolley lines and has already been utilized with marked success.

Thus, viewed from every standpoint the conviction is irresistable that the storage battery is destined to play as important a part in electrical work in America as it now does in Europe. When one stops to consider the relative number and magnitude of the central stations in the United States compared with those of European countries, the prospects for storage battery work in this country assume gigantic proportions.

THUNDER AND LIGHTNING AS BOGIES.

A CURRENT news item gives the results of an investigation carried out by Dr. G. Stanley Hall, president of Clark University, on the things that most excite fear in people. Of the 298 classes of objects of fear to which 1,707 persons confessed, thunder and lightning lead all the rest, although in certain localities, as, for instance, those subject to cyclones, etc., the fear of the latter predominates. It may be accepted as probably true that thunder storms constitute the most pronounced source of fear with the majority of people, due, no doubt, to the always impressive and not infrequently overpowering nature of the phenomenon. But is there any justification in fact for this fear, so far as fatal results are concerned? We believe there is not, but on the contrary, that many other causes which barely have a place in Dr. Hall's list are infinitely more entitled to the distinction as fear producers, than lightning. As proof of this we may cite statistics of the U. S. Weather Bureau. These show that for the four years 1890-93 the deaths from lightning numbered 784 or an average of 196 a year. Again, Mr. H. F. Kretzer, of St. Louis, found from the record of nearly 200 newspapers, that for the five years 1883-8 there were 1,030 deaths caused by lightning, or an average of 205 a year. We doubt whether, of the number of deaths classed as "accidental" in the whole United States, any one group can show so small a number. In New York City alone over 200 hundred people are drowned every year, while nearly 150 are burnt or scalded to death, and close on to 500 persons meet their end by falls of one kind or another. Comparing the record of 200 lightning fatalities for the whole country with the above records for New York City with its total of nearly 1,500 accidental deaths every year, it will be seen how groundless is the popular fear of lightning. It is a survival, an inherited superstition.

But there is another point in connection with this matter, which ought to be particularly comforting to city dwellers, albeit country dwellers may not be affected in a like manner, and that is, that statistics show that the risk of lightning is five times greater in the country than in the city. The cause of this immunity for city dwellers is not far to seek. It is doubtless due to the predominance of metal roofs, the well grounded water pipes in houses and probably as much as anything to the protective network of overhead electric wires of all kinds.

The popular belief that a stroke of lightning is invariably fatal is also not borne out by facts. Indeed one record specially devoted to this feature shows that of 212 persons struck only 74 were killed. Taking it all in all, there seems to be no more groundless popular fear than that of lightning. Indeed, if one can go by statistics the risk of meeting death by a horse kick in New York is over 50 per cent. greater than that of death by lightning. Yet with all the weight of statistics against its deadliness lightning will probably continue to scare people as heretofore. Perhaps, after all, there may be a more direct cause than the mere psychological one usually ascribed to it, and that is the fact that many people of nervous temperament are affected hours before the approach of a thunder storm and thus rendered particularly powerless to stand the strain which more or less affects even the most phlegmatic natures during a disturbance in the heavens.

RUNNING ALTERNATORS IN PARALLEL.

AMERICAN electrical engineers are apt to look with complacency on their record of work accomplished in the furtherance of the industry, and while they might well be entitled to a temporary rest from their labors during the past fifteen years, can they claim to have brought central station practice up to its highest state of perfection permissible by the state of the art? Leaving out of consideration types and efficiency of apparatus, is the apparatus as it stands utilized and operated to its best advantage? Take the case of our alternating stations. How many managers couple their machines in parallel to a common bus-bar? Probably not one in a hundred. And yet, how important a factor of economy this method is. The majority of American alternating stations, in fact, are running what has very aptly been characterized as "a collection of small central stations arranged for the sake of convenience under one roof," each feeding separate and individual circuits and regulated independently of all others. When to the disadvantages of such independent operation within the station are added the inconvenience and the disturbances caused thereby on the outside circuits, it is indeed a matter of surprise that no serious attempt has been made to introduce a more rational system into the alternating stations. We believe that most, if not all, types of alternators now employed commercially have been or can be operated successfully in parallel. The question, then, resolves itself into devising proper means of keeping them in step, when once they have reached that condition. It must be admitted that the methods best adapted for insuring successful parallel working of alternators, as a rule, require some study and experiment, but this ought not to constitute a bar to making the attempt. Just what conditions have to be fulfilled in the matter is very well brought out in the two articles by Mr. J. E. Woodbridge concluded in this issue of The Engineer. We believe that a careful study of the suggestions contained in them will enable the central station engineer to accomplish the paralleling of any alternating station.

CHANGING ONE'S SKIN ELECTRICALLY.

NOW that the summer is coming along, with its outdoor sports and exercises, the "summer girl" and the summer man will be exhibiting all shades and styles of sunburn. The fact that one's skin is ruddy or tanned is regarded in many circles as proof of ability to leave the city and spend time and money in pastimes; and those who cannot so indulge have hitherto been credited with closing up the front of their houses and living a secretive hermit life in the rear, to conceal their presence in town. A process of artificial sunburning by electricity has now been seriously put forward, and is likely, it is said, to be largely patronized in fashionable but impecunious circles. Per contra, Prof. Lucien I. Blake has been raising wild hopes in the breast of colored humanity by stating in a lecture at Kansas City that by means of electrical cataphoresis he expects to remove the black pigment from under the epidermis of the negro race, and thus render it easy to become white. Experiments on some parts of the body of willing subjects are reported to be going on, and the results are eagerly looked for. Care is necessary, however, in such work, for it will be remembered that in using the X-ray for removing superfluous or kinky hair, more harm than good has been done.

Stamping out heresy by killing the heretic is an old practice, but its analogue hardly goes in modern medicine. We trust that our black citizens who wish to change their color may find it possible to do so with the aid of electricity, simply and safely, for with the increase of our negro population a new and permanent branch of electrical industry would thus be created.

IT is an item of personal gossip of more than ordinary interest that Transvaal Raider Jameson is now to go to Lake Tanganyika to help in the construction of the transcontinental telegraph line from Cape Town to Cairo. He could not be better employed. Electricity will put the plucky Boer in his right place more quickly than anything else; and that line of wire across Africa is as good as a railroad.

A COMMON sight in Western cities, even the largest, is that of numbers of buggies hitched on the street in the most crowded parts of the town. But it would appear that the revolutionary trolley car is changing all that. At Columbus, O., farmers from 15 or 20 miles around, leave their traps and teams on the outskirts and board the trolley cars for the remainder of the trip. The plan is popular and works well. As the local Dispatch puts it: "They can save time, avoid the dangers of the city with horses unfamiliar with city sights, and be free from the responsibility of their teams, besides saving the expense of putting them up at a livery stable." More and more, the farmer swears not at the trolley, but by it.

THE utilization of Niagara power on the Canadian side has now reached an interesting stage. The Niagara Falls commission has notified the power company that it must begin operations on its Canadian plant by May 1 or lose its franchise to hold which it has been paying $25,000 a year. The company had applied for an extension of time, but this privilege having been denied, it has faced the problem by actually beginning work. Details for the plans of the Canadian side have already been published in The Engineer, but it is still too early to say when the work will be completed or what the exact present intentions of the power company are as to the disposal of the power that it generates. It is said that large customers stand ready for it, and it can only be hoped that this is true.

A THOUGHTFUL mayor is an inestimable boon to any community. Mayor Marshall of Corunna, Mich., has just exhibited this quality of considerateness to a marked degree by recommending that during the summer evenings the local electric light company be instructed to turn out its lights. This inaugural recommendation has caused great joy amongst the young folks, and it is said that the mayor can be re-elected if he choose or has only to say the word to be pushed for the gubernatorial office now held by Potato Patch Pingree. Authentic cases are on record where request has been made by courting lovers for the removal of an ostentatious and obnoxious arc light, but never before has a mayor come forward and thus assumed the part of a wholesale Cupid, by suggesting to shut down whole circuits, and thus smooth by darkening the course of true love.

TELEPHONY AND TELEGRAPHY

THE SYNCHRONOGRAPH.—A NEW METHOD OF RAPIDLY TRANSMITTING INTELLIGENCE BY THE ALTERNATING CURRENT.[1]—I.

BY A. C. CREHORE AND G. O. SQUIER.

THE alternating current is at present successfully employed for transmitting considerable amounts of power over long distances, and the whole system is periodically subjected to a regular and uniform succession of waves rising gradually from zero to a maximum, and then gradually decreasing, reversing, and increasing to a negative maximum. Recognizing these facts, it seemed probable that it would constitute a good means for the rapid transmission of intelligence, if the characters of a telegraphic code could be impressed upon such a current without seriously affecting its regular operation. It is to the consideration of a system of rapid transmission of intelligence by the use of the alternating current that we invite your attention.

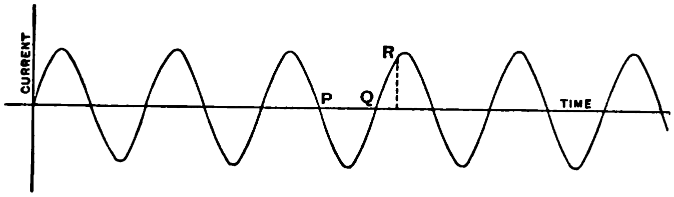


FIG. 1.

Let the sine curve, Fig. 1, represent a regular succession of simple harmonic current waves given to the line by an alternating current generator. If the current passes through a key which may be opened or closed at pleasure, then, provided the key previously closed is opened at a time corresponding to the point P of the wave upon the horizontal axis, it is known that the current which was zero at the instant the key was opened, will remain zero thereafter, in circuits which have resistance and inductance alone. Again, if the key could be closed exactly at a time corresponding to the point Q on the curve also upon the axis, the current will resume its flow undisturbed according to the sine curve. The true current obtained by opening the key at P and closing it at Q is shown in Fig. 2, where the current remains zero between these two points. If the key had been closed at any other point than Q, as at R, the current would not have resumed its flow according to the simple sine wave; but, it can be shown, would follow the heavy curve of Fig. 3, and give a succession of waves alternately smaller and larger than the normal sine wave until after a very few alternations, when it practically coincides with the sine wave. In like manner if the key is opened at some other point than P, when therefore the current is not zero, a spark may be observed at the break, and it requires time for the current to fall to zero.

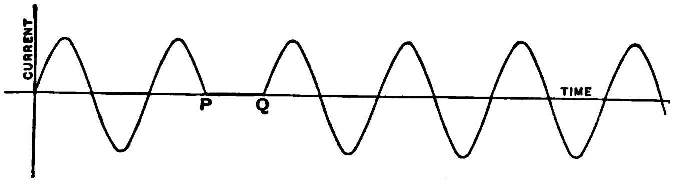


FIG. 2.

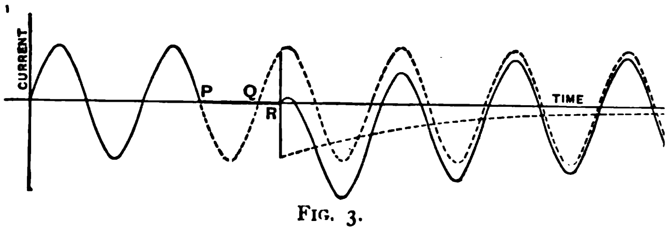


FIG. 3.

Let us consider the advantages of thus operating upon an alternating current. It is evident that the advantages above mentioned of using a system subjected to a perfectly regular alternating electromotive force, and capable if necessary of transmitting considerable amounts of power, are by this method made available. In addition, no spark is made in a transmitter adjusted to break the circuit at the exact times indicated by the curve above, when the current is naturally zero. This makes it possible, if it is found desirable, to use comparatively large electromotive forces and currents on the line, for no matter what the maximum value of the current, it is made and broken by this plan with no sparking. It is also possible to employ waves of high frequency upon the line, the upper limit obtainable from an alternator being probably much higher than can be transmitted over the line.

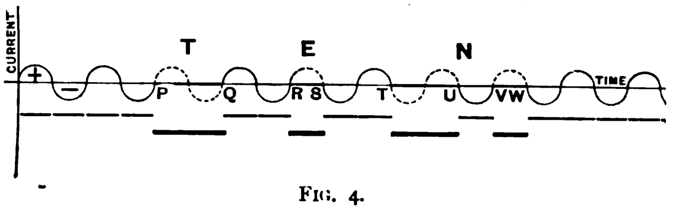


FIG. 4.

If a receiver were used which could reproduce an exact trace of the actual waves sent over the line, it might resemble such a combination as that represented by the heavy curve in Fig. 4. The sine wave continues uninterrupted to the point P when the key is opened, and it is held open for one complete wave-length P Q, when it is again closed for a wave-length Q R; then for one-half a wave-length R S; closed for a wave-length S T; opened for a wave-length T U; closed for half a wave-length U V; opened for half a wave-length V W and finally closed. By this plan it is possible to use the ordinary Continental code in telegraphy, a dash being indicated when two successive waves, a positive and a negative one, are omitted by keeping the key open, and a dot meaning where a single half-wave is omitted. The space between parts of a letter, as between the dash and dot of the letter "n" is indicated by the presence of one-half a wave-length, and the space between letters, as between "t" and "e" in the word "ten," by the presence of two half-waves, while the space between words may be represented by the presence of three half-waves, and between sentences of four half-waves or more.

If we suppose that the frequency is an ordinary one used in alternating current work, viz., 140 complete waves per second, the time required to send the word "ten" is .0394 of a second, or, by allowing three additional half-waves for the space between the words, the word "ten" would be sent just 1,200 times in one minute. There is no difficulty in using over some lines, a frequency four times as great as that ordinarily used, namely, as high as 560 or even 600 periods per second. This would correspond to speeds of 4,800 and 4,143 times sending the word "ten" per minute. The limit in each instance is only determined by the particular line used.

Hitherto it has not been pointed out how it is possible to manipulate a key at the high speed mentioned, so as to open and close the circuit hundreds of times per second as desired at the exact instants when the current is naturally zero. Evidently the proper place to manipulate such a current controller where the circuit must be made and broken at distinct points of phase, is at the generator itself, or in connection with any motor running synchronously therewith.

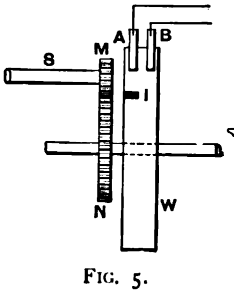


FIG. 5.

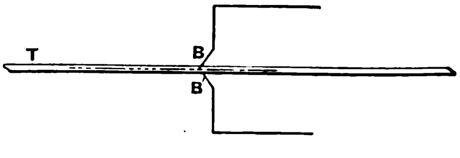


FIG. 7.

It will be sufficient for purposes of illustration to show by a special example how any single half-wave may thus be controlled at the generator; for obviously any word or sentence may be formed by a repetition of this operation.

In Fig. 5, S represents the shaft of an ordinary 10-pole alternating current generator which drives through the gears M and N, the wheel W. The circumference of this wheel is one continuous conductor presenting a smooth surface for brushes to bear upon. If the periphery of the wheel is divided for example into 40 equal parts, and it is geared to run at one-fourth the speed of the armature, each division thereof corresponds to one semi-cycle of the electromotive force produced by the generator. Upon the wheel W bear two brushes A and B carried by a brush-holder which is capable of adjustment. These two brushes are connected in series with the line, so that the current which passes in at one brush, is conducted through the wheel to the other brush, and thence to the line. The current used may be obtained from the generator, the shaft of which is represented at S, either before or after it has passed through any number of transformers, since it is the frequency alone with which we are concerned.

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[1] Read before the Amer. Inst. Elec. Engrs, April 21, 1897. Abstract.

The line current is brought to the wheel W to be synchronously operated upon. If both brushes remain continually in contact with the wheel, the current transmitted would have the regular sine form represented in Fig. 1, and for each revolution of the wheel there would be 40 semi-waves or 20 complete waves transmitted. If one-fortieth of the circumference of the wheel is covered by paper or other insulating material as indicated at I, Fig. 5, and the brush A adjusted to ride on to and off from this insulation just as the current is changing from one semi-cycle to the next, that is, changing sign, while the brush B is in continuous engagement with the wheel, the semi-cycle represented by the section covered will be suppressed and without any sparking, even if the potential used is high. In practice, the brush A is easily adjusted to this point by moving slightly backward or forward around the circumference of the wheel until the sparking ceases. This adjustment once made, the brush is fixed in position and so remains. In each succeeding revolution of the wheel, this cycle of operations is exactly repeated, and the current sent over the line would resemble that shown in Fig. 2, having every fortieth semi-cycle omitted. It is only necessary to cover other similar sections of the circumference of the wheel in a predetermined order according to a code, to transmit intelligence over the line. The above illustration of the operation of a transmitter on this principle is given for simplicity only, and is evidently far from a practical form of transmitter.

The employment of alternating waves of different frequencies upon the same line by the method shown, does not have the same objections which exist when a constant electromotive force is used. Since the circuit is by this system always interrupted when the current is naturally zero, the frequency employed is within certain limits a matter of indifference as the line is in the same condition whether a long or a short wave is used.

A new type of receiver having no inertia in the recording mechanism was used in developing the transmitter described in these experiments. This instrument has already proved of value as a chronograph for the measurement of minute intervals of time, and for the study of any kind of variable electric currents. Although its application as a practical telegraph receiver is not at present advocated, yet the realization of a massless receiver upon different lines merits description. This receiver is based upon Faraday's discovery of a direct relation between light and electricity. This discovery was that if a beam of polarized light is passed through some substance in the direction of the lines of magnetization within that substance, there is a rotation of the plane of polarization in a direction which is the same as the direction of the current required to produce such a magnetic field. The direction of rotation is unaltered, therefore, whether the light beam advances in the same or in the opposite direction to the magnetization, so that a beam reflected back and forth through the substance several times, has its rotation increased by equal amounts each time. The medium used in the receiver is liquid carbon bisulphide contained in a glass tube with plane glass ends. There are many other substances which will answer the purpose, some better than others. This was selected because it is very clear and colorless, and possesses the necessary rotatory property to a considerable extent. It only possesses this property, however, when situated in a magnetic field of force, and the rotatory power is proportional to the intensity of the magnetic field. To produce a magnetic field in the carbon bisulphide, a coil of wire in series with the line from the transmitter is wound around the glass tube. When the current ceases, the carbon bisulphide instantly loses its rotatory power. The operation is as follows: First, the polarizer and analyzer are permanently set in the crossed position, so that no light emerges from the analyzer. A current is sent through the coil around the tube. The plane of polarization is immediately rotated. This is equivalent to rotating the polarizer through a certain angle, and hence light now emerges from the analyzer. Break the current, the medium loses its rotatory power, and there is again complete darkness. This arrangement makes an effectual shutter for the beam without moving any mass of matter. An advantage of this receiver is that the speed is not limited by the receiver but only by the natural properties of the line or of the transmitter. Used in connection with the transmitter already described, the real limit is found to be in the line itself.

In these experiments, the operation upon the alternating current according to the principles already stated, was accomplished by means of a prepared perforated paper tape, which was caused to move by the generator itself. A view of this tape, showing a method of operating upon the current is given in Fig. 6.

The line current is brought through the wires W W to two brushes B B′ not shown in the view, held by the adjustable support S. The plan of the brushes is shown in Fig. 7. One brush B bears upon the tape from above, and the other brush B′ bears from below immediately opposite the other brush so that they will meet through the perforations in the transmitting tape T. When the brushes meet through the perforations in the tape, the line circuit is closed, and when paper passes between them, separating the brushes, the line circuit is broken.

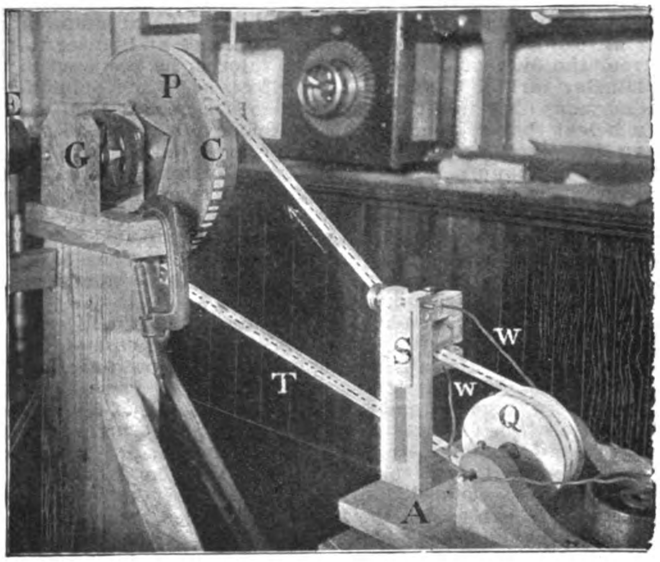

FIG. 6.

ANTI-BELL COMBINE AT MINNEAPOLIS.

A special dispatch from Minneapolis, Minn., of April 20 says: The Twin City Telephone Association which is made up of a number of companies doing business in this and immediately adjoining States, met at the West Hotel this morning to discuss means of pushing the organization and establishment of an exchange in the twin cities, which will give all of these different local exchanges a central exchange. The chief promoters of this scheme are J. E. Keelyn of the Western Telephone Construction Company of Chicago; J. F. Cass of the Western Electric Telephone system of Iowa and Southern Minnesota, and the Mississippi Valley Telephone Company of Keokuk. Representatives were present from Lake City, La Crosse, Winona, Winnebago City, Owatonna, Aberdeen, S. D.; Des Moines and other points. The purpose of the meeting was to form a permanent organization and to secure subscriptions toward the capital stock of the company to do business in the twin cities. Representatives of the Mississippi Valley company were present and became a part of the association, which would indicate that the Keelyn interests and the others will work together.

HYPNOTIZING BY TELEPHONE.

The dealers in the marvelous may derive solid comfort from the following:

Ravenna, O., April 17.—Ajo Joboe, a Hindoo hypnotist, has performed a remarkable feat over the telephone from Galion, 100 miles distant. William Morgan, at this end of the line, fell in a heap on the floor when Joboe spoke to him from Galion. Dr. White, a reputable physician, pronounced him in a perfect state of hypnotism. He said afterward the hypnotist over the wire had the same effect as at close range, and that the sensation was just the same. Joboe recently came to America.

LETTERS TO THE EDITOR

THE DUTY ON ARC CARBONS.

I HAVE read with interest the article published in The Engineer about the new duty on electric light carbons.

It seems to me that the manufacturers of arc lamps in the United States should use all their influence and power to prevent the duty of 50 per cent. ad valorem as proposed in the Dingley tariff bill, from taking effect, as in my opinion this enormous duty would raise the price of a good carbon to such a height that it would be an enormous tax upon the user of an improved arc lamp. As experience has shown in the past, the manufacturers of electric arc light carbons in the United States have not been able to turn out a carbon equal to the imported, and whatever the reasons may be of this fact, the users of a good lamp have been compelled to pay the price for imported carbons, although the price has been two or three times as high as the price of the common article manufactured in this country.

Should the 50 per cent. duty go into effect, it will certainly have the effect of still further increasing the cost of the imported article, and already importers of carbons are sending out letters, advising their customers of an increase in the price. No importer can afford to pay a duty of 50 per cent. in place of the old duty of 30 per cent without asking his customers to reimburse him for this additional tax. If, as I say, the 50 per cent. duty should become a law, the American public would be compelled to pay a price for the only carbon which they can use on their improved lamps, which would be four or five times as high as the price of the domestic article.

Who would get the benefit of it? Certainly not the American manufacturer, as even with the very much increased cost of the imported carbons, the American public would be compelled to continue using imported goods. It is not the price which has influenced the public to use imported carbons. It is simply the quality. If the American manufacturers had been able to turn out a quality equal to the imported, the imported carbon would have gone out of this market long ago, as the 30 per cent. duty which they have been paying in the past would have been more than enough to offset the probably somewhat lower cost of manufacturing in the old country.

There is certainly one effect that this 50 per cent. duty would have should the same become a law, and that is, it would handicap the progress made in the construction of arc lamps. The cost of using the improved lamp would be so high that some of the manufacturers and inventors would probably not think it advisable to spend their time and energy on still further improving the construction of the lamp with the object of giving better service to the public The arc lamp without the suitable carbons is of no value whatever, and if the only carbons that are suitable for such arc lamps cannot be bought at a reasonable amount, the improved arc lamps are of no value to the public.

I am sure you will find among your readers some that will indorse my views in the matter, and if so, I should think that some effort should be made immediately by the manufacturers of arc lamps in the United States to prevent this exorbitant duty of 50 per cent. from taking effect.

ONE OF THE PUBLIC.

Chicago, Ill.

ARGUMENTS FOR HIGH DUTIES ON CARBONS.

REFERRING to the letter in your April 21st number, under the head of "Arc Light Carbons and the New Tariff," permit me to object to the position evidently taken by your corespondent, to-wit: that the propsed tariff on arc light carbons is unjust.

Arguments so far appear to have been upon the alleged fact that the foreign production cannot be duplicated in this country. But such is not the case. I believe it cannot successfully be denied that the sole reason cored carbons have not been extensively made in America up to the present time, is that European cheap labor is so low as compared with the wages paid by our manufacturers that the foreign product can stand a 30 per cent. duty and still undersell domestic goods.

This condition has naturally discouraged much experimental work by home talent with a view of furnishing a carbon point for use on alternating circuits, and the claim made by some one recently that the material used in the foreign make-up could not be obtained except by import, is simply the ghost of a bug-bear, is not based on fact, and is too palpably absurd to be seriously considered.

More than 2,500 alternating arc lamps are in circuit in St. Louis at the present time, and the companies operating them reasonably look for a reduction in the cost of carbons as a result of legitimate competition; which, however, cannot be had until our domestic product has received assurance of adequate protection.

S. B. PIKE,
Secretary Edison Electric Illuminating Co.

St. Louis, Mo., April 26, 1897.

CHARGING STORAGE BATTERIES FROM ALTERNATNG CIRCUITS.

I am running one 1,100-volt 32-ampere alternator for commercial lighting. Can a storage battery be used in connection with it? For three hours the machine is now fully loaded, but for about four hours it is running on less than one-third its capacity.

CHARLES M. ARMSTRONG.

Barry, Ill.

Our correspondent raises a question which has probably confronted many another station manager. There is no practical obstacle whatever in the way of charging storage battery from an alternating machine as the initial source of current. All that is required is a rectifier or a rotary transformer. Both of these methods are in successful operation. In Europe several alternating current plants employ the Pollak rectifier with success on plants of moderate size. In the United States the Hartford Electric Light Company is charging a very large storage battery through rotary converters which take in alternating current at one side and deliver continuous current at the other to the storage battery.—Eds. E. E.

OBITUARY

F. G. BEACH.

We regret to announce that Mr. Franklin G. Beach, general manager of the Central Union Telephone Company, died on the night of April 28 at the family home, 1608 Forest avenue, Evanston, Ill.

Mr. Beach had been sick for three months with a complication of diseases which terminated in cerebral hemorrhage. His friends had been expecting his death for some time. Mr. Beach had been in the telephone business from the first and was one of the best informed men in that business in the country. Going to Chicago nearly thirty years ago, he was there at the introduction of the telephone, and no man in the city has been so closely identified with telephone interests and growth as he. It was frequently said of him, so well acquainted was he with the details of the business, that "he knew just where every telephone pole between Chicago and New York was located."

He was noted for his intense energy, and few men have been more devoted to their business. He was a native of Munroe, Mich., where he was born fifty-five years ago. In Evanston, where he has lived for ten years, he was popular and a favorite in the Evanston, Country and Boat clubs, being a member of all of them. He was also a member of the Lotos Club, of New York City, and was formerly president of the Chicago Electrical Society. His widow, Mrs. Elizabeth Beach, survives him.

M. C. BRISTOL.

M. C. Bristol, superintendent of construction of the Western division of the Western Union Telegraph Company, with headquarters at Chicago, died at his home there on April 30. He had been ill for two months with typhoid malarial fever. He was born in New York State in 1842 and entered the Western Union Telegraph Company's service in 1861. In 1862 he joined the United States military telegraph corps, later returning to the service of the telegraph company. He was appointed superintendent of construction of the Western division on February 1, 1879, and had been a resident of Chicago ever since.

T. C. PRICE.

We regret to announce the death by typhus, on March 31, of Mr. T. C. Price, late manager of the Electrical Supply Company, of the City of Mexico. Mr. Price, although a comparatively new man in the field, had already won a host of friends in the electrical field. His position as manager of the company has been filled by the appointment of Mr. Joseph Ketchum, of New York, who has been in the market as an engineer, manufacturer and dealer, for the past twenty years.

C. C. HINE.

The death is announced of Mr. C. C. Hine, at the age of 72, in Newark, N. J. He was an old time telegrapher and the first president of the Old-Time Telegraphers' Association in New York City. For a long time past he had been interested in insurance, and was the publisher and editor of the Insurance Monitor and Insurance Law Journal. He was a strong temperance man and an able amateur photographer.

MRS. C. H. CLOWRY

Mrs. C. H. Clowry, wife of Col. Robert C. Clowry, vice-president and general superintendent of the Western Union Telegraph company, died recently in Lincoln, Neb., of apoplectic paralysis. Mrs. Clowry was the only daughter of the late Experience Estabrook, who was attorney general of Wisconsin at an early day. Her musical compositions reached a sale of far beyond one million copies.

W. B. SOMERVILLE.

William B. Somerville, superintendent of the press service of the Western Union Telegraph Company, died in this city on April 24. He was born in Toronto fifty-seven years ago. He came to this country at an early age and thirty years ago entered the employ of the Western Union, in which he gradually rose to the responsible place he held at his death. He was greatly respected by the employés and officers of the company, and his death is sincerely regretted. Mr. Somerville served during the war, and soon after its close married, his wife's former name having been Mrs. Buckner. He leaves no children, but, besides Mrs. Somerville, several stepchildren and two sisters survive him. He had been ill about sixteen weeks, bladder trouble, which made necessary an operation, performed a week ago, being the cause of death. The burial took place at Cleveland, where his father, mother and three sisters are buried and where one of his surviving sisters lives.

Through his connection with the Western Union Telegraph Company, Col. Somerville became personally acquainted with many public men, and it was his boast that he had missed no national political convention since 1869. He was one of the leading military telegraph operators during the war.

In 1876 it was Col. Somerville who handled all the telegrams in this city on the election of President Hayes, and as all of the dispatches were signed Somerville, he had the crowds reading the bulletins wondering who Somerville was. He was a member of the Lotos Club.

MR. W. M. SKILLEN, an old time operator, and once a wealthy merchant in St. Louis, Mo., has just died at Kansas City, Mo., in the service of the Western Union Company, for whom he had worked during the past 15 years.

SOCIETY & CLUB NOTES

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Secretary Porter writes us: Arrangements have been made with the management of the International Hotel and Cataract House to accommodate members and guests attending our twentieth convention, to be held at Niagara Falls June 8, 9 and 10. Rates will be from $3 to $5 per day, American plan.

The papers to be read and topics discussed are of the utmost importance to central station managers, and the programme of entertainment embraces all points of interest in and about the Falls, which, since the introduction of electricity on so large a scale, are of unusual interest.

As the time approaches for holding our twentieth convention, unusual interest and activity is displayed by our members. The inquiries for hotel accommodations are very large, both from active and associate members and the trade in general, one company alone having reserved twenty-five rooms, another fourteen, and so on. Notwithstanding the heavy requisition for accommodations, we feel that ample provision has been made for all, as we shall practically have the resources of both the International Hotel and Cataract House at the disposal of our delegates and guests. It is well, however, to engage rooms early to insure choice locations. This can be done by addressing the hotels direct or the secretary at the headquarters of the association, 136 Liberty street, New York City.

THE TELEGRAPHIC HISTORICAL SOCIETY OF NORTH AMERICA.

The regular annual meeting of this society will be held in Washington on May 5, 1897, in the rooms of the Washington Board of Trade, No. 1410 G street, N. W. The first session will open at 10 a. m., when the routine business will be transacted. At a later session, in the afternoon or evening, formal papers will be read and discussed. Officers will be elected for the ensuing year and other important business will be transacted. Members are requested to notify the secretary whether they will be present, and they are at liberty to invite persons interested in the objects of the society to attend this meeting. Historical papers heretofore presented to the society have been printed and mailed to members. Mr. Geo. C. Maynard is secretary, No. 800 H street, N. W., Washington, D. C.

AMERICAN INSTITUTE FAIR.—The directors of the American Institute are actively preparing for what they mean to be the best show ever given by their institution. The next fair, which will be the sixty-sixth, will be held at Madison Square Garden. It will continue for six weeks, from Sept. 20 to Nov. 4. The Board of Trustees has chosen Mr. Alfred Chasseaud to be the Managing Director of the fair. The institute has established and will, until the close of the fair, maintain a temporary office for the Managing Director in the tower of the Madison Square Garden. Mr. Chasseaud is planning to amplify the departments that have become regular features of the American Institute fairs, and will inaugurate several new departures.

PERSONAL

MR. W. M. BROOKE.

The many friends of Mr. William M. Brooke, the popular representative of the Central Electric Company in Texas, will be glad to learn that Mr. Brooke's genial qualities, as well as his attention to wants of his customers, have been recognized in an unusual manner by the Texas Gas and Electric Light Association at their recent meeting in San Antonio, Texas, Mr. Goldrick, of the San Antonio Gas and Electric Light Company, on behalf of the association, presented Mr. Brooke with a handsome gold medal, inscribed "The most popular lighting man in Texas." Mr. Brooke's career in the electrical business began in the fall of 1893, when he identified himself with the Central Electric Company in a subordinate capacity, the management of which was quick to recognize his qualifications. His progress therefore was very rapid, his experience as a salesman in other lines being quickly adapted to the intricacies of the electrical supply trade. In 1894 Mr. Brooke was given full charge of the Southwestern territory, with headquarters in New Orleans. The wisdom of placing this important territory in Mr. Brooke's hands is evidenced by the action of the Texas Gas and Electric Light Association.

MR. H. B. COX.

Mr. H. B. Cox, the inventor of the Cox thermo-electric generator, has arrived in this country on a business trip from England, and will stay in this country for a few weeks to complete important negotiations and close up arrangements for the handling of his apparatus in this country, where the demand that has sprung up is at once large and insistent. The fire in his English factory has been immediately followed up by rebuilding and enlargement, and the factory has again begun to fill orders. Mr. Cox has been invited to deliver two lectures before the Royal Institution on his interesting investigations and successful work, but before returning to England has kindly promised to deliver an experimental lecture before the New York Electrical Society. Mr. Cox's address while in this country will be 126 Liberty street, New York.

MR. F. J. SPRAGUE has sailed for Europe last week on important business connected with his electrical work.

MR. F. L. WRIGHT has been elected superintendent of the electric light plant at Smyrna, Del.

MR. W. J. CLARK, of the General Electric Company, has been called to England by important business engagements, and sailed last Saturday for Liverpool.

MR. R. R. BOWKER, first vice-president of the Edison Electric Illuminating Company, of New York, is about to sail for a European trip.

MR. L. J. HIRT delivered an interesting lecture on street railway work, on April 24, before the Metropolitan Street Railway Association of New York, at its rooms on Fiftieth street. He dealt specially with underground conduit railway construction. During the evening a life-size oil painting of President H. H. Vreeland was presented to him by the employés, who had raised the amount necessary by subscription. Mr. Hirt made the presentation speech.

MR. J. P. BARRETT, on request of the new mayor of Chicago, Mr. Carter H. Harrison, has tendered his resignation along with those of other city officials. No charges of any kind were on file against him. He had been in the service of the city for 35 years, and for 21 years was head of the Electrical Bureau.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 27, 1897.

Alarms and Signals:—

SEMAPHORIC ELECTRIC SIGNAL. R. S. Roberts, Philadelphia, Pa., 581,430. Filed October 16, 1896.
Adapted for use in block signal systems on railways.

ELECTRIC CALL. H. C. West, New York, 581,446. Filed July 29, 1896.
Adapted for use separately for annunciators, alarms, or signals, or in connection with telephones.

ELECTRICAL ALARM DEVICE. J. J. Barton, Ypsilanti, Mich., 581,528. Filed December 12, 1896.
For use on call systems in hotels, etc.

THERMOSTATIC FIRE ALARM. O. A. Enholm and T. H. Beck, New York, 581,544. Filed November 23, 1896.
Employs a rotatable recessed disc containing fusible material, and a spring one end of which rests in a surface of wax, the disc and the spring being connected with the terminals of the circuit.

Batteries, Primary:—

PRIMARY BATTERY. R. R. Moffatt, Brooklyn, N. Y., 581,426. Filed Septemher 1, 1896.
Comprises a metal frame having a plurality of openings and independent battery vessels, each consisting of two cups having rims secured in the openings of the frame.

Batteries, Secondary:

SECONDARY BATTERY. V. M. Harris, Chicago, Ill., 581,283. Filed July 6, 1896.
Comprises a central metallic positive element, a porous cup surrounding the same, a mass of active material within the cup and about the element, an outer copper gauze mercury-covered negative element, a case to contain the whole, and a suitable fluid within the same.

Distribution:—

ELECTRICAL TRANSMISSION OF POWER. R. M. Hunter, Philadelphia, Pa., 581,684. Filed November 9, 1887.
A primary generator wound for currents of low intensity, a secondary generator arranged close to the primary generator, a local circuit of low resistance from the primary generator through the coarse-wire coil of the secondary generator, and an induction translating device in the long line circuit.

Dynamos and Motors:—

MAGNETO ELECTRIC MACHINE. E. B. Cutten, Atlantic Highlands, N. J., 581,340. Filed February 12, 1897.
Hand machine especially adapted for electro therapeutic uses.

ELECTRIC GENERATOR. C. C. Poole, Evanstown, Ill., 581,366 Filed February 26, 1894.
A generator of the oscillator or reciprocating type, in which the generating coils are attached directly to the piston rod.

Electro-Metallurgy:—

AMALGAMATOR. W. Wright, New York, 581,643. Filed June 12, 1896.
Means for electrically controlling the deposit surfaces of the amalgamator whereby the current may be reversed to effect a release of the materail from its receiving surfaces.

Lamps and Appurtenances:—

MANTLE OR HOOD FOR INCANDESCENT GAS LIGHTS. E. Nienstaedt, New York, 581,364. Filed March 12, 1897.
A compound for an incandescent mantle including nitrate of rhodium, nitrate of bismuth and boric acid.

REVOLVING ELECTRIC HEADLIGHT. J. Kirby, Jr., Dayton, Ohio, 581,465. Filed February 2, 1897.
Adapted for trolley cars; details of construction.

Measurement:

REGISTERING MECHANISM. W. H. McFall, Philadelphia, Pa., 581,298. Filed February 6, 1897.
Comprises a counter, a rotating cam engaging with the gearing of the counter to actuate it, and a motor for rotating the cam.

GAS VOLTAMETER. H. A. Naber, London, Eng., 581,363. Filed March 30, 1896.
Details of construction.

Miscellaneous:—

ELECTRIC GAS LIGHTER. L. L. Borradaile, Philadelphia, Pa., 581,327. Filed December 23, 1896.
Of the pendant class.

PHOTOGRAPHIC APPARATUS. J. Dennis, Rochester, N. Y., 581,540. Filed January 16, 1897.
Apparatus for the production of radiographs.

PUZZLE. J. Nesbit, Newark, N. J., 581,678. Filed August 4, 1896.
Comprises a base-board, intersecting grooves in the board, a ball adapted to roll in the grooves, and a pivotally arranged magnet on the board.

VALVE GEAR. W. Engberg, St. Joseph, Mich., 581,577. Filed February 10, 1897.
Comprises an electric circuit containing two relays, an electro magnet for each relay and provided with an armature lever, two slidable bars adapted to be engaged and locked by the corresponding armature levers, the bars controlling the position of the valve and means for making alternate ground connections for the relays.

Railways and Appliances:—

ELECTRICAL CONNECTION. H. P. Brown, New York, 581,263. Filed February 2, 1895.
Plastic alloy rail bond.

TRACK CLEANER. W. M. Brown, Johnstown, Pa., 581,264. Filed July 18, 1896.
Comprises a set of magnets carried by the car and so arranged that any magnetic material on the track is removed by them.

UNDERGROUND TROLLEY CONDUIT. J. D. Griffen, New York, 581,281. Filed May 22, 1893.
Details of construction.

SUPPORT FOR ELECTRIC RAILWAY CONDUCTORS. E. D. Priest, Schenectady, N. Y., 581,368. Filed August 23, 1896.

RAIL BOND. H. S. Newton, Syracuse, N. Y., 581,562. Filed October 5, 1896.
Consists of a thin single piece or band of copper.

CONTROLLER FOR ELECTRIC CARS. S. W. Huff, Baltimore, Md., 581,557. Filed July 26, 1895.
Two relatively movable plane parts, a series of terminals to be connected, suitably spaced apart on one of the parts, and a corresponding series of bridging contacts carried by the other of the parts, each projecting into a space between two adjacent terminals and pressed against the opposed faces of the same.

Regulation:—

ELECTRIC MOTOR CONTROLLER. W. H. Chapman, Portland, Me., 581,658. Filed February 24, 1896.
For use on shunt wound power motors.

Switches, Cut-Outs, Etc.:—

MOUNTING THE FUSES. W. W. Dean, St. Louis, Mo., 581,455. Filed September 19, 1896.
Employs wrenches for manipulating the terminals and fuses.

MOUNTING FOR FUSES. W. W. Dean, St. Louis, Mo., 581,455. Filed September 19, 1896.
Similar to above.

ELECTRIC FUSE. W. E. Harrington, Philadelphia, Pa., 581,460. Filed October 29, 1895.
Comprises a central primary section, terminal sections of greater cross-section and masses of non-conducting material arranged to surround portions of each of the terminal sections without enclosing the central primary section.

Telegraphs:—

PRINTING TELEGRAPH. J. Burry, Long Island City, N. Y., 581,411. Filed June 27, 1896.
Comprises a shaft, a loose gear thereon; a spring fast at one end to the loose gear; a spring fast at one end to the shaft; friction devices connecting the springs; and intermittently acting means for turning the shaft to wind up the spring fast thereto.

Telephones:—

TELEPHONE INSTRUMENT. J. E. Keelyn, Chicago, Ill., 51,350. Filed January 5, 1897.
Receiver in which the magnets may be readily adjusted toward and from the diaphragm.

TELEPHONE RECEIVER. W. J. Morton, New York, 581,406. Filed May 15, 1895.
Embodies a soft iron diaphragm and one or more perforated diaphragms located between two magnetic poles.

SELECTIVE SIGNAL FOR TELEPHONE CIRCUITS. H. W. Mason, New Bedford, Mass., 581,561. Filed July 31, 1896.
Details of construction.

THE STOCK MARKET

THINGS QUIET AND DULL.

The effect of conditions in Europe has been to tangle up things here in uncertainty and to bring about a little lower range of prices, although firmness is a pronounced characteristic of all good securities. The resumption of the gold basis in Austria is likely to take away some $15,000,000 of the precious metal, but it can well be spared. The redundancy of gold is, in fact, but another sign of business inactivity. It will be interesting to see whether the usual burst of springtime hope and confidence makes itself felt to any degree. Railroad returns, and retail shopping reports indicate that people are beginning to spend more freely.

Western Union on sales of 41,251 shares is off to 76¼, chiefly on expectancy of a reduction in the dividend. General Electric is stagnant around 31 to 32, with only 1,825 shares sold last week. The report given out shows a smaller business but better status. American Bell went to 224.

COPPER.

The "Iron Age" reports the New York copper market as follows: It is believed that business of somewhat extensive volume has been effected at or very near to 11c. for Lake Superior Ingot and that contracts for other varieties of the metal have been taken at prices relatively as low, but particulars are guarded very closely. It is no secret, however, that offers have been made to sell at 11⅛c. for Lake Ingot, 10⅞c. to 11c. for Electrolytic and 10½c. to 10⅝c. for casting stock.

REPORTS OF COMPANIES

FIFTH ANNUAL REPORT OF THE GENERAL ELECTRIC CO.

ANTICIPATORY figures have already been given in The Electrical Engineer of the report of the General Electric Company. We are now able to give the reports of President Coffin and Second Vice-President Ord:

Mr. Coffin's report to the stockholders says: The business of your company has suffered during the past year, in common with that of all manufacturing enterprises, from the disturbed financial and political conditions which have prevailed during a considerable portion of the time. These conditions have curtailed the amount of capital ordinarily available for the establishment and extension of power and lighting plants, and have enforced the practice of great economy on the part of its customers. As a result, the shrinkage in orders received by your company was very marked, especially during the later half of the year. This shrinkage is not shown by a material falling off in shipments, as given in the Profit and Loss Statement of this report herewith, but the amount of work in progress and unfilled orders on hand is considerably less than a year ago.

Consolidated Balance Sheet of January 31, 1897.

ASSETS.			
Patents and Franchises			$8,000,000.00
Factory Plants			3,400,002.00
Real Estate (other than factory plants):			
Edison Building, New York City		$417,584.63	
Other Real Estate		230,431.61	648,016.24
Stocks and Bonds			8,540,795.68
Cash			703,483.84
Notes and Accounts Receivable		4,578,600.96	
Work in Progress		517,866.30	
		5,096,467.26	
Inventories:			
Factories	$3,375,511.07		
General and Local Offices	621,489.32		
Consignments	37,752.65	4,034,753.04	9,131,220.30
Profit and Loss			12,957,413.40
			$43,380,931.46

LIABILITIES.		
Capital Stock:		
Common	$30,460,000.00	
Preferred	4,252,000.00	$34,712,000.00
5% Gold Coupon Debentures		8,000,000.00
Accrued Interest on Debentures	66,666.65	
Accounts Payable	402,264.81	
Mortgage on Edison Building	200,000.00 *	668,931.46
		$43,380,931.46

*Paid off February 26, 1897.

With a return to normal commercial conditions, a corresponding revival in the business of your company may be expected. The volume of business secured by it for the first three months of the current year is slightly in excess of that for the same period in either of the three previous years.

On January 31, 1895, the sum of $2,000,000 was set aside, as shown in the Annual Report of that year, to provide for shrinkage in assets, exact values of which it was then extremely difficult to fix. During the past year your directors have been able to value these items with substantial accuracy, and the $2,000,000 fund has been found sufficient and has been used to provide for the proper adjustment of all accounts and other assets for which it was created.

BUSINESS OF THE YEAR.

Gross earnings	$12,820,395.87	
Less expenses	11,207,388.65	
		$1,613,007.22
Deduct.		
Interest on debentures*	431,250.00	
Less interest and discount, and interest and dividends received on securities owned	370,479.70	
		60,770.30
		1,552,236.92
Deduct amounts written off.		
Sundry losses and allowances for possible losses	318,531.13	
Patents	349,919.20	
Inventories and consignments	61,084.36	
	729,534.69	
Less.		
Profit on securities sold and debentures canceled	136,955.85	
		592,578.84
Reduction of the deficit of previous years		$959,658.08

Additional purchases of your company's debenture bonds have been made during the year to the amount of $750,000 leaving now outstanding $8,000,000. All debentures purchased have been canceled.

The decrease in the amount of interest and dividends received as compared with the previous year, is due largely to the cessation of dividends by the Canadian company, which it is hoped will soon resume dividends on its reduced capital. As a partial offset, there has been an increase in the income derived by your company from dividends on stocks held by it in various local companies.

In the last annual report attention was called to an arrangement which had then been concluded with the Westinghouse Electric and Manufacturing Company for an exchange of licenses under patents owned and controlled by the two companies. Your directors are pleased to report that the result of this arrangement has been highly satisfactory.

The result of the work of your company in protecting its patents and enjoining infringers thereof has been especially encouraging, and a considerable number of patents of value has been acquired by it during the year. The courts have invariably recognized the validity and controlling importance of the Van Depoele patents on the electric railway trolley and switch system, and at the present time substantially all manufacturers of infringing trolleys and switches are under injunction. The company has met with no reverses in its patent litigation during the past year. Many new suits have been brought, involving important patents, and are now being actively pushed.

Consolidated Profit and Loss Account of January 31, 1897.

EXPENSES.		
Balance January 31, 1896		$13,917,071.48
Cost of Goods Sold	$9,691,504.12	
General Expenses and Taxes	1,515,884.53	11,207,388.65
Interest on Debentures		431,250.00
Sundry Losses and Allowances for Losses	318,531.13	
Depreciation of Inventories	50,354.85	
" " Consignments	10,729.51	379,615.49
Patents and Patent Expenses		349,919.20
		$26,285,244.82

EARNINGS.		
Sales	$12,540,993.88	
Royalties and Sundry Profits	279,401.99	$12,820,395.87
Dividends and Interest received on Stocks and Bonds owned	282,143.69	
Interest and Discount	88,336.01	370,479.70
Profit on Sales of Stocks and Bonds	79,816.76	
Discount on Debentures Purchased and Cancelled	57,139.09	136,955.85
Balance January 31, 1897		12,957,413.40
		$26,285,244.82

E. & O. E.

J. P. ORD, *Second Vice-President.*

The great improvements made by your company during the past year in the design and construction of its apparatus have been very satisfactory. The development in long-distance transmission of electricity and the progress made in electric railway service have been especially noteworthy. Many new enterprises, involving the application of electricity to railways now operated by steam, are under consideration, and the ensuing year promises to be marked by a very rapid growth in that field of work.

Your company has added one large factory of brick and steel construction to its plant in Schenectady during the year, besides completing and occupying another, which was commenced in 1895. Other important improvements at these works are in preparation, designed to add to the facility and economy of handling their output.

The report of Mr. Ord to President Coffin is as follows: The balance sheet and statement of profit and loss, herewith transmitted, include the assets and liabilities and profit and loss accounts of the Edison General Electric, Edison Electric Light, and Thomson-Houston Electric Companies (which, for convenience of bookkeeping, are consolidated with those of the General Electric Company) at January 31, 1897; and when "the company" is spoken of, all the above mentioned corporations are included.

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*On $8,750,000 for ten months and on $8,000,000 for two months.

I submit explanations of what each item on the balance sheet represents.

ASSETS.

Patents and Franchises.—During the year there was expended for acquiring new patents and patent litigation, $349,919.20, all of which has been written off to profit and loss; leaving the patents franchises, good will, etc., of the company standing unchanged at $8,000,000.

Factory Plants.—This account represents the real estate (lands and buildings); machinery, tools, appliances, etc.; patterns, drawings, etc.; and sundries (fittings and other small property accounts) of the factories at Schenectady, N. Y.; Lynn, Mass., and Harrison, N. J. The lands amount to over 72 acres and the total factory floor space of all buildings is approximately 1,416,000 square feet. All are free from mortgage or other lien. These plants being a permanent investment, all expenditures for their maintenance and repair, plus an allowance to provide against depreciation, are charged to operating expenses. Their book value at the date of the last annual report was $3,468,002.00. The amount written off during the fiscal year for depreciation, over and above the total cost of all maintenance, repairs and additions, was $68,000.00—leaving the book value of factory plants at January 31, 1897, $3,400,002.00.

A summary of the changes in this account during the past year is as follows:

	Book Value Jan. 31, 1896.	Cost of additions.	Written off for depreciation.	Book Value Jan. 31, 1897.
Real estate,	$1,800,000.00	$92,092.45	97,092.45	$1,795,000.00
Machinery,	1,668,000.00	205,321.90	268,321.90	1,605,000.00
Patterns,	1.00	47,794.34	47,794.34	1.00
Sundries,	1.00	34,361.68	34.361.68	1.00
Totals,	$3,468,002.00	$379,570.37	$447,570.37	$3,400,002.00

Book Value of Each Plant.	Jan. 31, 1896.	Jan. 31, 1897.
Schenectady factory	$2,135,000.90	$2,157,000.90
Lynn factory	1,038,000.80	993,000.80
Harrison factory	295,000.30	250,000.30
Totals	$3,468,002.00	$3,400.002.00

Real Estate. (Other Than Factory Plants.)—This account represents the investment in the Edison Building, 44 Broad street, New York City, also a large building covering five lots on the corner of Avenue B and Seventeenth street, New York City, and sundry parcels of land in various places, mostly improved and rented, which have been acquired at various times, chiefly in payment of debts. All will be sold when opportunity offers.

Stocks and Bonds.—Schedule A. annexed hereto contains a list of nearly all the company's stocks and bonds which are carried at more than merely nominal values[1].

Those having a market value are carried at slightly under the price of recent sales. The book value of those not readily salable has been fixed after careful examination of their present worth.

I believe their actual present value is equal to the aggregate at which they stand in the balance sheet, viz.: $8,545,660.68. In addition, the company owns various miscellaneous securities of many manufacturing, selling and patent owning corporations, and also of street railway and lighting companies. As the present value of these is doubtful and their future value speculative, they are carried at one dollar for each lot, making in all $135.00. Total book value of all stocks and bonds, $8,545,795.68. The book value of stocks and bonds in the last annual report was $5,479,332.23. Increase, $3,066,463.45.

Although some securities have been purchased for cash, most of those acquired during the year have been accepted in payment of old indebtedness.

The principle items of the above increase are:	Par value.
Edison Electric Company of New Orleans.	
Received in exchange for the claim against the receivers of the Fort Wayne Electric Company, and for cash advanced to the Edison Electric Co. to purchase the Louisiana Electric Light Co. and build a large new central light and power station	
First mortgage bonds	$ 891,000.00
Preferred stock	1,980,000.00
Common stock	1,000,000.00
Baltimore & Ohio Railroad Co.'s receivers' certificates, received in payment of balance due for electric plant and electric locomotives for its tunnel under the city of Baltimore	323,000.00
Bonds of the city of Jacksonville, Fla., received in part payment of a lighting plant	58,000.00
Sacramento Electric Power & Light Co., received in part payment of a contract	44,000.00
Bonds of the Brush Electric Co. (the entire issue outstanding) received in payment of notes and purchased for cash	369,000.00
Bonds of the Columbus R. R. Co., Columbus, Ga., received in payment of claim against Brush E. L. & P. Co., of Columbus	50,000.00
Preferred stock of the United Electric Securities Co. bought for cash	74,200.00
Bonds of the Citizens' General Electric Co. of Louisville, Ky., purchased	94,000.00
Bonds of the Tacoma Ry. & Motor Co. purchased under old contracts with the United Electric Securities Co.	231,000.00
Bonds of the Augusta Ry. & Electric Co. received in exchange for claims against Thomson-Houston Electric Co. of Augusta, Ga.	41,000.00
Stocks and bonds received from licensees in payment of royalties	119,750.00
	$5,274,950.00

Sales of Stocks and Bonds.—The past year has not been favorable to the established policy of selling securities which there is no special reason for holding permanently, and but few have been sold since the last annual report.

Securities whose par was $326,115, were sold for	$285,829.56
They were carried on the books at	206,012.80
Profit	$79,816.76

The cash thus received was used toward the purchase of securities mentioned on the preceding page.

CASH.

The policy of the previous two years has been adhered to and sales maintained on a basis of cash or short credit to desirable customers. It has not been necessary to borrow money, nor has the company's credit been used during the year either by issuing notes, indorsing customers' paper for discount or lending its name in any way. During the year all purchases have been paid for in cash. None of the money realized from the sale of assets was required for the current business of the company during the year.

Notes and Accounts Receivable.—These accounts represent the total amount now due the company by customers. They appear in the balance sheet at an estimated realizable value (i. e., their face, less allowance for possible losses) which I believe to be a fair one. They may be classified approximately as follows:

	Face value.		
Current notes	$1,196,715.81		
Current accounts	2,901,773.96		
		$4,098,489.77	
Slow notes	766,974.05		
Slow accounts	207,188.16		
		974,162.21	
			$5,072,651.98
Due from local lighting and street railway properties owned by the company			217,700.92
Due from the Brush Electric Company			194,516.85
Total face value*			$5,484,869.75

Collection of the old indebtedness remaining from previous years has been as satisfactory as was possible under the financial conditions of the year.

Work in Progress.—This account does not include anything in process of manufacture; but represents expenditures for labor, material, etc., on 194 installations of manufactured apparatus delivered at various places $900,807.52

Less partial payments thereon, received under the terms of the contracts as work progressed 382,941.22

Balance $517,866.30

None of the estimated profit to be derived from these installations is included in the earnings of the year, and no allowance is made thereon for possible loss.

Inventories.—These accounts represent raw materials and goods manufactured and in process of manufacture at the factories; manufactured goods in storerooms of local offices and on consignment; office furniture, fixtures, instruments, etc., in the general office and in local offices; tools and materials in local repair shops; and also shipments in transit to local storerooms. All have been counted and valued item by item. Raw materials have been valued at the market prices prevailing on January 31, 1897; active selling finished and partly finished apparatus and supplies at factory cost; inactive or slow selling apparatus and supplies at about 50 per cent. of factory cost; obsolete apparatus and supplies at scrap value; and tools, instruments, furniture, etc., at present value. The inventories of the factories showed an excess over book value of $141,184.98, which is not taken as a part of the year's profit, but is retained as a reserve. All other inventories showed a shrinkage from book value of $50,354.85, which has been written off as a loss for the year. As goods are taken in and out of local office inventories at factory cost, at the time being, the bulk of the above shrinkage is due to factory costs at January 31, 1897, being lower than at January 31, 1896; and the remainder to writing down the book value of slow selling apparatus and other personal property.

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[1] The schedules show some 71 lots of stocks and 79 lots of bonds of a total par value of $15,427,259. Eds. E. E.

*In addition, there are old notes and accounts receivable of 435 debtors aggregating $2,644,547.59 which have all been written off to Profit and Loss except the nominal book value of one dollar for each debtor. They are being liquidated as rapidly as possible.

Consignments.—Finished apparatus for novel uses has been delivered to various concerns, subject to purchase if its operation is successful. The greater part of this account represents such contingent sales, and the remainder represents apparatus on exhibition, or loaned to regular customers for temporary use by them.

All the above apparatus is charged, at factory cost, to this account at a total of	$73,729.80
Less allowance for depreciation	35,977.15
Net book value of Consignments	$37,752.65

Liabilities.—The company has no notes payable, nor is any paper bearing the company's endorsement of guaranty under discount.

Debentures.—During the year the company has purchased and canceled $750,000 of its own debentures at an average cost of 92.38 per cent.

Accrued Interest on Debentures.—This account, as its name implies, is the full amount of interest accrued to January 31, 1897, on the company's $8,000,000 outstanding five per cent. gold coupon debentures.

Accounts Payable.—This account includes all unpaid audited indebtedness. At the close of business on January 31, 1897, the unpaid vouchers on hand amounted to only $40,155.32, and none of these was due under the terms of purchase. The difference between that amount and the amount of accounts payable shown in the balance sheet, $402,264.81, represents expenditures belonging to the year, vouchered between January 31 and February 23, the date of closing the general books. The amount of vouchers which have to be carried over in this way monthly, owing to keeping the books—other than the cash book—open a sufficient time to include expenditures of a particular month in that month, is usually about $500,000.

Mortgage on Edison Building.—A mortgage, created when the company's building, No. 44 Broad street, New York City, was erected. It was paid off in full February 26, 1897.

LEGAL NOTES

TROLLEY GRADE CROSSING ENJOINED IN PENNSYLVANIA.

An important decision relating to electric and other railway companies has been handed down by Justice Dean, in Philadelphia, in the case of the Delaware and Hudson Canal Company against the Scranton and Pittston Traction Company. The Canal Company operates, as lessees, a steam railroad between the cities of Scranton and Wilkesbarre, on which about 135 freight trains are run every day.

The Lackawanna Street Railway Company, incorporated under the act of March 14, 1889, was authorized by its charter to build and operate an electric railway from a point on Center street, at the Scranton city line, over a certain route along streets and main road to the village of Moosic and to the borough of Avoca and return. This route crossed the canal company's steam road at two points at grade. This the canal company objected to and applied for an injunction against the Scranton and Pittston Traction Company, which had contracted with the electric railway company to build the road, to restrain them from constructing their grade crossings. The matter was taken to the Common Pleas Court of Lackawanna county, which finally enjoined the making of a grade crossing at Spring street, but allowed it at Wyoming avenue, in Moosic.

An appeal was taken to the Superior Court by the Canal Company, and that court sustained the judgment of the Common Pleas Court, two judges dissenting. Appeals were then taken to the Supreme Court, and it is these appeals which have just been decided.

"The reasonably practicable," says Justice Dean, "is not to be determined by want of corporate power to invade the rights of the property owner. The construction of the crossing is what the statute expressly says shall be regulated by the courts, and this with a view to avoid danger and protect the older franchise from injury by the younger one. The act of 1889 gives the right to cross at grade, but then we are met by the act of 1871, which says the court shall, by its process, prevent it, if an overhead crossing be reasonably practicable. This leaves only for the court the physical problem to be solved, by the influence warranted from the character of the two roads, the business done upon them, the topography of the territory, and like facts." * * * "If the act of 1889 does not confer upon electric railway companies those full powers necessary to their construction and corporate prosperity, the Legislature is the body to which application should be made for more extensive grants. And we may further say that after ample time for the most thorough consideration, we are determined to unflinchingly adhere to the rule announced in Perry County Railroad vs. Newport Railroad, 150 Pa. 193; Pa. R. R. Co. vs. Braddock R. R. Co., 152 Pa. 116, and subsequent cases."

The decree of the lower courts allowing the grade crossing was reversed and the injunction restraining its construction was granted.

RESPONSIBILITY FOR THE BOSTON SUBWAY DISASTER.

The report of Judge Ely of the Municipal Court, Boston, upon the inquest into the death of William A. Stuart, one of the victims of the gas explosion in the subway excavation in that city March 4, has been filed with the District Attorney. Judge Ely finds that Stuart's death was due to the unlawful act of the Boston Gas Light Company, and that the gas light company is mainly to blame for the explosion. It was, he finds, guilty of gross carelessness and negligence.

He further finds, however, that the Metropolitan Construction Company and the Transit Commission were not without fault, in that they, as well as the gas light company, were negligent in not providing inspectors and watchmen to oversee the operations attending the building of the subway under Tremont street, at or about the point where the explosion occurred.

RULES AS TO DELIVERY OF A TELEGRAM.

A rule not to deliver messages outside of a half-mile limit is held, in Western Union vs. Robinson (Tenn.) 34 L. R. A. 431, insufficient to excuse a delay in delivering message sent to a small town a few miles away, summoning a minister of the gospel to a person near death, when the rule was not known to the sender and was not mentioned by the agent who received the message about dark, stating that it could be delivered that night.

VALUE OF A SUBWAY GRANT.

A municipal grant to a corporation of the right to lay subways for electric wires under all the city streets, without reserving the power of supervision and control, not only of the work of excavating in the streets, but of all matters incident to its location, construction, maintenance and use, is held, in State, ex rel. St. Louis Under Ground Service Company vs. Murphy (Mo.) 34 L. R. A. 369, to be beyond the power of the city, although the sole purpose of the subway may be that of leasing to public wire-using corporations.

KEEPING INSULATION PERFECT.

The utmost care to keep the insulation of dangerous electric wires perfect at places where people have a right to go for work, business or pleasure is held necessary in McLaughlin vs. Louisville Electric Light Company (Ky.) 34 L. R. A., 812, although at other places very great care may be deemed sufficient. And the fact that the insulation of wires is very expensive or inconvenient is no excuse for failure to make it perfect at points where people have a right to go for work, business or pleasure.

TRADE NOTES & NOVELTIES

THE CASHIER'S ELECTRIC SAFETY CABINET.

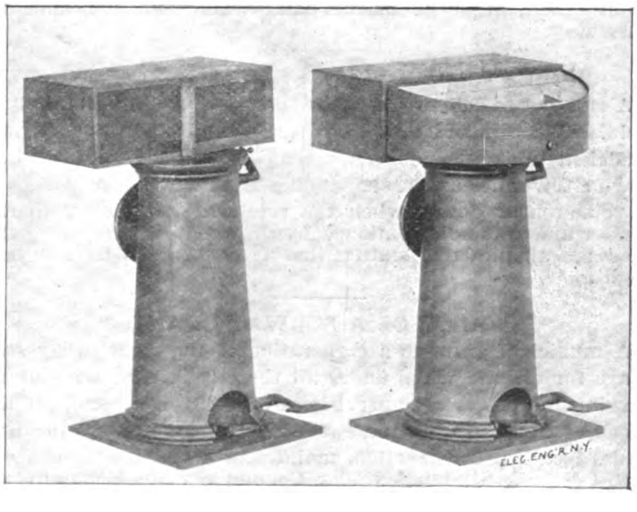
EVERY reader of the newspapers is familiar with the almost daily publication of some bank or business house that has been raided, and from a few hundred to several thousands of dollars extracted therefrom, and in many instances, the faithful cashier or proprietor has surrendered his life in the vain attempt to protect the funds.

To prevent such thefts the device illustrated in the accompanying engravings and known as the cashier's electric safety cabinet, has been constructed. The operation of this machine is both mechanical and electrical; mechanical, during the routine of business; electrical, when the dash is made by robbers upon the bank or business house.

With this cabinet in use, the funds, which have hitherto been placed in drawers and on top of counters, offering a tempting bait for robbers and sneak thieves, will be all placed inside the cash receptacle, which receptacle is always locked by the service mechanism, except when the cashier desires access into the receptacle in the ordinary course of business; by a quick and very convenient manipulation by the foot, the cabinet opens and remains open just so long as the cashier requires it, and at the instant it no longer needs to remain open the cabinet automatically closes and locks by the day locker, and remains locked until necessary to open again.

In the event of a raid, notwithstanding the fact the cabinet is locked by the service mechanism, to place the cabinet and its contents absolutely beyond all power to open, wires are stretched from the base of the cabinet to all points of the bank or business house, with push buttons at every desk in the bank, and all along the inside of the counters of business houses.

When the rush is made by the raiders, and the command is given "Hands up," instantly every hand goes up, and by an employé moving a foot a few inches and touching the push button, the electric current instantly operates the emergency mechanism which locks the machine absolutely. It is then impossible for the burglar to open the machine; neither can he compel any one else to open it, for it cannot be opened until an instrumentality, remote from the bank or business house, is applied. At the instant of the emergency locking, in case of a raid, the electric attachment also disengages and starts ringing a large gong, the sound of which can be heard a long distance, calling help from every direction. Thus it is readily seen that, with the emergency lock in force, rendering the cabinet absolutely closed, the gong sounding, the raider is not going to tarry very long.



Cashier's Safety Drawer.

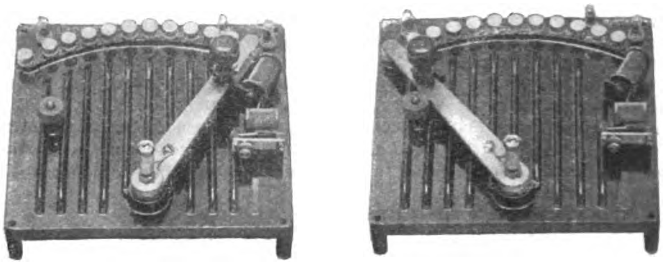
Mr. P. F. King, the well-known inventor of the famous screw door bank safes, that have never been opened by burglars, is the inventor of this cabinet, which, from the knowledge and ingenuity of the inventor, of the needs of the hour, ought to render it an exceedingly valuable and necessary device.

The machine is made in three sizes, weighing from 400 to 700 pounds, and is built by the Cashier's Electric Safety Cabinet Company, of Cleveland, O.

THE WARD LEONARD "D A" MOTOR RHEOSTAT.

THE accompanying engravings represent the latest form of motor rheostat built by the Ward-Leonard Electric Company, of Hoboken, N. J., and patented to Mr. H. Ward Leonard.

This device is known as the "D A," which stands for "double automatic," and in its construction but one lever is employed which is the rheostat contact lever. The rheostat has two controlling magnets. When the lever has been moved so that all the resistance has been gradually cut out and the contact lever stands in its final or short circuit position, it is held in this normal running position, against the action of a retractive spring, by a magnet which is connected directly across the terminals of the motor armature. The contact lever carries a keeper for this magnet, which keeper is brought into contact with the poles of the magnet when the contact lever has been moved to its final position. The holding magnet, it will be observed, is subjected under all normal conditions to a voltage which is the counter e. m. f. of the motor.



Figs. 1 and 2.—The Leonard "D A" Motor Rheostat.

If the supply e. m. f. fails, the counter e. m. f. of the motor rapidly falls and when the motor comes nearly to rest the magnetism of the holding magnet becomes so reduced that the spring which is constantly tending to move the contact lever so as to insert the rheostat resistance, overcomes the magnetic pull and moves the rheostat lever to its starting position, so that if the supply e. m. f. be again restored the motor armature will be protected against excessive current.

The circuit of this holding magnet passes through a contact normally kept closed by a spring. Attached to this spring is a keeper placed near the poles of a magnet whose winding is in series with the armature current. When the current through the motor armature, and hence through this magnet, exceeds a predetermined amount, the magnet attracts the keeper sufficiently to overcome the spring and hence causes the keeper to move toward the magnet poles. This opens the contact in the circuit of the holding magnet, which magnet consequently loses its magnetism and the rheostat contact arm is moved by its retracting spring to its starting position. Thus it will be seen that in case the supply e. m. f. becomes too low or the current through the motor becomes too large, the rheostat lever is automatically moved to its starting position, thus protecting the motor against any possible damage.

It will be observed that the current may fall to zero or reverse without causing the automatic release to operate so long as the current does not exceed the desired maximum. This feature is of vital importance in a rheostat used for an elevator motor or any other kind of motor, which, under certain conditions, temporarily performs as a generator or approximates to that condition.

This D. A. type of rheostat is applicable without any adjustment to any kind of continuous current motor of the horse power and voltage for which the rheostat is made.

In the illustrations, Fig. 1, shows the position of the rheostat when the motor is running full speed, and Fig. 2 with the resistance automatically inserted.

RECENT SALES BY THE WALKER CO,

The Walker Company, Cleveland, O., have recently closed the following contracts: Generators—C. C. Chandler, Chicago, one 100-kilowatt belted; J. C. Hubinger & Co., Keokuk, Ia., one 200-kilowatt belted; Northfoss & Sons, Wadena, Minn., one 75-kilowatt belted; Naugle, Holcomb & Co., Chicago, one 250-kilowatt direct connected, (for Suburban Railway, Chicago), one 400-kilowatt direct connected; Baltimore and Ohio Railroad Company, one 300-kilowatt booster; Foresters building, Toronto, five 50-kilowatt direct connected; Queens Insurance Company building, New York, one 100-kilowatt direct connected and one 50-kilowatt direct connected; Wendell & MacDuffie, New York City, one 75-kilowatt belted; Ludwig Baumann, New York City, two 75-kilowatt direct connected and one 30-kilowatt direct connected; Troy Gas Company, Troy, N. Y., two 150-kilowatt belted; Municipal Gas Company, Albany, N. Y., one 200-kilowatt belted; New York and Staten Island Railroad Company, one 800-kilowatt direct connected; Memphis Street Railway Company, Memphis, one 800-kilowatt direct connected; Columbia Electric Light & Railway Company, one 150-kilowatt belted; J. E. & A. L. Pennock, New York City, two 75-kilowatt direct connected; (for the new St. James building), one 50-kilowatt direct connected and one 25-kilowatt direct connected; Hon. J. W. Hinkley, Poughkeepsie, N. Y., one 50-kilowatt direct connected; Penn Yan, Keuka Park and Branchport Railway Company, two 150-kilowatt belted; Agency Walker Company, Paris, France, one 100-kilowatt belted and two 150-kilowatt belted; Bagnall & Hilles, Yokohama, Japan, two 100-kilowatt belted. In nearly all of the above cases the Walker Company have supplied the necessary switchboard apparatus. Motors and car equipment—C. C. Chandler, Chicago, Ill., four No. 4A double equipments (8 motors); Naugle, Holcomb & Co., Chicago, fourteen No. 10 double equipments (28 motors); North Side Street Railway Company, one No. 3 double equipment (2 motors); D. M. Robbins, Minneapolis, Minn., one No. 5 double equipments (2 motors); Agency Walker Company, Paris, five No. 3 double equipments (10 motors); eighteen single No. 3 equipments (18 motors); twenty-one No. 4A double equipments (42 motors); Bagnall & Hilles, Yokohama, Japan, twelve No. 3 single equipments (12 motors).

G. E. SMALL DIRECT COUPLED ENGINES AND GENERATORS.

THE demand for small direct coupled engines and generators for marine plants meeting the necessary requirements of compactness, light weight, simplicity of construction, freedom from vibration and noise at high speed and perfect regulation as well as durability and low cost, is met by the direct coupled generating sets manufactured by the General Electric Company, of Schenectady.

These sets are built in sizes varying from 2½ kilowatt to 25 kilowatt, and the fact that both engines and generators are manufactured by one concern is an assurance that the fit and alignment are perfect, the finish uniform and the test thorough.

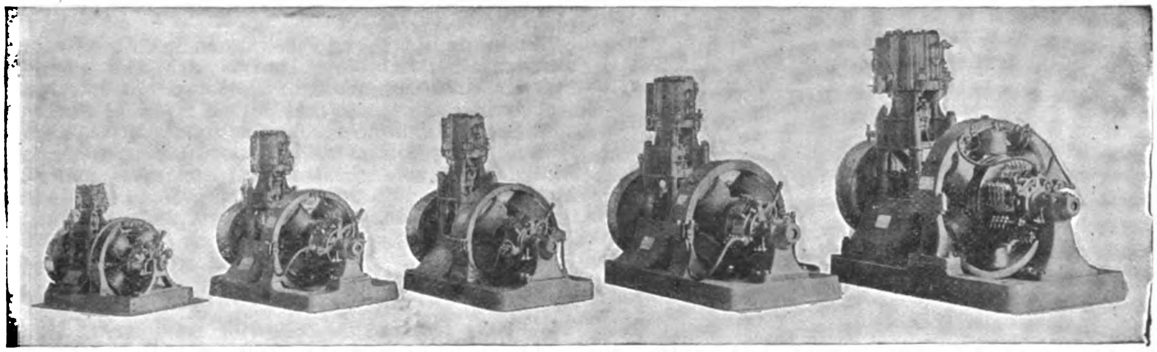
The engine is simple; it has but one valve drive direct from the eccentric pin of the governor. The set is compact; the engine having a short stroke and the armatures being specially wound, both height and length of the sets is reduced to a minimum. The engine bed is lengthened carries the generator, and although the appearance is somewhat massive, the bed is so carefully cored out that without sacrifice of stability the weight has been brought down to about one pound to 3½ watts.

Special attention has been given to the engine parts, to the end that the machine may run with perfect smoothness and regularity. The bearings are self-aligning and self-oiling. The coupling between the armature shaft and engine crank is a split sleeve, which allows of easy removal of the armature. The governor is compact with but few moving parts, which can give practically no trouble or wear out. The 4 kilowatt, 8 kilowatt and 20 kilowatt sets have double cylinder engines; the 2½ kilowatt, 7 kilowatt, 10 kilowatt, 15 kilowatt and 25 kilowatt have single cylinder engines.

All of the generators are four-pole 110 volt machines with the exception of the 25 kilowatt generator which has six poles and a full load voltage of 125 volts. The greatest floor space occupied is 30 in. x 47 x 68 in. high. The generators combine all the well known features of the General Electric machines, and the rating given to each has been calculated on a most conservative basis. Our illustration shows a full line of single cylinder sets—2½ kilowatts, 7 kilowatts, 10 kilowatts, 15 kilowatts and 25 kilowatts.

That the single cylinder engines are economical is exemplified by the fact that they show as low as 28 pounds of water per indicated horse-power hour non-condensing, and 23.5 pounds per indicated horse-power hour condensing, using steam at an initial pressure of 80 pounds just as it comes from its boiler without superheating or making any allowances for entrainment. These results have been reached by a series of tests in which the water has been accurately measured.

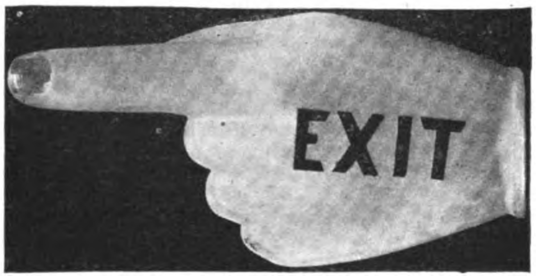
Sets below 10 kilowatt capacity are of course somewhat less efficient, but they compare favorably with engines representing the best practice.



G. E. SMALL MARINE GENERATING UNITS.

THE "GLAD HAND."

THIS is the appropriate designation which has been given to the excellent specialty, the Davis indicating globes, just brought out by the Phoenix Glass Company, of 42 Murray street, New York. Its object is so apparent that it scarcely requires explanation. The hand is 11 inches long and is designed to slip over an incandescent lamp, thus making a most effective guide in hotels, theatres and public buildings generally. These globes are made in opal, ruby or flesh tints with clear letters, showing words such as "fire escape," "stairs," "office," "elevator," etc. There ought to be a big demand for this fetching—or rather, pointing—device.



THE GLAD HAND.

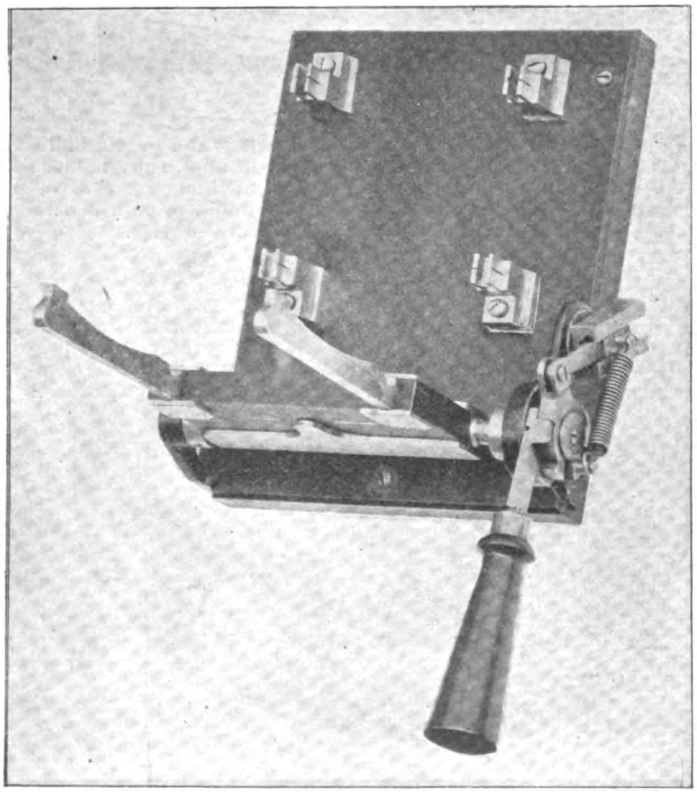
"THE TOOL CATALOGUE."

IF one were asked for a manual, dictionary and encyclopædia of modern American tool practice, the very best answer would be found in the opinion of a great many people, in the magnificent publication of Montgomery & Company, 105 Fulton street, New York City, called "The Tool Catalogue." As a matter of fact it is a fitting companion to Appleton's Cylopædia of Modern Machinery, doing for tools what that standard work has done for machines; and presenting the state of the tool art with a fullness, clearness and accuracy that is little short of marvelous. The book is 10½ in. x 7½ in., has 710 pages, and contains over 3,000 illustrations. An admirable method has been adopted to make this book universally available by those interested. In linen cover it is sent on receipt of 35 cents, and in a handsome cloth binding, in a box, express paid, on receipt of one dollar. This charge is refunded on the first purchase amounting to over $10 and a discount sheet is sent with each book. To specify even the carefully descriptive data and tables in this book is impossible, but it may suffice to say that there is no tool necessary in the electrical factory or repair shop that is not listed and illustrated in detail, and that there are innumerable things given that are needed in electrical line construction, pipe work, cable laying, and interior installation in general. Montgomery & Company enjoy already a good electrical trade, and the possession of this wonderful book—a perfect mine of information—will certainly tend to the more economical management of electrical work of all kinds, by the persons who deal with them.

AN INSTANTANEOUS "MAKE AND BREAK" SAFETY KNIFE SWITCH.

THE Hope Electrical Appliance Company, of Providence, R. I., has just put on the market a very ingenious double pole knife switch, which is claimed to be the only instantaneous "make and break" knife switch now on the market,—a claim conceded by prominent electricians and insurance inspectors who have made most careful examination of it.

We illustrate in the accompanying engraving a style adapted to 500 volt circuits, which has a rated carrying capacity of 50 amperes. The mechanism moving the switch consists of a link motion operated by a handle, which puts in tension a coiled steel spring connected to the axis on which the blades revolve. As soon as the spring is brought to the maximum tension, the slightest further movement of the handle starts the blades, and they are immediately thrown open. The same operation in a reverse direction instantly closes the switch. The action is positive and all four contacts are broken at exactly the same time. This is a very important feature. When the switch is in a normal position, either open or closed, the spring is under no tension whatever. If by any chance it should become broken it does not destroy the quick make and break action.



AN INSTANTANEOUS "MAKE AND BREAK" SAFETY KNIFE SWITCH.

The wearing parts are of drop forged steel having a machine finish. The blades, which are securely riveted to a block of fibre, are of the highest grade of rolled Lake Superior copper and the contact edges are carefully milled to size. The same metal is put in the brushes, which are of ample size to provide sufficient carrying capacity. Brass composition of the highest conductivity is used in the construction of the posts that have milled slots into which the brushes are securely wedged and riveted.

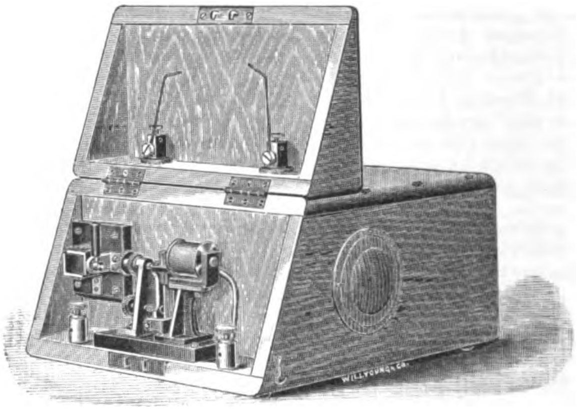
The switch is made with the utmost care in order to secure an easy working of the parts and special attention is given to the accurate alignment of the blades and brushes. Since the switch is operated only by the action of the handle, it can be set in a sufficiently high position to prevent injury or an accidental short circuit of the blades and they can never be thrown out of line by careless handling. The position of the handle at the lower corner of the switch eliminates any danger to the operator, which is especially desirable on high voltage circuits.

The Hope Electric Appliance Company has given special attention to standardizing all the parts so that any becoming broken can be easily replaced. The switch is mounted on a marbelized slate base, and with the high polish presents a very pleasing and attractive appearance. It is made in sizes to carry 25, 50, 75 or 100 amperes for circuits of any voltage.

THE "W-S" PORTABLE INDUCTION COIL FOR X-RAY WORK.

WE illustrate in the accompanying engraving a portable X-ray induction coil recently devised by Messrs. Willyoung & Co., of Philadelphia. The advantage of this coil consists in the fact that it can readily be carried from place to place, being constructed specially for such service.

This coil, as well as all other forms now made by Messrs. Willyoung & Co., is equipped with the new "Ideal" automatic interrupter, reversing switch, and adjustable discharge points, as shown. The entire instrument is mounted in a portable oak case with outside dimensions 14 x 12 x 6½ inches, weighing less than 25 pounds. It is provided with lock and key and heavy metal handle. The spark length of this coil is from four and one-half to five inches, and such discharge can readily be obtained from two cells of storage battery. With such combination and a Bowdoin focus tube of proper exhaustion, practically any X-ray work at present possible can be accomplished.



THE "W. S." PORTABLE X-RAY COIL.

The outfit is especially recommended for "bedside" service and traveling exhibitors, but is also well adapted to office practice. An equipment of this sort, but of larger size, has just been ordered by the Marine Hospital Service to be included in the exhibit which it will make at the Tennessee Centennial Exposition. Mr. James G. Biddle, 910 Drexel building, Philadelphia, sole agent for all apparatus manufactured by Messrs. Willyoung & Co., will be glad to supply further particulars in regard to the "W-S" Portable Induction Coil or other X-ray specialties of the same class.

PEERLESS RUBBER MFG. CO.

We have received the following from Mr. C. H. Dale, president and general manager of the Peerless Rubber Manufacturing Company of 18 Warren street, New York:

Discharged and ex-employés of this company are making false claims as to the founding of this company and the manufacture of its goods. For the benefit of the public we will say that this company was founded in the year 1872 by Charles Foster, Jr., and Henry S. Winans, who associated with themselves as superintendent Mr. John H. Deming, who has had entire charge of the manufacturing department. Mr. Deming has been with this company continuously since 1872, and is at present our general superintendent. He has had thirty-four years' continuous experience in the manufacture of fine mechanical rubber goods. This long experience places Mr. Deming in the front rank of manufacturers. We believe him to be without a peer.

Rainbow packing was suggested by a prominent merchant to C. H. Dale, then general sales agent, and with all other goods made by this company was introduced to the trade solely by Mr. Dale; and Mr. John H. Deming is the only man who has ever manufactured Rainbow packing, and is the only man who knows how. We would also say that Mr. Deming is the only superintendent this company has employed, or had in its employ as superintendent, since it was founded in 1872. All other claims are false.

CARD GENERATOR AND MOTOR INSTALLATIONS.

The Cleveland Ship-Building Company have awarded contract to the Card Electric Company, of Mansfield, O., for the entire electrical equipment for their new ship-building yards and establishment, which will be located at Lorain, O. The electrical apparatus covered in this contract calls for the following: One 100-kilowatt 240-volt direct-connected generator, at speed of 250 r. p. m.; one 40-kilowatt 240-volt belted generator, and twenty-six motors, varying in size from 2 up to and including 40 horse power. These motors are to be used in various sections or departments of their works, for driving machinery of different kinds. In this equipment of motors there will be two of 30 horse-power capacity, to be used for operating two large bending rolls, etc., the total equipment aggregating 500 horse-power. The Card Company say that there are only two electrical manufacturers in the United States besides them that were in position to manufacture and furnish all of the apparatus called for in their specifications, owing to the design and various sized motors which could be adapted for their special use. This is said to be the largest contract of the kind that has been let by one corporation in a long time.

In addition to the above recent orders have been received by the Card Company for the following: One 30-kilowatt direct-connected generator to Thos. McGraw, to be installed in McGraw building, Detroit, Mich.; one 50-kilowatt direct-connected generator, Mechanical Rubber Company, Cleveland, O.; two 10-horse-power motors, with automatic controller for operating elevators, to the Edmonds Elevator Company, Cleveland, O.; one 100-kilowatt direct-connected generator to the Ohio and Pennsylvania Coal Company, Salineville, O.; one 10-horse-power motor to M. A. Bradley, Cleveland. O.; two 10-horse-power motors to Wolverine Manufacturing Company, Detroit, Mich.; one 100-kilowatt belt-driven generator, Monongah Coal and Coke Company, Monongah, W. Va.; one 65-kilowatt belt-driven generator, Jeffrey Manufacturing Company, Columbus, O.; three 25-horse-power motors to H. J. Heinz Co., Allegheny, Pa.; one 11-kilowatt belt-driven generator, Union City (Tenn.) Ice Company, Union City; one 50-kilowatt belt-driven generator and switchboard, Wm. Metcalf, Pittsburg, Pa.; one 20-horse-power motor, Mansfield (O.) News; one 25-kilowatt belt-driven generator, Oak Ridge Hotel, Green Springs, O.; one 10-horse-power motor, Stewart, Howe & May, Cleveland, O.; two 100-kilowatt belt-driven generators, one 67-horse-power and two 30-horse-power motors, to the Raton Coal and Coke Company, Raton, New Mexico.

NEW YORK OFFICES OF THE WALKER CO.

The general sales office of the Walker Company, formerly at 253 Broadway, will be located in the new building on the northwest corner of Wall and Nassau streets, New York City, after May 1, 1897. The Walker Company have taken a whole floor in this new building. Increased business has necessitated these large and more centrally located quarters. The Walker Company are to be congratulated for their enterprise which is indicated by this change of location, and for the success which has rendered an increase of accommodations unavoidable.

POPULARITY OF THE "STANDARD" AIR BRAKES FOR STREET CARS.

The Standard Air-Brakes Company closed contracts with the Dighton, Somerset and Swansea Street Railway Company, of Taunton, Mass., the Commonwealth Street Railway Company, of Boston, Mass., and through their foreign agents, for air-brakes for the continent. The company is also supplying to the Pennsylvania State College, Department of Electrical Engineering, for use on its experimental line, which has been built to teach the students practically, a complete working outfit showing the operation of the "Standard" system.

We quote the following from "The Morning Herald" of February 19, 1897, Sydney, N. S. W.: "A trial departmental trip was made over the tramway extension recently completed, to the waters of Mosmann's Bay, yesterday morning. It was in every way a success. One of the new motor cars left the sheds at Ridge street shortly after 9 a. m., and was taken over the whole route, going up and down the hill from the bay two or three times, everything working smoothly. A second car made a similar trip in the afternoon with great success. The motor cars are of an improved pattern and much more powerful than those at present in use. The cars are fitted with air-brakes (provided with pressure gauges) from the works of the Standard Air-Brake Company of New York." This tramway was opened for traffic on the 1st of March. The grades on this route rise as high as 7.69 per cent.

ADVERTISERS' HINTS

MESSRS. H. B. COHO & COMPANY, the New York agents for the Eddy Electric Manufacturing Company, have removed their office to the St. Paul Building, 220 Broadway, New York, where they will be glad to see their friends.

THE OHIO STORAGE BATTERY COMPANY, 59 Wade Building, Cleveland, Ohio, make a battery for horseless carriage service. They are represented in New York by Machado & Roller, 203 Broadway, New York.

FELTEN & GUILLEAUME, Carlswerk, Mulheim on Rhine, Germany, manufacture single, concentric and biconcentric electric light cables of any section for both alternating and direct currents up to the highest tensions.

BROWNLEE & COMPANY, Detroit, Mich., make some very practical remarks on the selection of poles. The stock they carry embraces poles of every size as well as cross arms.

KEYSTONE ELECTRICAL INSTRUMENT COMPANY are advertising their polarity indicator and detector galvanometer which indicates the polarity of light and power mains on two or three-wire circuits, and also polarity of dynamos and batteries. The price is $2.50, and further information may be obtained by addressing them at Ninth street and Montgomery avenue, Philadelphia.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, say universal commendation is the result of presenting to a large number of engineers the "Universal" enamel rheostat. They claim for it all the good points.

THE RIKER ELECTRIC MOTOR COMPANY, 45 York street, Brooklyn, N. Y., have brought out a fan motor which takes but ¼ ampere at 110 volts on full speed. It is of the iron clad type and presents a very neat appearance.

PETEREIT-WEHRLE MANUFACTURING COMPANY, manufacturers of novelties in brass turning, screws, cocks, gas and electric fittings, have removed to 140 Sullivan street, near West Houston street, New York.

MR. H. B. COX, of the Cox Thermo Electric Company, is now in this city with a view to establishing an American agency for the sale of the Cox thermo generators. Temporary quarters have been secured at 126 Liberty street, where machines are on exhibition and may be purchased.

L. T. WEISS, 286 Graham street, Brooklyn, N. Y., is advertising the Weiss drill case, which was recently described in our columns. It is arranged to show every drill it contains at a glance, is a perfect drill gauge in itself which can never be lost and tells what drill to use for any tap. A circular may be obtained giving full information.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., present some interesting figures for the consideration of central station managers.

THE HOPE ELECTRIC APPLIANCE COMPANY, Providence, R. I., are supplying make and break safety knife switches of all voltages. These switches have been approved by the National Board of Fire Underwriters.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, represent the Standard Paint Company and carry in stock a full line of the P. & B. specialties.

THE STANDARD UNDERGROUND CABLE COMPANY have removed their New York office to 18 Cortlandt street.

THE PACIFIC ELECTRIC COMPANY, La Crosse, Wis., are introducing a standard for incandescent lamps which should be cordially welcomed by readers. The lamp is placed in the top of the shade so that the full candle power is reflected on the page at the same time screening all direct rays from the eyes.

MONTGOMERY & COMPANY, 105 Fulton street, New York, have just issued a catalogue of tools containing 710 p.p. and over 3,000 illustrations. They say it may well be called an encyclopædia of tools, as it contains everything conceivable in that line.

THE MAGNOLIA METAL COMPANY, 267 West street, New York, the manufacturers of the world-famous "Magnolia" anti-friction metal, will send a 15-inch brass-edged rule to any engineer sending three cents in stamps and mentioning this paper.

THE PHOENIX GLASS COMPANY, Pittsburg and New York, are selling a style of globe which must prove very useful. It is made in the shape of an index hand to fit over an ordinary incandescent lamp, and in it is blown in red letters the name of the place indicated, as office, stairs, etc.

THE SCOTT & JANNEY ELECTRIC AND MANUFACTURING COMPANY, Filbert street, Philadelphia, are now ready to take contracts for long distance railways, from fifty to one hundred miles single or double track, which they will operate from one power station by their single-phase alternating current railway apparatus.

NEW YORK NOTES.

MR. ELMER P. MORRIS is now comfortably settled in his new quarters at 15 Cortlandt street, and is having remarkably good business in his specialties. Mr. Morris is paying particular attention at present to export business and has just sent a large consignment of Keystone instruments and Cutter circuit breakers to Mexico, besides having some nice orders for general electric lighting supplies for South America.

BI-METALLIC ELECTRIC TRANSMISSION COMPANY will on and after May 1 be located at 121 Liberty street, New York City, to which address all communications should be sent.

H. B. COHO & CO. have removed to new offices in the St. Paul building, Broadway, opposite postoffice, and have recently added to the list of machinery which they handle the Warren alternator and the Diamond transformer. Business in the old reliable Eddy motors and dynamos continues good.

JOHNSON & MORTON.—The business of Nightingale, Johnson & Co., electrical engineers and contractors, 26 and 28 Catherine street, Utica, N. Y., will after this date be carried on under the firm name of Johnson & Morton, Mr. Nightingale retiring from the business. The old firm has met with gratifying success in contracting work and also in the manufacturing of special junction boxes and switchboards, and the new firm will carry on the same work, making every endeavor to give entire satisfaction to customers. Added machinery has been placed in the shop so that the firm is now equipped to do a general electrical repairing business.

JAMES S. BARRON & COMPANY, Hudson and Duane streets, New York, are now comfortably settled in their new quarters. The offices of the Electrical Department are on the second floor, where they will be glad to meet any of their friends and discuss business to mutual advantage. They make a specialty of Eclipse telephone booths and John Weldon's hand-made climbers.

WESTERN NOTES

THE CHICAGO INSULATED WIRE COMPANY have removed their offices from 153 Lake street, Chicago, to 152-154 Lake street, where their new premises are situated exactly opposite to the old quarters which they have just vacated.

MR. H. B. CROUSE, of the Crouse-Hinds Electric Company, Syracuse, N. Y., made a business trip to Chicago recently. Mr. Crouse states that his concern find business much improved, and are pushing the sale of their make of switches, switchboards, panel boards, the Syracuse changeable electric headlights, and other electrical specialties.

MR. J. R. CRAVATH, who for some time has served most creditably as the electrical editor of the "Street Railway Review," of Chicago, and is the very active secretary of the Chicago Electrical Association, has gone into business for himself to push his new recorder, which keeps tab on each motorman's consumption of current, and checks excessive use. His new headquarters will be Room 825 Monadnock Building, Chicago.

FOREST CITY ELECTRIC COMPANY, Cleveland, O., have issued a dainty and pithy brochure on rail bonding and the merits of their "protected rail bond," which consists of coils of flattened copper wire attached under the fish plates or angle irons.

THE ELECTRIC APPLIANCE COMPANY, Chicago, are introducing a new electrical soldering iron, which they are ready to guarantee is an electrical and commercial success. They have given it a very extensive test, and stand ready to guarantee the results.

MR. A. W. KILBOURNE has taken the general agency of the Ohio Storage Battery Company of Cleveland, and will have his headquarters at the Wade Building in that city.

SAN FRANCISCO, CAL.—Articles of incorporation of the John M. Klein Electrical Works have been filed with the County Clerk. The capital stock is $50,000, of which $2,700 has been subscribed by the following directors: John M. Klein, Charles W. Nevin, Harry A. Sayles, John T. Stone and John W. Felt.

NEWPORT, IND.—Mr. Wm. Rheuby, chairman of the Electric Light Committee, desires to communicate with responsible parties with a view to the installation of an electric light plant in the town of Newport, Ind.

BIDS WANTED BY ASTORIA, ORE.

The city of Astoria, Ore., is in the market for a 60-light arc plant, 2,000 candle-power lamps, to be run by the city's water plant.

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The Electrical Engineer.

Vol. XXIII. MAY 12, 1897. No. 471.

MECHANICAL

THE PRINCIPLES AND CONSTRUCTION OF WATER WHEELS.—I.[1]

BY W. E. WINES.

THE importance of the water wheel as a prime mover may be appreciated from a consideration of its extensive use at the present day and the almost unlimited water power awaiting development. In 1880 there was employed in the United States a total of about 3,500,000 horse power, of which approximately one-third was derived from water and two-thirds from steam. The application of electricity to long-distance power transmission, and the improvement in the design and efficiency of water wheels have no doubt, during the last sixteen years, greatly increased that proportion of the total power derived from water. A few plants in this country and abroad may be cited as examples. The Tivoli station which supplies the city of Rome, Italy, with current for lighting, utilizes about 2,000 horse power; at Lauffen, Germany, are placed Pelton wheels developing about 1,000 horse power; the well-known Pomona (Cal.) plant is operated by Pelton wheels, aggregating about 1,000 horse power; thirteen miles north of Portland, Ore., on the Willamete River, are water falls capable of delivering from 200,000 to 250,000 horse power, and work has been started on a plant which, when completed, will utilize Victor turbines of about 13,000 horse power; the Niagara Falls Hydraulic Power and Manufacturing Company are at work on a plant which when completed will contain Leffel turbines capable of furnishing 7,000 horse power; mention must also be made of the gigantic undertaking at Niagara, this installation being designed to develop ultimately over 125,000 horse power.

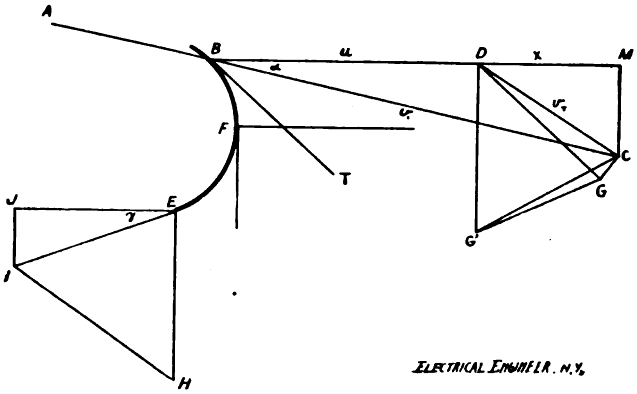

FIG. 1.

Notwithstanding that these plants, a small fraction of the whole, are capable of generating an immense amount of power, still, when it is remembered that the water power of the United States alone is estimated at 200,000,000 horse power, it is evident that the water wheel has a vast field of usefulness before it, and also that it is needless to fear the consequences of the exhaustion of our fuel supply.

Before proceeding to any detailed description or discussion of the different classes of water wheels it will be necessary to lay down a few fundamental principles relative to the efficiency of water wheels in general and to the action of a jet of water upon a vane.

If M is the mass of the water passing through the wheel per second, and if its velocity when entering is $v_1 = \sqrt{2gh}$, the energy supplied per second is $\frac{1}{2} mv^2 = mgh$. The losses in the wheel may be divided into two classes: First those due to the transformation of energy into heat caused by the foaming and eddying of the water, friction on rough surfaces, etc.; second, those due to the velocity v with which the water reaches the level of the tail race. The loss due to the first of these causes may be represented by mgh', h' being the equivalent loss of head; the loss due to the second cause is evidently $\frac{1}{2} mv^2$. Hence the energy per second delivered by the wheel is

$$mgh - mgh^1 - \frac{mv^2}{2}$$

and the efficiency is

$$\frac{m\left(gh - gh - \frac{v^2}{2}\right)}{mgh} = 1 - \frac{h^1}{h} - \left(\frac{v}{v_1}\right)^2.$$

This expression[2] gives the efficiency of the wheel considered solely as a hydraulic motor and takes no account of the losses of energy due to mechanical causes; it is applicable in modified forms to all classes of water wheels and shows that the efficiency will become unity only when $h' = 0$ and $v = 0$. That is, the design should be such that no loss of energy occurs due to the flow of the water through the wheel, and that when the water leaves the wheel it should have zero velocity with reference to the earth.

When a fluid stream strikes a smooth plane surface[3] it is not reflected, as a solid would be, but spreads out into a sheet and flows over the surface with its velocity changed in direction but unaltered in magnitude, this change in direction giving rise to a pressure called the impulse. If the surface be curved, as in the accompanying diagram, Fig. 1, the velocity in the direction of motion is not entirely destroyed until the point F is reached and the whole effect up to this point is due to impulse alone, and is precisely the same as if the jet had impinged upon a plane surface and been instantly deflected. After passing the point F the water continues to flow along the surface, leaving at the point E in the direction E I, the velocity being unaltered in magnitude but still further changed in direction. This added change in the direction of flow produces a pressure on the surface due to the reaction of the water. Hence the energy imparted to the surface may be divided into two parts, viz., that due to impulse and that due to reaction.

If M denotes the mass of water striking the surface per second, x the velocity of the jet relative to the surface, and u the velocity of the surface, the energy due to impulse imparted per second to the surface is mxu; this is apparent since mx is the momentum imparted to the surface in unit time, which is the force acting upon it, and u is the distance through which this force acts in one second. Similarly the work done by reaction may be represented by mx_1u where x is the velocity imparted to the jet in a direction opposite to the motion. The total energy W imparted to the surface is evidently the sum of these two.

$$\therefore W = \underline{mxu} + \underline{mx_1u} = \underline{m^1xu} + \underline{x_1u.}$$

If, on leaving the surface, the water has zero velocity with reference to the earth x_1 is evidently equal to $-u$ and the efficiency of the system is unity.

If the surface be plane, $x_1 = 0$, the entire effect is due to impulse and $W = mxu$; if the velocity of the jet in the direction of motion of the surface equals the velocity of the surface $x = 0$ and the whole effect is due to reaction, $\therefore W = mx_1u$.

These three cases

$$\begin{array}{ll} W = m(xu + x_1u) & \text{impulse and reaction.} \\ W = mxu & \text{impulse.} \\ W = mx_1u & \text{reaction.} \end{array}$$

explain the whole theory of the action of water wheels except those cases in which the weight of the water is caused to do work, and the only change needed is the addition of a term mgh in the expression for work.

In nearly, if not quite, all water wheels of modern construction one or more jets of water are made to impinge upon curved vanes or buckets, the water doing work by both impulse and reaction; hence it will be necessary to an intelligent understanding of the correct design and action of water wheels to investigate a little more in detail the action of a jet of water upon a moving vane.

Let B F E, Fig. 1, represent a curved vane having a velocity of translation u represented in magnitude and direction by BD, and suppose that a jet of water, or other incompressible fluid, having velocity v_1, represented in magnitude and direction of BC strikes the vane at B. Then $DC = v$ is the velocity of the jet with reference to the vane, and x is the component of v^r in the direction of motion of the vane. As soon as the jet reaches B it is deflected in the direction of BT the tangent at B; drawing D G parallel to B T and equal to $D\,C = v_r$ we obtain C G as the instantaneous deviation at the moment of impact. When the jet reaches the point F its motion is perpendicular to that of the surface, and is represented by D G′ drawn equal to v_r and perpendicular to B D. C G′ represents the deviation suffered by the jet during its motion from B to F and its component in the direction of u is $x = v_1 \cos a - u$.

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[1] Read before the Technical Society of the Armour Institute, Chicago.

[2] The above is from Prof. Merriman's "Treatise on Hydraulics."

[3] The following is adopted from "Turbine Wheels," by Prof. W. P. Trowbridge.

Since the velocity of the jet in the direction of u is wholly destroyed at the point F the effect up to this point is due to impulse alone and the work done on the vane is, as shown before,

$$mxu = m (v_1 \cos a - u) u.$$

After passing F the jet flows over the surface F E and leaves the vane in the direction E I. Drawing E H equal and parallel to D G′ and E I equal to vr, H I represents the change in velocity between F and E, and its component in the direction of u is $EJ = x_1 = EI \cos \gamma = v_r \cos \gamma$. This change in the direction of the jet produces the pressure of reaction and the work due to the reaction is

$$mx_1u = (mv_r \cos \gamma) u.$$

The total work done by the jet due to both impulses and reaction is

$$m (xu + x_1u) = m [xu + (v_r \cos \gamma) u]$$

If $\gamma = o$ the work of reaction is v_ru and the total work is $m (xu + v_ru)$. This is a maximum when $u = v_r$ i. e., when B D = D C. Making this substitution the total work is

$$m (xu + u^2)$$

From the geometry of the figure when B D = D C, we have $BD . DM + BD^2 = \frac{BC^2}{2}$, or $xu + u^2 = \frac{v_1^2}{2}$, and $m (xu + u^2) = \frac{v_1^2}{2}$.

The left hand member of this equation is the work done and the right hand member is the total energy of the impinging water; since these two are equal the efficiency is unity. It is well to notice that this is the case only when $v_r =$ and $z = o$. If z is a very small angle the efficiency may easily be shown to be $1 - \frac{1}{4} \left(\frac{\sin^2 \gamma}{\cos^2 a}\right)$ and it is apparent that this is increased by making a and γ very small.

Since in all wheels the vanes move not in straight lines, as assumed above, but rotate about the axis of the wheel the analysis given above is not applicable directly to any form of water wheel, but the fundamental principle to be borne in mind has been set forth, viz., that to obtain an efficiency of unity both the impulse and reaction of the water must be utilized. This point cannot be too strongly emphasized. It has been overlooked by such authorities as Weisbach and Rankine, who insist that the velocity of the wheel vanes and jet should be equal to avoid what they call shock, but which in reality causes the loss of the impulse action of the water. The honor of correcting this error and building turbines which utilized both the impulsive and reactive effects of the water belongs to two Americans, Uriah A. Boyden and James B. Francis, whose improvements have been universally accepted and followed, at least in this country.

POWER TRANSMISSION

ELECTRIC TRANSMISSION AND THE PACIFIC COAST CLIMATE

BY L. M. HANCOCK, Chief Electrician, Nevada County Electric Power Co.

During the discussion of Dr. Duncan's inaugural address on the "Present Status of the Transmission and Distribution of Electrical Energy," before the American Institute of Electrical Engineers, some one remarked, evidently without the knowledge of the conditions, that "the success of power transmission on the Pacific coast was due to the mild climate."

It is not always mild, balmy summer in the whole of California, which, on the contrary, has anything one could ask for, from a parched desert to a glacier. The wires of the Nevada County Electric Power Company are run at right angles to the ridges and canyons through a foot hill district not low enough to be free from snow nor high enough to have dry snow. The average rainfall is about 40 inches per year, and the snow fall about the same, while for a single twenty-four hours, since the plant has been in operation, there has fallen 4.64 inches of rain and 24 inches of snow, to say nothing of numerous and heavy thunder storms.

On the night of March 5, 1897, there was a fall of 24 inches of very wet snow, and as a result on the morning of the 6th, out of 100 telephones in Nevada City, 21 were in service, and in Grass Valley out of 75 telephones, 7 were in service. Our service was interrupted several hours during the daytime of the 6th, mainly on account of the broken and grounded telephone lines; we had but one wire broken on our new lines.

The rainfall, as recorded at Nevada City for 1896, was 69.37 inches. On April 6, 1896, 3.36 inches; on November 24, 1896, 3.78 inches; while during twelve hours of the night of March 27, 1897, 2.32 inches.

A Pacific Coast Winter Scene.

The plant commenced giving commercial service February 5, 1896. During the tewnty-four hours of January 4, 1895, 6 inches of rain fell. The most extraordinary weather conditions recorded, occurred during the winter of 1889 and 1890; up to February 22, 1890, there had fallen 5 feet of snow on a level and the next day 5 inches of rain fell, giving about as trying conditions as one would care to experience. True, we have not encountered anything so severe as yet, but there is no telling when we will.

We have already encountered about as severe atmospheric electrical disturbances as are common in the Eastern States; we have been shut down completely several times on account of damage done by lightning and have to be as well protected from its discharges as the best of Eastern practice requires.

The accompanying view was taken in Nevada City just after a wet snow had fallen this winter.

THE PERFORMANCE OF THE SPRAGUE ELECTRIC ELEVATORS IN THE MINNEAPOLIS CITY HALL AND COUNTY COURT HOUSE.

BY FRANK J. SPRAGUE.

One of the elevator contracts which, perhaps, has caused more bitterness among, and met with more opposition from, the hydraulic companies than any other, is the one which was awarded to the Sprague Electric Elevator Company over a year ago for equipping the Minneapolis City Hall and County Court House with electric elevators. The combination of hydraulic interests, during the competition for this contract, used every possible means, fair and unfair, to prevent the award, but it remained for one of the most prominent of the Western companies to be especially bitter.

Many unaccountable and unusual troubles have been experienced with the plant since the installation; test after test was made, and finally one by an electrical engineer, who, at the same time, is reported to have sent a report, which was for the private information of the Committee of the City Hall and Court House, to newspapers for publication. Since this report was made, the character of which was manifest on the face of it, extracts have been sent anonymously to architects and engineers throughout the United States.

The Sprague Electric Elevator Company realizing the necessity for thoroughly investigating and exposing the methods under which this plant was operated, took the necessary steps to have the machines inspected and readjusted. A competent engineer was sent to Minneapolis, and the plant was by him put in perfect condition, and the incompetency, to say the least, and the apparent animus, of the engineer and his associates were absolutely demonstrated, with the result that the engineer in charge was dismissed and a successor appointed, since which time there has been no trouble, and the installation, instead of being a source of irritation and correspondence, is spoken of in the Minneapolis "Journal" of March 16, 1897, as follows:

"County Commissioner Ed J. Conroy returned from New York yesterday after quite an extended trip through Washington, New York and Boston. During his trip, Conroy took especial pains to inspect the electric elevators placed in New York buildings by the Sprague Electric Elevator Company. In every instance the elevators were working admirably, without any of the tangible evidences of inefficiency which, during all of last year, followed the working of the elevators here. Since Electrician Rosenbusch has been here, however, the elevators in the Court House have been doing satisfactory service, and Engineer William Robertson speaks highly of their efficiency and work."

In addition to the foregoing, it has the further endorsement of an independent committee who were employed by the commissioners to thoroughly test the machines. The full report of the committee is given below. Its conclusions are so well defined and positive that despite the outrageous treatment to which the machines have been subjected, their performance under rigid test fully satisfied the City Hall and County Court House Commissioners of their full compliance with all the extreme guarantees made for them.

TO THE HONORABLE BOARD OF COURT HOUSE AND COUNTY COMMISSIONERS, HENNEPIN COUNTY, MINNESOTA.

Gentlemen:—Your committee being employed by you December 26, 1896, to test the engines, storage battery and electric elevators, begs leave to supplement their previous reports on Court House machinery with the following report of tests made upon the electric elevators in the same building. The instruments used were Weston ammeter and voltmeters, Schaeffer & Budenberg tachometer, Thomson recording wattmeter and Fairbanks scales. The instruments were all tested and known to be correct or to have ascertained constants. The cars and counter-weights of all the elevators were accurately weighed.

The guarantee made by the elevator contractor was that each elevator should lift a live load of 2,500 pounds at a rate of speed of 350 feet per minute, exclusive of counter-weight with a potential of 110 volts at the motor terminal; the electrical horse-power to lift the live load of 2,500 pounds at the rate of speed of 350 feet per minute is guaranteed not to exceed 40 horse-power with a down speed of 250 feet per minute with only the operator in the car.

Each car was underbalanced 797 pounds; there were three (3) tests made of No. 1 elevator under varying conditions of load, to ascertain the efficiency under the different loads, the average results being as follows:

Screw Elevator No. 1, Test 1.

Weight in car, live load	750	lbs.
Weight in excess of counterbalance	1,547	"
Average speed of car	386	
Average volts at motor	108.7	
Average amperes	199.8	
Average electrical horse-power	29.1	
Theoretical horse-power	18.1	
Efficiency from motor terminal	62.2%	

Screw Elevator No. 1, Test 2, Guarantee Load.

Weight in car, live load	1,703	lbs.
Weight in excess of counterbalance	2,500	"
Average speed of car	352.3	
Average volts at motor	109	
Average amperes	265.5	
Average electrical horse-power	40.4	
Theoretical horse-power	26.7	
Efficiency from motor terminal	66%	

Elevator No. 1, Test 3.

Weight in car, live load	2,500	lbs.
Weight in excess of counterbalance	3,297	"
Average speed of car	351	
Average volts at motor	112.5	
Average amperes	351.5	
Average electrical horse-power	53	
Theoretical horse-power	35.	
Efficiency from motor terminal	66%	

Screw Elevator No. 2, Guarantee Load.

Weight in car, live load	1,703	lbs.
Weight in excess of counterbalance	2,500	"
Average speed of car	355	
Average volts at motor	111	
Average amperes	256.5	
Average electrical horse-power	38.1	
Theoretical horse-power	26.9	
Efficiency from motor terminal	70%	

From the above figures it is seen that the efficiency and capacity of the screw elevators are fully up to the guarantee, their speed being from 2 to 10 per cent. above guarantee; the average electrical horse-power of both elevators 39.5 horse-power.

All instruments were read simultaneously when the car was in the middle of hoistway and at full speed.

These screw elevators were taken apart and thrust plate and nut on screw examined and found in first-class condition. The safety brake was then taken off and the car allowed to drop down to ascertain with what velocity the car would drop; but the speed obtained was but slightly above normal, showing that it is impossible to injure any one should the brake fail. It is the opinion of your committee that the construction of these elevators is good, ample provision being made for all wearing parts and safety devices; the nut on screw being hardened will not wear, the screw being the only part of the machine to wear out. This can be replaced at small expense.

WORM GEAR ELEVATOR.

The guarantee for this elevator is to have a capacity to lift a live load of 2,500 pounds in the car exclusive of counterweights or weight of car at 200 feet per minute with a potential of 110 volts at motor terminal, to have a down speed of 200 feet per minute with only the operator in the car. The electrical horse-power to lift the live load of 2,500 pounds at the rate of speed of 200 feet per minute is guaranteed not to exceed 35 horse-power. The car was overbalanced 321 pounds.

The average results are given in the following table:

Weight in car, live load	2,841	lbs.
Weight in excess of counterbalance	2,520	"
Average speed of car	216.	
Average volts at motor	98.5	
Average amperes	210.6	
Electrical horse-power	27.8	
Theoretical horse-power	16.4	
Efficiency from motor terminal	59%	

The above figures show that this elevator more than fullfils the guarantee, the speed being about 8 per cent. above requirement. With a load of 2,841 pounds in the car the elevator responded quickly in both up and down trips. This load equals 18 people of 150 pounds average weight. The worm gear of this elavtor is of the latest improved type and seems to show no signs of wear, ample provision being made for safety devices.

In order to determine the actual cost of operating the three elevators a Thomson recording wattmeter was connected into the elevator service wires and a continuous record was obtained for the energy used by these, the results were as follows:

Total number of kilowatt hours used for three elevators in nine days:

Kilowatt hours (9 days)	850
Kilowatt hours (1 day)	94.4
Cost to run 3 elevators per day	$4.72
Cost to run 1 elevator per day	$1.57

These figures are based on the regular motor rate of 10 cents per kilowatt hour charged by the Minneapolis General Electric Company and a reduction of 50 per cent. on bills of $250 and over per month. At the rate of 94.4 kilowatt hours per day that were used, there would be used 2,832 kilowatt hours for 30 days. At 10 cents per kilowatt hour this would come to $283.20 per month, 50 per cent. off, $141.60 per month for three elevators. This is remarkably low considering the work they are doing.

The wattmeter was then put on to the two screw elevators only, and reading taken for six days. The total number of kilowatt hours used were as follows:

Kilowatt hours used (6 days)	433
Kilowatt hours used (1 day)	72.1
Kilowatt hours used (30 days)	2,165
Cost to run 2 elevators for 30 days	$108.25
Cost to run 1 elevator for 1 day	$1.80

The wattmeter was then put on the Prison elevator for 10 days and reading taken each day.

Kilowatt hours used (10 days)	366
Kilowatt hours used (1 day)	36.6
Kilowatt hours used (30 days)	1,098
Cost to run Prison elevator for 30 days	$54.90
Cost to run Prison elevator for 1 day	$1.83

The wattmeter was put in the circuit of the three elevators January 7, at 7 a. m., and taken out January 16, at 6 p. m.; then put on to the two screw elevators January 18, 7 a. m. and taken out January 23, at 6 p. m.; then put into the circuit of the worm gear elevator January 27, at 7 a. m., and taken out February 6, at 6 p. m. Readings were taken each day at 7 a. m. and 6 p. m.

(Signed)
A. H. BROCKMAN,
A. HARVEY,
J. S. KUPFER.

PROF. GEORGE FORBES ON NILE POWER.

Professor Forbes, who has just returned to Cairo from Wady Halfa, expresses a highly favorable opinion about utilizing the power of the cataracts of the Nile for generating electricity, and considers the general circumstances of Egypt exceptionally well adapted for its use as motive power. Irrigation could be extended as well as cheapened by the saving in cattle, and especially in coal, which becomes enormously dear in Upper Egypt, owing to the expenses of transport from Alexandria. He considers that the cataract power would be available all the year round for working the railway, cotton-ginning mills, sugar factories, irrigation machines, etc., also that it could be supplied over distances of several score miles at a cost much below that of coal. He will, in September, make a complete survey and present the government with a project for utilizing the electricity to be generated at the Nile cataracts.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—IX.

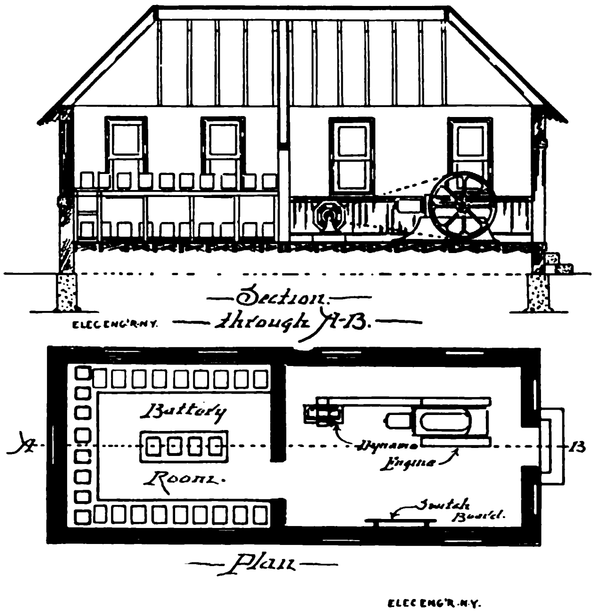
APPLICATION OF STORAGE BATTERIES TO ISOLATED PLANTS.—Continued.

BY JOSEPH APPLETON. (Copyright, 1897.)

FIGS. 28, 28A and 28B, illustrate the general arrangement of a model power house for an isolated plant of this description. Figs. 29, 30, 31 and 32 show, respectively, views of a power house, engine and dynamo, battery room and switchboard for private residence plant.

In all storage battery installations, special attention should be given to the switchboard, as the success of the installation depends largely on being able to control and operate the plant easily and without complication.

A switchboard for this work has features quite different from those found on switchboards for controlling ordinary direct current installations and it is very neccessary that all the details be arranged to suit the conditions, otherwise the flexibility of the system, which is one of its most useful features, may be destroyed.



FIGS. 28 AND 28A.—GENERAL ARRANGEMENT OF MODERN POWER HOUSE FOR ISOLATED STORAGE BATTERY PLANT.

In the second class of isolated plants, the storage battery plays a different part to that described in the previous case. Here the battery acts as an auxiliary to the generating plant, increasing its capacity and efficiency, usually furnishing only a comparatively small portion of the total current instead of the bulk as in the former application.

There are very few isolated plants of this description where a storage battery of suitable capacity will not prove advantageous from both an engineering and financial point of view. Of course the actual conditions of each plant must be carefully examined in order to ascertain what benefit can be derived from the use of a storage battery; there are so many points to be taken into consideration that in order to obtain the best results each situation should be treated as a distinct engineering problem and dealt with accordingly.

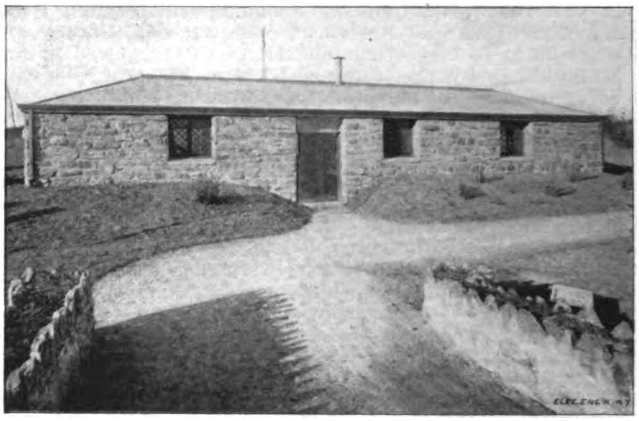


FIG. 29.—POWER HOUSE FOR ISOLATED PLANT.

The following are some of the features which have an important bearing on the question: 1. Nature of load and length of duration. 2. Relative proportion of minimum, maximum and average loads. 3. Size of generating units.

The ordinary isolated generating plant as installed in office buildings, large stores, hotels, etc., does not produce current at the lowest price on account of the conditions which exist; the load is variable and liable to sudden fluctuations, all of which have to be provided for in the generating plant. Where electric elevators are used, the conditions are exceedingly bad in this respect. The following are the points in which a storage battery will prove advantageous and economical in an isolated plant:

1. Smaller generating plant required, capacity for the average load instead of maximum load being sufficient.
2. Possibility of operating at point of highest efficiency whatever portion of the generating plant is running, thus effecting large saving in fuel consumption.
3. Possibility of operating both electric elevators and lamps from the same generators with satisfactory results.
4. Greater reliability of service, and better provisions for meeting sudden increase of load due to weather changes, etc.
5. Reduction in length of time during which the generating plant need be run, the battery alone carrying load during hours of light demand.

Having enumerated the points in which a storage battery will effect economies in isolated plants of this class, we will now consider each of them separately.

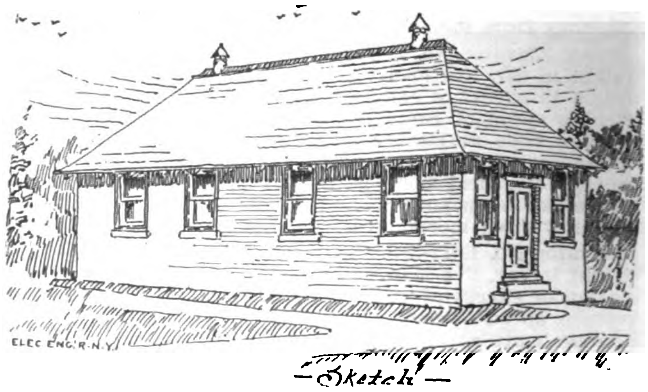

ELEC. ENG'R. N.Y.
—Sketch—

FIG. 28B.—EXTERIOR VIEW OF MODERN POWER HOUSE FOR ISOLATED STORAGE BATTERY PLANT.

1. A smaller capacity in generating plant can be used where a storage battery forms part of the equipment for the following reasons: In an ordinary isolated plant of this description sufficient generating machinery has to be kept running to meet the maximum demand due to the fluctuations which last only for a few minutes at a time, and may be anywhere from 20 per cent. to 100 per cent. above the average load according to the nature of the installation.

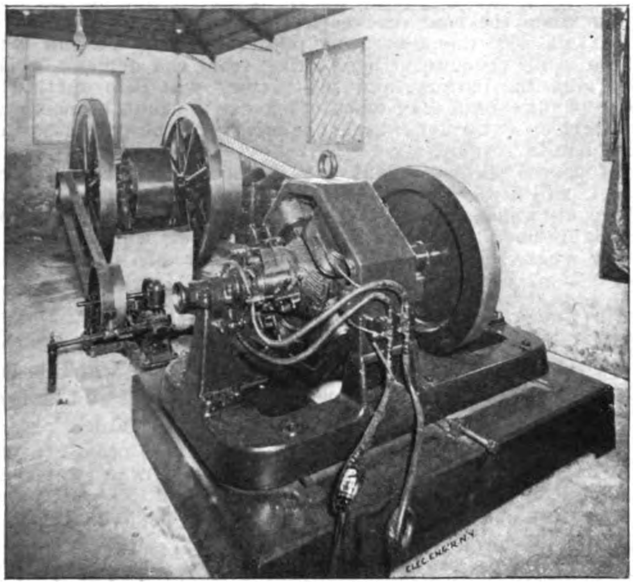


FIG. 30.—ENGINE AND DYNAMO ROOM IN ISOLATED PLANT.

Fig. 33 shows a curve of the fluctuation of current and voltage which exists in elevator service. This curve was plotted from readings taken at ten-second intervals from a modern office building installation. The total variation from minimum to maximum load is enormous, the average load being only 30 per cent. of the maximum. It will be seen that the capacity of the generating plant required for the maximum load is only needed for a very small portion of the time, yet has to be provided, while the load frequently drops to the minimum which is only 5 per cent. of the maximum. Under these conditions the steam consumption of the plant for the output must be very high.

Where a storage battery is used, the conditions are changed entirely; the capacity of the generating plant required is that of the average load, plus the amount of current necessary for charging the battery for the work required of it after the generating plant is shut down, instead of the maximum load. Under these conditions, when a sudden increase in load occurs, the current used during average and minimum load for charging the battery can be diverted and used for supplying the extra demand, thus assisting the generating plant. The adoption of a storage battery in these installations will generally reduce the capacity of generating plant required by one-third to one-half with an accompanying reduction in labor, etc.

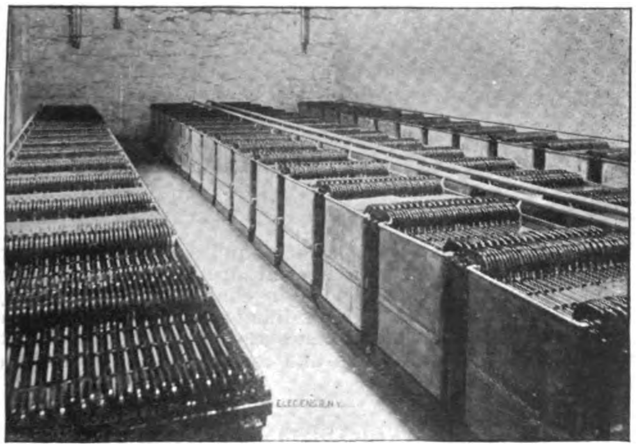


FIG. 31.—BATTERY ROOM IN ISOLATED PLANT.

2. The second point, or operation of generating machinery at higher efficiency when running at a steady and economical, instead of a variable load, follows as a matter of course, on the first. It is not easy to give reliable figures regarding the steam consumption of engines working under variable load as compared with a steady and economical load, as few proper and independent tests of this kind have been made,

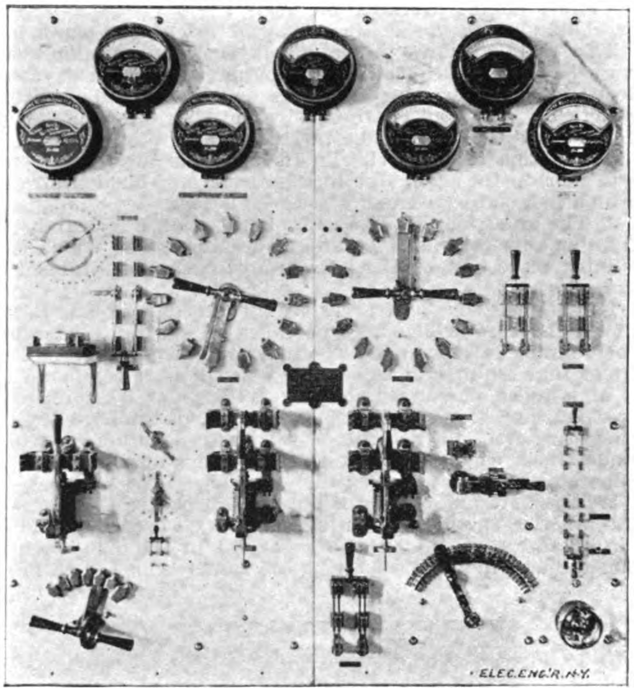


FIG. 32.—SWITCHBOARD FOR ISOLATED PLANT.

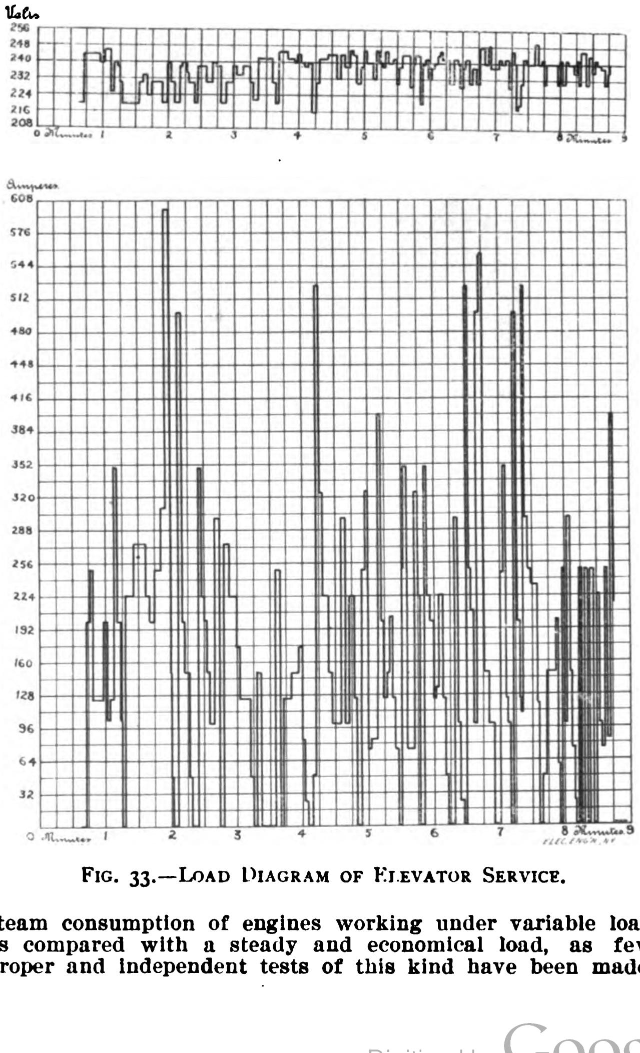


FIG. 33.—LOAD DIAGRAM OF ELEVATOR SERVICE.

but the following may be taken as a fair average of the results obtained in modern isolated plants of this description.

Engine working at full load, or thereabouts, continuously.... 31 lbs. steam per h.-p.
Same engine working on variable load....................57 lbs. steam per h.-p.

This plainly shows the saving in fuel consumption, which may be obtained by taking an engine working at a variable load and altering the conditions so that it will operate at practically full load continuously, this is the function performed by the storage battery.

In addition to the saving in fuel there is the reduced wear and tear on the plant due to the absence of sudden strain to which it is subjected under a variable load.

3. The question of operating both electric elevators and lighting service from the same generator is one which is becoming more important as the use of electric elevators is increasing rapidly.

Elevator service is of necessity an intermittent one in spite of all the care which may be taken to control and regulate the running of elevators. The starting current is from 2 to 3 times that required to hoist, and when it is remembered that a high speed passenger elevator takes 40 or 50 horse-power to hoist, and that in an office building, or similar situation, there are frequently eight or ten such elevators, it will be understood what an effect this service would have on the generators.

Where a storage battery is not used, it is almost universally the practice to run the lighting and elevator service from separate generators; this increases the size of the plant required, and reduces the load factor of the same. It has been proved beyond doubt that with a proper storage battery equipment these two services can be combined and operated from the same generators.

4. The reliability of the lighting and power service in any building open to the public use is of the utmost importance, and should receive the first consideration from those in charge of the plant; nevertheless many instances can be found where in the case of a sudden increase of load due to weather changes the supply has failed partially, if not entirely, and confusion has resulted. In order to prevent this, a reserve must be constantly maintained even though required only once or twice a year. Central stations have found a storage battery the best means of providing this reserve, and the service required from isolated plants of this description is similar though on a smaller scale.

5. The reduction in length of time during which an isolated plant is run means a reduction in expenses in many ways. A storage battery equipment enables the generating plant to be shut down at such times when there is not sufficient load to run it economically, the battery alone carrying the load during hours of light load.

For example: In an office building the period of heavy load occurs for a short time during the morning and a longer period in the afternoon; the interval between these peaks can be utilized for charging the storage battery, thereby maintaining the load on the generating plant fairly uniform throughout the run. The function of the battery is to carry the entire load while the generating plant is shut down, which will be from the time the heavy load goes off in the afternoon until the next morning, also in many cases to assist the generating plant during the short time in the afternoon when the load reaches its maximum.

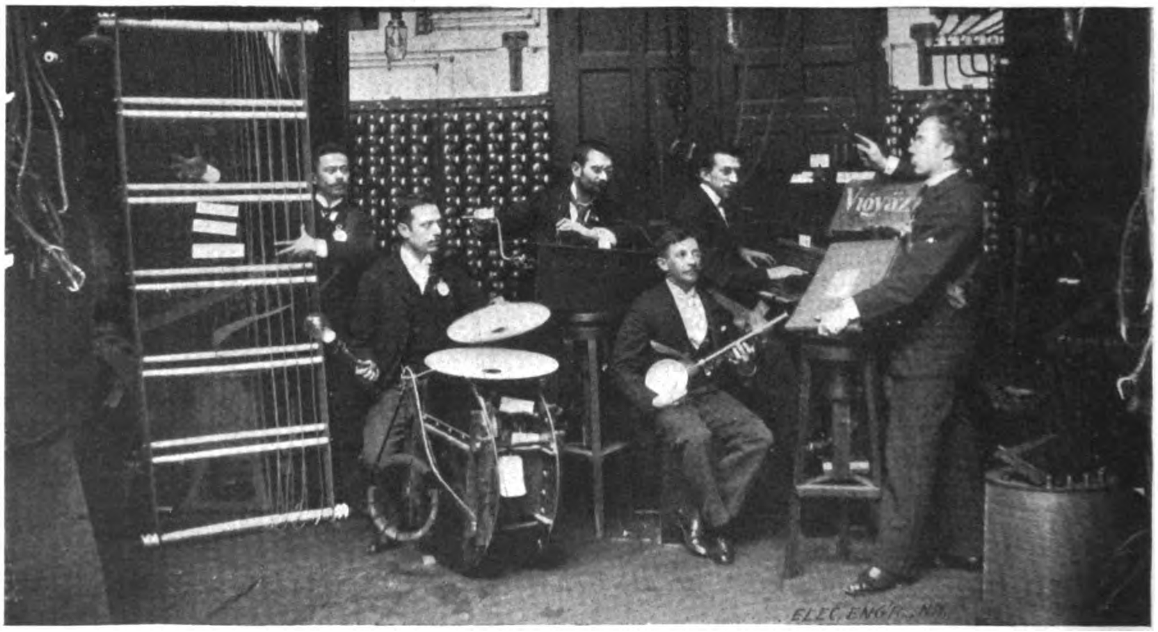
In this way the generating plant need only be run when there is an economical load either from the demand, or for charging the battery, and the battery will help out during time of maximum load when otherwise it would be necessary to start up extra generating machinery for perhaps less than one hour's service.

Of course the conditions vary according to circumstances, but it will always be found in installations of this class that there are times of heavy load, with the intervening periods of light load, and it only requires a little consideration to show where a battery will prove advantageous.

THE ELECTRICAL ORCHESTRA.

THE accompanying engraving represents the first electrical orchestra of its kind ever organized, which is now rehearsing actively at Budapest and, we understand, expects to go on an extensive concert tour in the near future.

The instruments composing this remarkable orchestra consist of a banjo (Cardew voltmeter), a hand organ (wattmeter resistance), a harp (large charging resistance), a triangle (Prony brake), a piano (switchboard with contacts as keys), cymbals (pair of flat lamp shades), and a bass drum (Blathy transformer), beaten by a special drumstick (incandescent lamp). Finally the leader's baton consists of a Leyden jar discharger. This clever bit of humor will no doubt be enjoyed by our readers, and shows that fun can be extracted even from the prosaic tools and apparatus of the electrical engineer.



An Electrical Orchestra.

PIPE ELECTROLYSIS IN DENVER, COL.

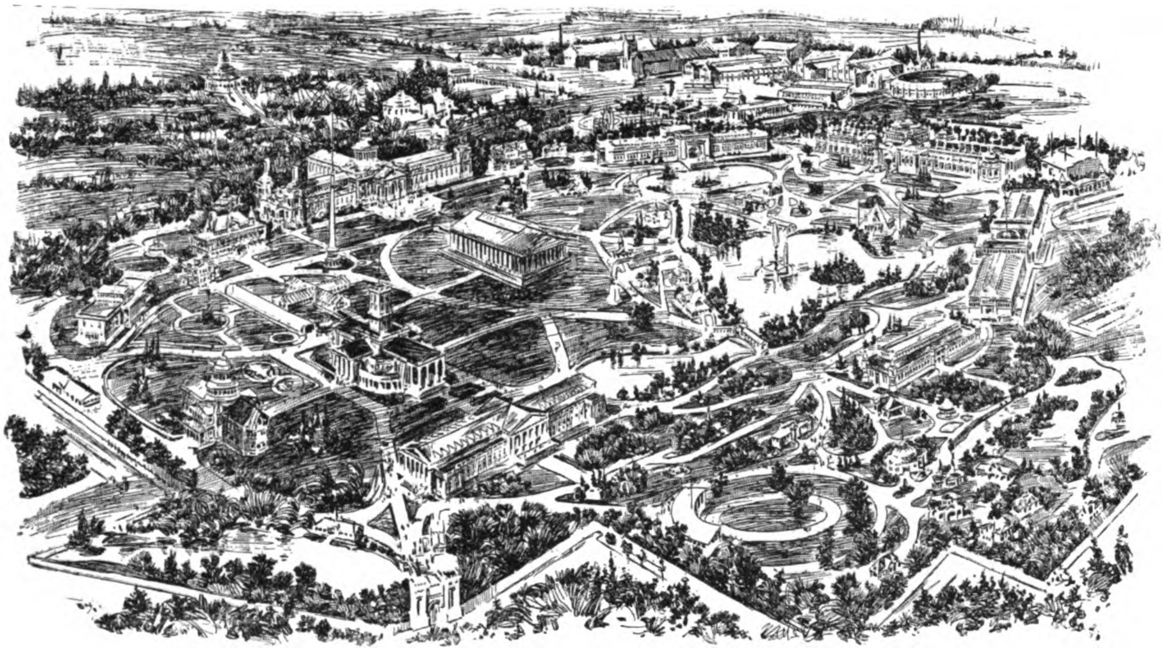
The subject of the destruction of water and gas pipes by electrolysis is just beginning to receive attention in Denver, Colo. Although the extensive systems of electric railways have been in operation for over seven years the effect of the stray currents has been noted only in the last year or so, probably delayed by the dryness of the soil for which that section of the country is noted.

A sufficient number of mysterious breaks in the water pipes have occurred of late to convince the Chief Engineer of the Water Company, Mr. C. P. Allen, that a thorough examination and test is necessary.

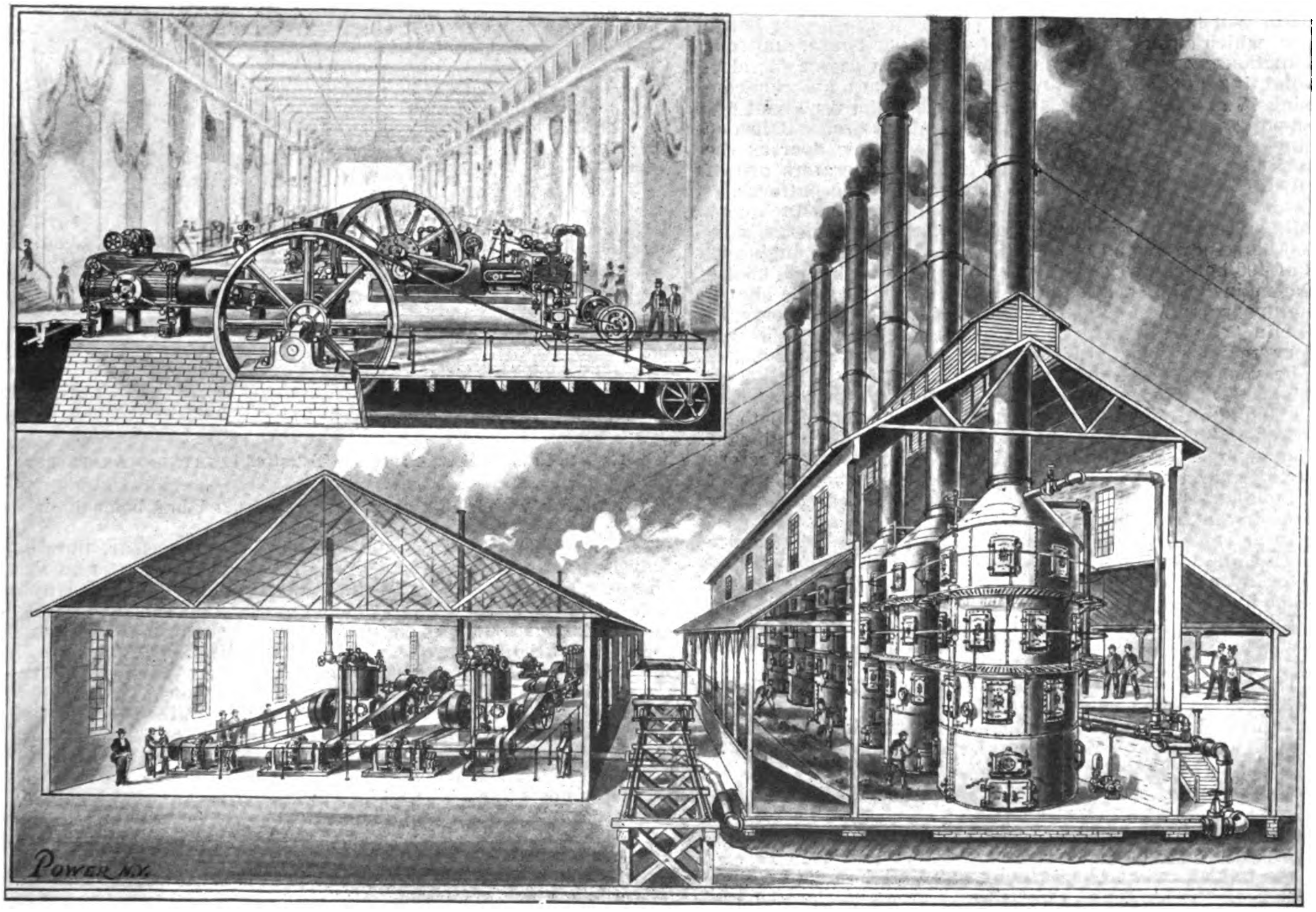
Mr. Lewis Searing, of that city, has been placed in charge of the work for both the water and gas companies, and a very extensive investigation will be conducted.

ELECTRIC POWER PLANT AT THE TENNESSEE CENTENNIAL AND INTERNATIONAL EXPOSITION.

ON May 1 President McKinley, at Washington, pressed the key which started in motion the machinery of the Tennessee Centennial Exposition at Nashville.



BIRDS'-EYE VIEW OF THE TENNESSEE CENTENNIAL AND INTERNATIONAL EXPOSITION, NASHVILLE, TENN.



POWER PLANT OF THE TENNESSEE CENTENNIAL AND INTERNATIONAL EXPOSITION, NASHVILLE, TENN.

Tennessee is the first State to celebrate its centennial in this manner. A tract of two hundred acres of well wooded land on the outskirts of the city, two miles West of the State Capitol, is the site of the exposition. On its picturesque knolls and surrounding its pretty artificial lake, a miniature World's Fair has arisen, and patriotic Tennesseeans already know it as the "Fair White City of the South."

For two years the work has been in progress, and the expenditure of $2,000,000 has wrought wonders in the park. Like their Chicago prototypes, the buildings, most of which are of steel, have all the outward marks of white marble palaces, and are all on a consistent and artistic architectural plan. The exposition is the most important of its kind ever attempted in the South.

THE BUILDINGS.

The Machinery Building is 375 x 138 feet, and somewhat resembles the Propylaeum, in Munich. The Commerce Building measures 591 x 250 feet, and its general style is based on the Corinthian and Ionic orders of the Graeco-Roman. Over the central pavilion a dome rises to the height of 175 feet, from which a most magnificent view of the surrounding country may be obtained. The Agriculture Building is 300 x 200 feet, and the central dome the feature of the design, rises to a height of 100 feet, flanked on either side by three minor domes.

The Children's Building is a most interesting structure and was erected by funds collected solely by the children.

The Negro Building is one of the most attractive in the Exposition group, and has a commanding position on Lake Watauga. It will show the progress of the negro race in America from the old plantation days to the present. The Railroad Exhibits and Terminal Station Building is in the Renaissance style of architecture, and is 100 feet square.

The "Midway Plaisance" at Nashville is called "Vanity Fair."

THE POWER PLANT.

To accommodate the power plant two separate buildings have been erected, views of which are given in the accompanying engravings, for which we are indebted to our esteemed contemporary, "Power." These buildings consist of a boiler and an engine house near the Machinery Building, and in the boiler house, steam will be generated by four 500 horse-power and two 250 horse-power Climax boilers, each with a separate iron stack projecting through the roof. The boiler house has an open balcony extending along the front from which visitors can inspect the general arrangement. The boilers are rented by the Exposition at five dollars per horse-power from the builders, and are erected and taken down at the Exposition's expense. They are constructed to carry 120 pounds pressure. The stoking will be by hand, the coal being brought to the boiler house in cars and dumped in front of the boilers, by means of the chute as shown.

Steam will be delivered to the engines of the power house proper, which stands in the rear of the boiler house, and four Westinghouse compound engines will furnish power for electric lighting and electric power. The engines are non-condensing 18 and 36 x 16 and are expected to deliver about 400 horse-power each. They are belted direct to two, and in one instance three, generators, situated on the same floor as the engines, as shown in our engraving. The generators are of the Brush, Western Electric and General Electric patterns.

The boiler plant will also furnish steam to the Machinery Building proper, where one Hamilton-Corliss engine 24 x 48 of 500 horse-power, and one Lane & Bodley Corliss engine 22 x 48 of 400 horse-power, will furnish power for the line shafts of the main building. These engines are belted as is shown in the upper panel of the engraving, to line shafts underneath the main floor, from which belts are brought up to the machinery to be driven. In some instances, short jack-shafts will be used over the driven machinery, and a variation of speeds will thus be secured. Machinery Hall will also contain a 100 horse-power Weston engine, direct connected to an 80 kilowatt Triumph generator, and one Phœnix engine of 150 horse-power, direct connected to a 100 kilowatt Western Electric generator which will complete the power plant of the Machinery Building. Two 50 kilowatt Wood generators will be driven from the line shaft.

Steam is conveyed to Machinery Hall from the boiler house through a 10-inch pipe at the end of which a small pump and receiver return the condensation of this pipe to the boilers. Another line of 6-inch pipe extends to the fire pumps located in a building at the side of the lake in the exhibition grounds where one Worthington and one Laidlaw, Dunn, Gordon pump furnish ample protection. The boilers are fed by Laidlaw, Dunn, Gordon boiler feed pumps 10 x 6 x 10 and Hancock inspirators also supply each boiler.

The entire department is under the management of Capt. George Reyer, chief of Machinery Department, who is superintendent of the Water Works at Nashville, Tenn.

WHAT HO!

The following query and answer are from the Trenton, N. J., Sunday "Advertiser":

Please tell me what is meant by a "Watt hour," the time by which electricity for illuminating purposes is charged.

UNCLE SAM.

A division of time made by James Watt, the inventor of modern condensing engines. The Watt hour is of about the same length as the standard hour, and is used on electric meters.

SIEMENS & HALSKE NEW HIGH TENSION LIGHTNING ARRESTER.

In a paper read by Mr. H. Goerges before the Berlin Electrotechnical Society, that gentleman described a new form of lightning arrester made by Messrs. Siemens & Halske, of Berlin, and adapted especially for high tension circuits. The lightning arrester is primarily due to a suggestion of Mr. Oelschläger. It is designed to satisfy the conditions that a lightning arrester ought to fill primarily, namely, that it be without self-induction, that any arc formed be automatically extinguished, and, finally, that it leave the arrester in a condition to operate immediately for a succeeding lightning discharge.

As will be seen in Fig. 1, the new arrester consists of two heavy copper wires bent in a peculiar manner, and placed opposite each other. The lower part of each wire is horizontal, then turns up vertically, and then takes an oblique direction with a gentle curve. The wires are carried above and below on cast-iron caps cemented to porcelain insulators, and the horizontal low ends of the wires are inserted in bushings and can be moved in and out, so that the distance between the wires can be regulated. One of these wires is connected to the circuit to be protected and the other to earth.

When lightning strikes the circuit the arc which follows travels upward and is extinguished in a few seconds. The experiments undertaken in the factory of Messrs. Siemens & Halske show that this new form of lightning arrester works the better the higher the potential. At low potentials the arc is not driven upward with certainty, and as a result the lowest limit for which this arrester can be used has been determined at 2,000 volts.

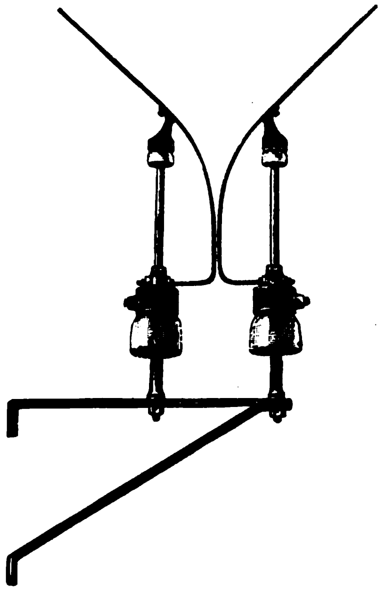
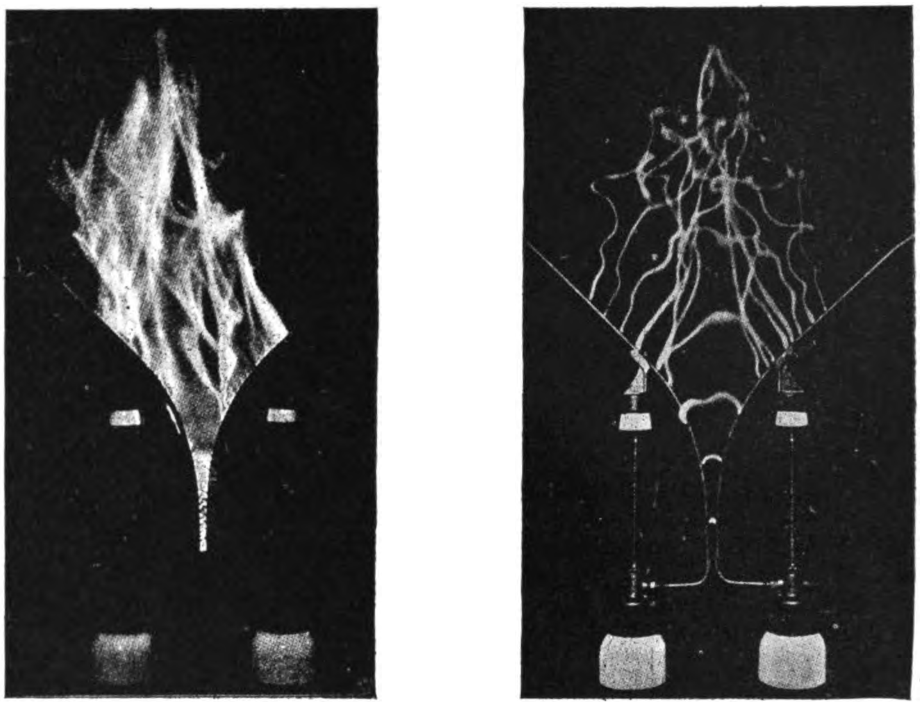


Fig. 1.—Siemens & Halske High Tension Lightning Arrester.

The reason for this phenomenon is not quite clear, but it may be due to the properties of the arc, which are different at high tensions from those at low. For example, it is noteworthy that the wires are scarcely attacked by the high tension arc. In one test about 100 short circuits were made with a 10,000 volt machine of 100 kilowatt capacity driven by a 50 h. p. motor. A 30,000 watt transformer furnished the high potential. At the conclusion of this test no particular burns were discernible on the wires, which gradually attained a black, roughened surface. From this the conclusion may be drawn that those spots at which the arc starts are not highly heated by high tension currents. The case is different, however, with low potentials. In the latter case burns are very readily produced and the arc remains stationary at these points.

The reproductions, Figs. 2 and 3, show the action of the new arrester. Fig. 2 is a time exposure of about two seconds, during which the arc traveled upward and was extinguished. The alternations of current may be recognized in the engraving, and the time calculated within which the arc was driven up a given distance. Fig. 3 is a reproduction of a photograph taken by means of a rotating disc, having a narrow radial slit. In this way only a few of the many arcs which are blurred in Fig. 2 are visible. They show that at every instant the arc constitutes a thin thread that follows the currents of air in wave-like motions.

The arc may attain considerable magnitude. Experiments were made with the lightning arrester in an installation operating at 8,000 volts. A turbine of 750 h. p. drove a 3-phase machine, the potential of which was raised to 8,500 volts through several large transformers of 200,000 watts capacity. The arc flames rose nearly ten feet in height, but the arc was extinguished in every instance after a short while. During these experiments the turbine was running at half-gate. The arrester was employed in Germany, in an extensive installation, during the whole of last summer, which was particularly remarkable for the occurrence of heavy thunderstorms, the lightning arresters being placed in every case in the open air and without further protection. No rain guard is required if care is taken not to approach the wires too close to each other at the lower ends. In all installations in which a sufficient number of these lightning arresters have been installed not a single case of damage by lightning has been recorded, nor has the arrester itself been damaged sufficiently to make any repairs or renewals necessary.



FIGS. 2 AND 3.—ARC FORMED WITH SIEMENS & HALSKE HIGH TENSION LIGHTNING ARRESTER.

ROENTGEN RAYS

ADJUSTABLE X-RAY FOCUS TUBES.

BY A. A. C. SWINTON.

As all who have had occasion to use X-rays for practical purposes are aware, the penetrative value of the X-rays produced by any given Crookes tube, depends very largely upon the exact degree to which the tube has been exhausted. Further, as is well known, a tube originally exhausted to any particular vacuum, is found in practice to alter its degree of vacuum with age and with use. With tubes of the Jackson focus type, that have been well exhausted in the first instance, the vacuum usually increases the more the tube is used, particularly if sufficient power is employed to heat to redness the platinum anti-cathode. Indeed, it is not unusual for this increase of vacuum to be such that it is eventually found impossible to get any discharge to pass through the tube at all.

Various arrangements have from time to time been suggested and tried for the purpose of regulating the vacuum in tubes. One plan is to keep the tube permanently attached to the mercury pump, so that a little air can be pumped out or a little let in whenever it is found necessary. Another arrangement is to place some material, as, for instance, caustic potash, which is capable of absorbing air and giving it out again when warmed, in a small pocket or annex to the tube, which can be heated by means of a spirit lamp, and the vacuum reduced as occasion requires. This, however, as also the ordinary plan of heating the whole tube by means of a spirit lamp, or Bunsen burner, so as to drive off into the interior of the bulb the gases condensed upon the glass, are at best only make-shift expedients, which, though capable of good effect in the hands of skilled experimenters, are not permanent in their results or adjustable with sufficient accuracy to be really satisfactory. Further, exceedingly minute alterations in vacuum will make all the difference between satisfactory and unsatisfactory results in some of the more difficult cases to which X-rays are now applied.

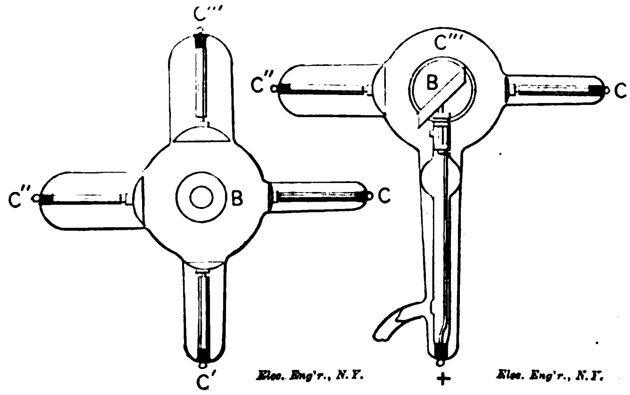
Under these circumstances, the writer has devoted considerable attention to devising a method whereby the penetrative value of the X-rays produced by a focus tube could be easily varied without alteration to the vacuum, and whereby further, the penetrative value of the rays could be maintained constant at any desired degree, in spite of the uncontrollable variations in the vacuum that are found to occur in practice.

A full account of the writer's experiments in this direction will be found in a paper entitled "The Production of X-Rays of Different Penetrative Values," recently read at the Royal Society, but here it is only necessary to mention two of the results obtained, namely, that the penetrative value of the rays for any given degree of vacuum, depends among other things upon the area of the cathode disc, and upon the lineal distance between the cathode and anti-cathode.

Upon these principles the writer has designed two separate forms of adjustable focus tube, Figs. 1 and 2, being two views of one of these tubes, and Fig. 3 a view of the other.

In the form of tube shown in Figs. 1 and 2, advantage is taken of the difference of effect produced by employing cathodes of various sizes. As will be seen from the illustration, the tube is provided with four concave aluminum cathodes, c, c′, c″, c‴, all of the same radius of curvature, namely, .75 inch, but of four different diameters, varying from .5 of an inch in the case of c, to 1.125 inches in the case of c‴. The cathodes are so placed that they all focus on a point in the center of the bulb of the tube, and the inclined anti-cathode disc B is mounted upon a small steel spindle, turning in aluminum sockets, so that the anti-cathode can be easily rotated by tapping the tube, so as to face any one of the four cathodes that it is desired to work with.

The anti-cathode disc B, made of aluminum, is of considerable mass, being in oblique section about .25 of an inch in thickness, cut from an aluminum rod 1 inch in diameter. The cathode rays are not received directly upon the aluminum, but upon the surface of a disc of platinum about .6 inch in diameter, and about .025 inch thickness, tightly wedged and riveted into a shallow circular depression turned out of the face of the aluminum block. The reason for the particular shape of the aluminum portion of the anti-cathode, is to ensure its being balanced in all positions of the tube, so that it should have no tendency to rotate of itself. The object of the general arrangement is to prevent the platinum from attaining an excessive temperature, even when great electrical power is employed, this resulting from the considerable radiating surface of the aluminum, and its considerable mass requiring a less time to heat it up to any high degree.



FIGS. 1 AND 2.

This arrangement makes the tubes take considerably longer to exhaust in the first instance, but renders them much more permanent, as not only is there no danger of melting the platinum, as frequently occurs in the ordinary form of anti-cathode, but also the difficulty experienced with the red hot platinum including the residual gas, and thus increasing the vacuum, is largely done away with, while in addition, the platinum having only one surface exposed, and never getting very hot, the tubes do not blacken so quickly.

As will be seen from the illustration, the anti-cathode is supported in a long double glass tube, through which passes an aluminum connection to the anode terminal. By this method great rigidity and accuracy are attainable, and the anode and cathode terminals are kept well apart.

During the process of exhaustion, it is necessary to make each of the cathodes operative in turn, so as to expel the residual gas, and finally the tube in exhausted to the necessary vacuum to produce X-rays of medium penetrative value, when one of the intermediate sized cathodes is in use. The tube is then sealed off, and afterwards the penetrative value of the rays can be varied at will by turning round the anti-cathode so as to face any one of the cathodes, and making that cathode alone operative. The small cathode gives rays of the highest penetration, and the large cathode, rays of the lowest penetration.

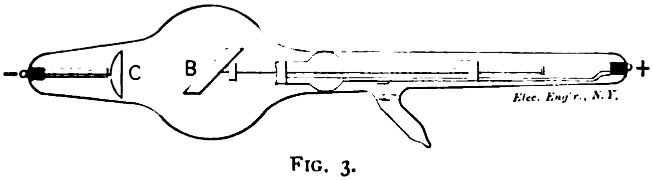


FIG. 3.

With cathodes of the dimensions given, the range is very considerable. It can be diminished or increased by making the cathode more nearly of one size, or the reverse. In place of the rotating anti-cathode, a fixed one may be used of four-sided pyramidical form with a platinum disc let in on each face opposite to each cathode. The anti-cathode terminal need not be used as anode, as when one disc is cathode, the immediately opposite disc may be employed as anode.

The other tube, with which the penetrative value of the rays can be altered by quite a different method, is shown in Fig. 3. In this case the tube is fitted with but a single cathode C, and the anti-cathode B, which is of similar construction to that used in the other tube, is carried upon a steel rod which slides in two aluminum blocks, mounted in a glass tube and connected to the anode terminal. By slightly inclining and shaking the tube the anti-cathode can be made to slide along in the bulb so as to alter the distance between the cathode and the center of the anti-cathode from about one-quarter inch to 3 inches. Stops are provided upon the sliding steel rod to prevent its traveling too far in either direction.

With a tube of this description it is found that the shorter the distance between the cathode and anti-cathode the higher is the penetrative value of the X-rays, and vice versa, so that by simply altering the position of the anti-cathode it is possible both to compensate for variations in vacuum, and also, within limits, to produce X-rays of any desired penetrative value.

The writer is indebted to the assistance of Mr. J. C. M. Stanton and Mr. H. L. Tyson Wolff, who made the tubes illustrated, as also all the earlier tubes with which the original experiments were carried out.

LETTERS TO THE EDITOR

STATION APPARATUS FROM THE MANAGER'S STANDPOINT.

THE examples of the most recently constructed stations given in your paper have shown us the trend of practice to secure economy, efficiency and reliability and have shown us the course we will have to take to keep up with the best practice. While the troubles of most stations are about the same, I think ours have been a little peculiar. Quite all of our trouble has resulted from the peculiar construction of an alternator. It seems to have been designed on purpose not to be "fixed" at the station, but to be sent back to the factory. No. 11 threads; blind connections of the field coils so that the whole machine would have to be dismantled to get at one of the twenty coils to rewind the same; sharp edges on the inside of the field magnets that would cut through any insulation when the centrifugal force is applied; the 200 volts terminals of converters coiled so close together that a short circuit is a dead certainty.

We have rewound coils and coils and eliminated all the defects that ought to have been kept out by the use of a little common sense and commercial honesty at the factory. We paid for it but didn't get it. How I would like to plan a dynamo from the standpoint of the one who has to opreate it and make dividends.

We are getting along very well in spite of the electrical concert. We have learned enough about the business to keep from being cheated and swindled by the new-thing-just-what-you-want man. We wish you great success with your journal, and may it prosper as it deserves. B. C. D.

April 21, 1897.

ARC LIGHT CARBONS AND THE NEW TARIFF.

AFTER reading the letter written by Mr. S. B. Pike on the above subject, I think that in justice to the central station men who desire to have this question debated in a disinterested way, he should have signed the letter not as the secretary of the Edison Illuminating Co. of St. Louis, but for the Phœnix Carbon Co. of St. Louis, whose president I am informed he is. Station men would then at once know what value to place on his rather doubtful arguments in favor of the preposterous rate of duty on imported carbons. From Mr. Pike's letter it appears that no inducements had ever been held out for home talent to furnish a carbon equal to the imported. This is speaking rather slightingly of the home talent, as we all know that we Americans are generally considered as not being slow when an ambition is to be satisfied, quite apart from the fact that a large fortune is in store for the man who succeeds in teaching home manufacturers how to make a carbon that would undoubtedly command the home trade.

Mr. Pike's allegation that foreign carbons have undersold the domestic, contradicts the actual facts quite as much as his statement that this alleged condition has discouraged much experimental work by home talent. Any station man knows that the imported carbon to-day commands a much higher price than the domestic on account of its fine quality, and although I consider myself a good business man, who watches the interests of his station very carefully, I have never yet been able to buy a fine class of imported carbon at anywhere near the price at which the domestic product is sold.

In regard to the second part of his statement, it is a fact, I am told, that at least three of the leading home manufacturers have been experimenting for years at a great expense, and after failing in their efforts, admitted that they would never be able to equal the imported product.

I wish to remind Mr. Pike of an advertisement that appeared in some of the trade papers about two years ago, and in which a certain firm informed the trade that by importing the man from Europe who had made the imported carbon, they had succeeded in making a carbon that would excel any imported article. The central station men have been waiting for this excellent article ever since.

Mr. Pike is, however, particularly unfortunate in his astonishing statement that as soon as the domestic product is adequately protected, the St. Louis companies would look for a reduction in the cost of carbons. By this statement Mr. Pike himself proves that the high protection for which he pleads is not needed by the domestic manufacturer, who—according to his statement—is expected to reduce the cost of carbons to the St. Louis local companies as soon as he secures this protection; and if Mr. Pike had attempted to prove that the present duty of 30 per cent. ad valorem on imported carbons is sufficient protection for the home manufacturer, he could certainly not have done better.

All I asked in by previous letter was that the price paid at present for carbons should not be raised on account of the proposed rate of the Dingley tariff bill, and I am glad to say that Mr. Pike has assisted me materially in inviting the central station men to oppose the measure, which must have the effect of not only raising the price of the imported article, but also of the product of the domestic manufacturer, who naturally pleads for protection in order to get a better price for his goods. ANOTHER CENTRAL STATION MAN.

May 5, 1897.

News and Notes.

THE KEITH ELECTRO-CYANIDE PROCESS.

The process for recovering gold from ores is being exploited by some influential South African men, of whom Mr. Paddon and Mr. Tudhope, of the Johannesburg Consolidated Investment Company, are the chief. Dr. N. S. Keith, the inventor, is an American electrician, who has for several years been connected with the Sandycroft Foundry in England. The process consists of two parts, that may be separately considered: First, the process for dissolving the gold out of the crushed ore, and second, the recovery of the gold from the solution. Dr. Keith's improvement in the dissolving process consists in adding to the solution of potassium cyanide a certain amount of cyanide of mercury. In practice he states that he finds that the best results are obtained when the solvent contains 0.05 per cent. of potassium cyanide and 0.025 per cent. cyanide of mercury. This mixture of cyanides, it is claimed, operates very much faster than the simple potassium cyanide. At present we have no exact figures relating to the rate of solution, but experiments on a practical scale are now being made and will be available shortly.

The process for the recovery of the gold from the solution is an electrolytic one. The gold and the mercury are deposited together upon amalgamated copper plates. The amalgam so deposited is scraped off and the gold recovered by distilling off the mercury in the usual way. The anode is not allowed to dip into the cyanide solution, but is placed in a separate compartment and surrounded with a solution of an alkaline salt, so that the cyanide does not become decomposed. The electro-motive force of the current need not be more than ½ volt and the current density on the depositing surface may be as low as 0.06 ampere per square foot.

ACCIDENTS WITH WIRES.

THE overhead electric wire is responsible for many disasters to life and limb. A long list of tragedies can be credited to this cause. Fatalities are frequent, says the "Age of Steel." An electric wire in its right place is a potent factor in modern business, but when, by the stress of service, time, or weather, it breaks from its holdings, and hangs like a fiery snake over the heads and at the feet of pedestrians, it is as deadly as a cobra in the tropics. It is a serpent of science, when out of its place, as it is one of its best servants when in midair. The "Railroad Gazette," in a recent issue, has given some startling figures of mortalities due to falling wires. In a compilation of accidents, obtained from press reports for the five months from May to September of last year, the following was obtained. As the sources of information were fragmentary and incomplete, the figures given are but an approximation of the total. From falling trolley wires there were 122 accidents; in 11 of these 12 persons were killed, and in 28 cases 31 persons were injured, and in 18 instances 24 horses were killed. Forty accidents occurred from falling electric and telephone wires, in which 9 persons were killed, 27 injured, and 7 horses made into calcined meat. Human fatalities for the period named numbered 21. At the same ratio for a period of twelve months, the death roll would include 50 persons. In contrasting this total of fatalities with those occurring on steam railroads, the "Railroad Gazette" says that for the year 1895 the railway mortuary list included but 38 passengers killed. Thus the deadly wire clearly outclasses the split rail, the misplaced switch, or the broken tie or bridge. It is evident from these facts that some plan for the better protection of human life from falling wires is needed. How best to bring it about may be more or less a problem, but of its urgent necessity there can be no division of opinion. The overhead system, however carefully constructed and secured, cannot, from the very nature of things, be otherwise than a menace to public safety. In many of our cities the lines of wires are thick and numerous as the threads in a spider's web. They outclass the complicated ravel of a full-rigged ship, and in sheer weight alone, at contiguous and intersecting points, are many tons in weight. In heavy winds, or local conflagrations, and under masses of debris or snow, the danger of these overhanging masses of copper and cable is increased. It is, moreover, a fact that, however rigid and close inspection may be, the detection of weakness and the prevention of sudden dislocation are not always possible. Wires will continue to fall and citizens to be electrocuted in spite of all precautions, and the death roll will still employ its copper pen until legislation supervises the deadly scribe. It has thrown its protecting shield over the railway and the mine, and sooner or later it will have a word to say on the perils of the wire.

SMELTING METALLIC ORES IN THE ELECTRIC FURNACE.

ACCORDING to an article in "Le Genie Civil," of Paris, M. Heibling has for some time been engaged in experimenting with the electric furnace, his object being to ascertain how to apply electricity best to the smelting of metallic ores, and especially whether the smelting operation in the electric furnace could not be maintained continuously, as in the blast furnace. He early recognized the fact that the slags resulting from the fusion of the ores were usually poor conductors of electricity, and that their presence in the furnace was very apt to break the electric current and thus put a stop to the operation. He therefore sought to obtain a flux which would be a good conductor, and found that by using a mixture of lime and carbon he could obtain a slag which was a good conductor and would not interrupt the current. Moreover, he found that after separating the metal the slag remaining was not worthless, but was a carbide of calcium, very impure, it is true, but still having some commercial value.

Under the action of the heat of the electric arc a part of the carbon takes up the oxygen in the ore under treatment, while another part combines with the lime and with different contents of the ore, transforming them into carbides, which are fusible and are conductors of electricity. The fused carbides take up and hold the infusible portions of the ore in suspension, while the metal settles in the bottom of the furnace.

In some experiments recently made at Puteaux the mineral treated was chrome-iron ore from Boucau in the Basses-Pyrenees. In treating this without the flux, though a large quantity of electrical energy was expended, he obtained the metal only in the form of irregular strips or ribbons, and these were very brittle, breaking up from their own weight. By adding certain proportions of lime and carbon, however, he obtained from the same weight of mineral, with a smaller expenditure of electrical energy, a greater quantity of metal. Moreover, the metal was ferrochrome and was in the form of a compact lump or ingot; while the carbides which formed the slag or residue from the operation gave nearly 250 liters of acetylene per kilogram.

THE SULTAN.—In a recent sketch of the "Great Assassin," Mr. Stephen Bonsal gives some details of his reading. He says that the Sultan is sick of the Napoleonic literary craze, but that he has lately read two books about Edison and wants more. He adds that the Sultan keeps abreast of modern science and discovery, although "the slaughter of Christians whenever the opportunity permits is part of his duty."

THE OSTRICH BOY, after a hearty meal of nails, screws and other boarding house fare, in Philadelphia, had his stomach X-rayed on April 30 by Dr. A. Goodspeed, of the Pennsylvania University. The repast was revealed in a state of rapid and orderly digestion. The time of exposure was two minutes.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. Commerford Martin and Joseph Wetzler, Editors.

A. C. Shaw, Secy. and Business Manager.

Western Office - - - - 1564 Monadnock Block, Chicago, Ill.
Philadelphia Office - - - - - - 916 Betz Building.

Terms of Subscription
United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

Vol. XXIII. NEW YORK, MAY 12, 1897. No. 471.

TELEGRAPHIC AND TELEPHONIC SPEED.

SO much has been said on this side of the water of the advanced position taken by European governments in the adoption of machine in place of hand telegraphy that it seems well worth while to inquire what are the facts in the case. This is all the more desirable as a number of schemes have recently been put forward in the United States, with a view to the establishment of machine telegraph systems here. A good opportunity for this comparison is afforded by the records of a telegraphic speed contest which was undertaken in connection with the recent celebration of the 50th anniversary of the introduction of telegraphy in Belgium. This contest is particularly interesting because it compared not only the relative speed of the Morse operator with that of the Hughes apparatus, but also with that of the speed at which messages can be transmitted by telephone.

The first test undertaken was with the Hughes apparatus, and consisted of the transmission of 640 words of plain text in foreign languages, 144 words in a text agreed upon, taken from English and French; 400 cipher words in groups of five and ten each; ten words in secret letters composed of five consonants, and finally a newspaper article of 700 words in French; that is, a total of 1,557 words. The "sledge" of the Hughes apparatus was run at a speed of 144 turns a minute, and the test lasted a little over forty-five minutes. To the time occupied by each contestant there was added 30 seconds for every word omitted, 20 seconds for a deformed word, and 10 seconds when a single letter in a word was altered. The result showed that the winner of the contest accomplished his task in 45 minutes and 12 seconds, which reduces to 2,397 words per hour. This was not considered an exceptional performance as several operators have records equal to that of the victor in the test. Experience has established the fact that a speed approaching to that above mentioned can be maintained for several hours, without excessive fatigue by skillful operators.

The work in the Morse contest consisted of the transmission of 670 words in languages other than the French, comprising a mixture of cipher and clear text. The operators in nearly all cases transmitted without error, and the lowest in the list only lost three dots. In the contest the receivers could neither ask for repetition, nor break. The actual contest commenced at a speed of fifteen words a minute, and towards the end ran up to twenty words a minute. During one hour there were received 1,591 words, containing 7,248 letters, consisting of 7,085 dashes and 11,403 dots; that is, a total of 18,488 signals, which represents five signals or two letters per second. It was difficult to say during how long a time such a speed could be sustained, depending as it did much on the temperaments of the operators. Thus whereas some, after one hour, appeared quite calm, the writing of others, receiving, denoted a marked nervous agitation. In the final test between the two who were originally marked first ex-aequo, one of the two collapsed after one-quarter of an hour's work. The noise of the sounder affected him painfully, and he was no longer able to write, whereas his rival at the end of one and one-half hours was as calm as at the start.

The figures cited above will come as a surprise to many. They show first that the Morse transmision, at least in Belgium, is far less behind the Hughes apparatus in speed than is generally supposed to be the case. Thus, whereas, with the latter system 2,397 words were transmitted in one hour, the Morse apparatus managed to get through 1,591, thus demonstrating an excess for the Hughes apparatus of only 50 per cent.

It is also interesting to compare the Morse figures obtained in Belgium with those reached in the United States. The most recent test of this kind was that of the employes of the Postal Telegraph-Cable Company between New York, Chicago and Pittsburg. In this contest Pittsburg sent to New York during five hours 10,216 words; that is, an average of 2,043 words per hour. This, it will be seen is only 15 per cent. less than the speed obtained with the Hughes apparatus, while on the other hand it exceeds the speed of the Belgium Morse work by over 28 per cent. This showing would seem to indicate the unmistakable superiority of the American telegrapher. Whether the result be due to the physical and mental superiority of the American Morse operator over his Belgian confrère or to the superiority and greater lightness of the American Morse key over the heavy foreign Morse key usually employed, is a question which might well be made the subject of an inquiry. On the other hand the slow speed of the Hughes apparatus is somewhat disappointing. Of course it must be taken into consideration that the Belgium test included considerable cipher work and transmission in foreign languages, but even that, we think, hardly accounts for the differences in speed noted.

But, perhaps, the most interesting event in this contest was the exchange of telegrams by telephone. In this test the French language only was used, and the proper names, numbers and texts of actual telegrams were employed for the purpose, so that the conditions were those of actual practice. The contestants had to observe the same measures of precaution as are employed in their daily work. The number of words received by each during a period of twenty minutes was 368, or at the rate of only 18 words per minute! The deduction made for errors in the case of the victor in the test was seven seconds, and the last on the list had one minute and forty-three seconds charged against him. The two operators classed first in this contest were then put to transmitting by telephone regular newspaper articles, and they succeeded in establishing a record of 38 words a minute. This record was considered remarkable considering not only the circumstances under which it was made, but also on account of the employment of a single receiver applied to the left ear. The Belgian administration is about to diminish the inconveniences of telephone work by putting on such operators four hours per day, in two shifts of two hours each, besides the employment of a telephone which permits the changing of the ear at will.

MR. TESLA ON X-RAY BURNS.

IT may be considered a rule of nature that every beneficent manifestation of force may be accompanied by deleterious effects unless guarded against by suitable precautions, and the Röntgen ray is no exception to the rule. The very earliest experimenters in this field noted a harmful action of the rays on the skin, but of late instances have been reported of serious injury due to so-called X-ray burns. It is probable that the cases mentioned are due more to neglect or improper treatment of the injury than to the original effect of the "burn;" nevertheless, it is eminently desirable that all possible means be adopted for the prevention of the injury to begin with, on the old principle that an ounce of prevention is better than a pound of cure. Mr. Nikola Tesla has doubtless done as much X-ray work as any one, and with apparatus whose sheer power has probably not been exceeded by that of any worker in this field and invariably without harmful results, when certain precautions were taken. The means employed with such good results, and their raison d'être, are described in an interesting communication appearing in our contemporary, The Electrical Review.

For the prevention of X-ray burns Mr. Tesla finds that a chief precaution is to interpose between the bulb and the person a thin sheet of aluminum or aluminum wire gauze, connected to the ground directly or through a condenser. This screen, according to Mr. Tesla, prevents the formation of electro-static streamers, which would otherwise issue from the body, and which have an irritating effect. In the course of his experiments, Mr. Tesla observed, however, that the injurious effects did not seem to diminish gradually with the distance from the terminal, but ceased abruptly. He accounts for this as due to the effect of the ozone generated, and supports this view by the fact that the generation of ozone ceases at a definite distance from the terminal.

But perhaps the most striking fact developed by Mr. Tesla in these investigations is, that bulbs containing platinum electrodes are more injurious that those provided with aluminum electrodes, in support of which assertion he cites a number of experiments.

To sum up, Mr. Tesla advises: 1. The abandonments of bulbs containing platinum. 2. The substitution for them of a properly constructed Lenard tube, containing pure aluminum only. 3. The use of a protecting aluminum screen, as indicated above, or, instead of this, a wet cloth or a layer of fluid. 4. Exposure at no less distance than 14 inches, and preferably to expose longer at a greater distance. As regards other physiological influences of the X-ray, Mr. Tesla records the fact that since he has begun to work with the X-rays his health has been improved and he has been entirely relieved of a troublesome cough; this same effect was observed on another person. He has also observed that when the head is brought close to a powerful tube the effect is similar to that produced when working for some time with a noisy air gap. As the X-ray tube gives forth no sound, Mr. Tesla concludes that the tube produces violent explosions and concussions, which, though they are inaudible, have some effect on the bony structure of the head. Their inaudibility, he explains on the assumption that not air, but some finer medium, is concerned in their propagation. In conclusion, it may be stated that Mr. Tesla still adheres to his oft-expressed opinion, that the X-ray tube when in action emits a stream of small material particles. Some of his experiments would seem to indicate that these particles start from the outer wall of the tube; others again seem to prove that there is an actual penetration of the wall, and, in the case of a thin aluminum window, Mr. Tesla has not the least doubt that some of the finely disintegrated cathodic matter is actually forced through. Mr. Tesla stands practically alone in his advocacy of the corpuscular theory of the Röntgen rays, but his faith in its correctness seems to be growing stronger as time passes and his experiments multiply.

FALSE TEACHERS.

IN his noble sympathy with the poor and the unfortunate, Bishop Potter has, we think, allowed himself to have been led into deep error and the grossest of false teachings, in his recent utterances at the Trinity Church celebrations in this city, when he made a fierce attack on modern machinery and invention. We had thought the church emancipated from such opinions as this: "It is doing away with intelligence in labor. It is turning the laboring man into a simple idiot. Not long ago I visited a large factory in this State and was much impressed with what I saw. The owner proudly showed me around, pointing out the manner in which labor was simplified. I saw a young man sitting before some sort of a large hammer. He sat with his legs crossed and all his work consisted in shoving into an opening in the machinery a small piece of iron. He would turn the metal two or three times, throw it into a large box, and take another piece. That was this man's work, day after day, week after week. No wonder that at night time he drank, gamoled and fought. He had to; otherwise he would go mad. How many of us would stand this and not cry out? Not one of us but would become a striker. Myself among the first." Not only is there an onslaught here on all that human ingenuity and invention have done to lighten the burden of labor, but an accusation is made against the laborer also, to the effect that he is becoming brutalized and degraded by his contact with machinery.

Having delivered himself in this wonderful way, Bishop Potter sought out the finest piece of modern machinery he could find—one of the fast Atlantic steamships—and hastened away to London, thus saving his time at the expense of his consistency; for he ought to have taken the slowest sailing ship afloat. Even that would come under his ban of pernicious machinery, for the whole trouble is the drawing of the line in these matters. The very earliest implements that lift men above barbarism are machines, of a rough kind, it is true, but still machines; and why should we slip back to rank savagery? To save our souls? The impossibility of rolling back the tide of advance is in fact about as plain as the sinfulness of Bishop Potter in urging men to smash things or to go on strike because of the assumed monotony of their calling. Was there no monotony of work before machinery of the modern type came into vogue?

If there is one thing well proved and easy to prove, it is the fact that machinery lightens labor, renders employment more regular, increases wages for the amount of work done, and by the constant shortening of the hours of toil is giving the laborer leisure and variety he never knew before. In New England wages have risen 91 per cent. in fifty years. Bishop Potter in excusing apathy, in teaching that machinery is an evil, and in palliating gross dissipation and vandalism, is a public enemy; and much as we admire frankness in such a man, it is a duty to protest against his unchristian utterances. We trust no electrical inventor will cease his work because of this dark discouragement from one whose Master described the lofty aim of their useful lives when, as the highest expression of his own spiritual mission he said: "Behold! I make all things new."

THEFT OF CURRENT.

INSTANCES of theft of current have become more numerous of late, and there is evidenced a disposition on the part of the courts and local companies to treat electricity as property. At Louisville, Ky., a saloonkeeper was held by the judge recently, on the ground that electricity is valuable property, although the defendant urged that in tapping the electric light wires he had taken nothing of value. A similar case has come up at New Bedford, Mass. The proprietor of a millinery store ordered his Edison lights discontinued and the meter taken out. This was done, but when an employé of the local company went around he noticed that the lights were still burning. An investigation revealed the fact that the connections had been made direct to the street mains again. It would not be hard to decide these cases on their merits, and brush aside the flimsy argument of the German courts that property to be stolen must be a thing filling space. What about copyright, patents and libel suits? They all deal with property that is intangible, whereas electricity can be measured, and, for the matter of that, weighed. Every Edison meter acts on the intrinsic principle of weighing the current consumed.

CARE OF STORAGE BATTERIES.

MR. F. P. SHELDON read a paper recently before some mill men in Boston on electricity for mill purposes, and suggested the use of both motors and storage batteries. Mr. Frank M. Messenger, of Grosvenordale, Conn., said that his experience had been that it required a $1,500 man to take charge of a $500 battery. Other members apparently agreed to this judging from the applause and laughter that greeted the remark. Mr. Clarke replied by telling the story of the man who bought a gold pen from a peddler and after using it a few days returned it with the words: "I don't know what I want of a gold pen; I can't spell any better with it than I could with the common sort." He said with a little study almost any one could learn how to run a battery. Any one who has read Mr. Appleton's recent articles in our pages will note how frequently the plants of batteries are now put in the hands of men who certainly would consider it an unearned increment to be classed as experts at $1,500 a year.

POSTMASTER W. W. CARR, of Philadelphia, is enthusiastic in his praise of the trolley car mail system as carried out on the 600 miles of trolley lines in that city. There are now thirty clerks at work on that service, and he states that the envelopes show by their record a great improvement over the old system of mail transfer by horse and wagon. The pneumatic tube system has been much talked about, but he sees no use for it unless it can handle mail sacks weighing 250 pounds apiece. It seems to us that this is a new field of work for conduit tube trolleys, of the telpher type, and we hope to see them introduced at no distant date. Meantime, the trolley mail car has been a beneficent factor in expediting the delivery of letters in nearly all our large cities, and as Mr. Carr intimates, the public wants more of it.

IT will be noted from our Legal Column, that the U. S. Supreme Court has, in the manner expected, refused to cancel the Berliner patent of 1891, the claims of which broadly control the art of telephony as based on the use of electrodes in constant contact with varying pressure. It is of course well understood that this decision does not sustain the patent on its intrinsic merits, so that the fight for infringement is still ahead, and may be a long one, even resulting in the cancellation of the patent as void. Meantime the position of the American Bell Telephone Company is measurably stronger.

RUMORS were afloat the last few days as to the breaking of the incandescent lamp pool. The story is positively denied in several authoritative quarters. It appears to have its origin in another rumor that one of the lamp companies has gone into strong hands, and that the most will be made of its special features. A letter from Cleveland informs us that the Adams-Bagnall Company have sold out their incandescent lamp factory to Fort Wayne interests, and that the Adams-Bagnall Company, reorganized, will hereafter make only arc lamps.

A VERY satisfactory test was made on Monday of the new third-rail system on the New England Road, between Hartford and New Britain. The ten miles were run in 13½ minutes on the official test, and stretches of track were covered at a much faster rate than one mile a minute.

TELEPHONY AND TELEGRAPHY

THE SYNCHRONOGRAPH.—A NEW METHOD OF RAPIDLY TRANSMITTING INTELLIGENCE BY THE ALTERNATING CURRENT.—II.

BY A. C. CREHORE AND G. O. SQUIER.

IT is arranged that the brushes pass off from, and on to the paper, thus making and breaking the circuit, at the instant corresponding to the points in the current wave, Fig. 1, when the alternating current is naturally zero. The tape T passes over a wheel P geared to the generator shaft, so that for one revolution of the armature, the type advances a fixed distance. If the generator has ten poles, this fixed distance on the tape corresponds to five complete waves or ten alternations or semi-cycles of the generator current. One-tenth of this fixed distance corresponds to one alternation or semi-cycle of the current, and may be taken as the unit of distance in perforating the tape. If therefore a hole is made in the tape equal in length to this unit, and the brushes B and B′ happen to pass off from the paper so as to meet through the hole at the instant the current is naturally zero, then they will pass on to the paper again, breaking the circuit at the next following instant when the current is also naturally zero, since the length of the hole corresponds to one semi-cycle of the current.

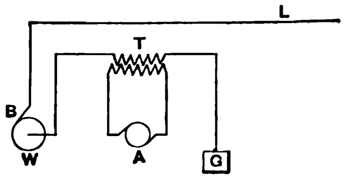


FIG. 8.

Suppose that a succession of these unit holes is made, the tape between the holes being also of unit length, then the circuit will be made and broken as by the first hole at the points of zero current. In practice it would probably not happen that the brushes were at first so situated as to pass off from and on to the paper at the instant the current is zero. In this case a succession of sparks appears, one each time the brushes pass on to the tape, and by moving the brushes along the tape it will be observed that this spark either increases or decreases in intensity, according to the direction moved; but at regular intervals, equal to the unit mentioned above, it disappears. This position of the brushes for no sparking is easily found by trial, and once obtained remains fixed. By this simple practical operation which experience shows requires but a moment to accomplish, the essential condition of synchronously operating upon the current in the manner described is secured. The brushes once adjusted always so remain, and since there is no sparking, it is possible to use high electromotive forces upon the line without injurious effect upon the brushes and tape. It is also plain that this method of operating upon the current is not affected by the speed of the generator, since the transmitting device is always in synchronism with the generator, whatever the speed. The speed of the generator, and consequently the rate of sending, as far as the transmitter is concerned, can be varied at pleasure between wide limits, without any effect upon the synchronous operation described.

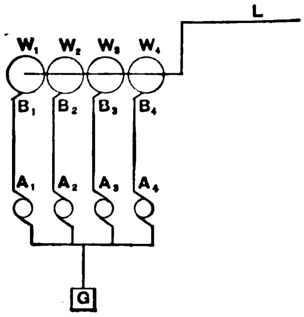


FIG. 9.

An example, giving the data from an early experiment, will illustrate how this is accomplished. The generator was a Fort Wayne 10-pole alternator giving a potential at its terminals of 1,000 volts. This was transformed to about 300 volts, being convenient to handle, and sufficiently high for the purpose. The end of the shaft E, Fig. 6, of the generator carries a small pinion, which engages the gearing G, and revolves the wheel P once in every 18.4 revolutions of the armature. This makes the 1-184 part of the circumference of the wheel P correspond to one semi-cycle of the current. The circumference of the wheel was about 100 cms., and the length of a unit, therefore, 1-184 of this, or .54 cms.

For convenience, a tape made of ordinary paper, had its two ends joined so as to make a continuous belt, which made it possible to use it repeatedly. The tape passed from the large wheel P to the loose pulley Q mounted upon a base-board A, and under the guiding pulley attached to the support S which controlled the tape, immediately before passing the brushes B B′.

In preparing the tape, the Continental code was employed as described, the omission of two half-waves meaning a dash, and one half-wave a dot. Having obtained the length of a unit on the wheel, the tape is first divided into these equal units, and then the proper units are cut out to form a message. The units which are not cut out form the dots and dashes. To use a continuous tape it is necessary for its length to be some exact multiple of the unit, in order that it may start on the second revolution exactly as it did the first. The generator current of high potential passed directly through the primary of a transformer, and the secondary was used as the source of electromotive force for the line. This secondary circuit which includes the line was brought to the transmitter to be operated upon as described. A diagram of the electric circuits as employed in this experiment is shown in Fig. 8, where A represents the alternator, T the transformer, B the brush bearing upon the transmitting wheel W, and L the line. Another diagram illustrating how the method may be used with currents of the same or different frequencies, is given in Fig. 9, where several generators A_1, A_2, A_3, etc., are represented upon the same shaft, and each is connected to a separate brush B_1, B_2, B_3, etc., bearing upon the wheels W_1, W_2, W_3, etc., upon a common shaft and connected to the line. By placing the insulating papers in the proper positions upon the wheels, it becomes possible to transmit in succession, first a current of one frequency and then of another, or of all at the same time.

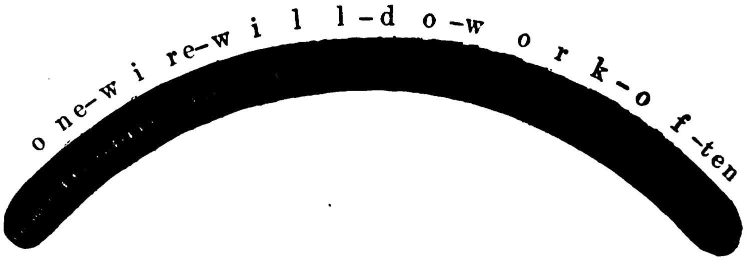


FIG. 10.

If any error is made in laying off the units upon the tape, or if the length of the tape changes in any way after they are accurately laid off, the effect of this error is cumulative from period to period, and although at any particular time the tape might be in phase, sometime later it would not be so, and sparking would occur. This would also be the case if there were any slipping of the tape around the wheel P. To overcome these difficulties it is only necessary to have holes punched at regular intervals in the tape which engage in pins at corresponding intervals on a wheel made to receive it.

A record obtained by the use of tape is shown in Fig. 10, where the sentence "one wire will do work of ten" was transmitted on August 10, 1896. This message was sent at the rate of 337 semi-cycles of current per second, thus requiring about half a second altogether.

Since the speed of transmission depends upon the frequency of the alternating current, the limit of speed is determined by the particular alternator used. In the above example the alternator available was designed to run at a speed of about 1,600 revolutions of the armature per minute, corresponding to a frequency of 133, or 266 alternations per second. To increase the speed of transmission this alternator was run as high as 2,400 revolutions per minute, beyond which it was thought dangerous to go. This corresponds to a frequency of about 200 complete cycles or 400 alternations per second. Through the kindness of Dr. M. I. Pupin of Columbia College, a special high-frequency alternator was loaned for the purpose of testing this system at high speeds of transmission. This alternator is in fact four alternators upon the same shaft, having 18, 22, 26 and 30 poles respectively. To obtain the highest speed, the

30-pole machine was used, and the transmitting wheel geared to the shaft as with the ten pole alternator. The speed of armature used was 2,180 revolutions per minute, corresponding to 1,090 semi-cycles per second, or 65,400 per minute, or a frequency of 545. No difficulty was experienced in sending and recording messages at this rapid rate which corresponds to between three and four thousand words per minute.

The Chemical Receiver.—In a practical form of receiver, it is an advantage to have the messages received in such form that they are ready for immediate use, and this is the case with the chemical receiver to which reference has already been made.

Through the kindness of Mr. Delany, some of the sensitive paper tape used in his system of machine telegraphy was obtained for experiments with the synchronous transmitter. A simple method of obtaining records of currents with this tape, which is certain in its action and does not involve any special apparatus, is to place the tape upon a smooth metal surface, which serves as one electrode, and to draw a steel needle, serving as the other electrode, along it guided by the straight edge of a ruler. If a direct current is used, no record appears when the current is in one direction, and it does appear when the current is reversed. If a second needle is substituted for the plate electrode, the record appears on one side of the tape for a direct current and on the other side for the reversed current.

If the two needle electrodes are placed side by side upon the tape, a record will appear at one needle for a direct current, and at the other for the reversed current.

By receiving with two needles side by side, all the alternations are recorded, those that were suppressed before now appearing at the second needle. The record then appears as two parallel lines of marks having the maximum intensities in one line opposite the spaces in the other.

The same message was then received in two lines, and one line gave the complete message as before, while in the other line there appeared a record for each complete unit in which the current was made. The papers of either the first or the second half of each complete cycle composing the message upon the wheel were next removed, and the message received in two lines as before. The result showed the message complete in one line, while in the other line appeared an uninterrupted succession of marks just as given by the simple alternating current received in one line.

If then an uninterrupted line of marks can be received in one line at the same time that a message is being received in the other, this uninterrupted line can be used for a second message entirely independent of the first. The next experiment accomplished this, and it is now possible to use the same line to send two entirely independent messages in the same direction at the same time at a high rate of speed. The preparation of the transmitting tape to accomplish this, simply requires that the two messages, each prepared with a double unit, shall be displaced a semi-cycle with respect to each other as they pass through the transmitter.

It is desirable in many cases to manifold the original copies of the message received, and experiments were made to accomplish this. All that is necessary is to attach to one terminal, instead of a single needle, as many needles as the number of copies desired, having each make its record upon a sensitive surface.

The alternating current is adapted to use with condensers in series with the line where a direct current cannot ordinarily be employed. An experiment was carried out to send a message through a condenser having a capacity of 9.57 microfarads in series with the line, and it was found that the message was transmitted correctly. One object of this experiment was to establish the possibility of using a set of Morse instruments upon the line at the same time that the messages were being transmitted at a high rate of speed by the alternating current. By shunting condensers around the set of Morse instruments it was found that the opreation of either system did not affect the working of the other, so that it becomes possible to use the same high speed line for a complete system of quadruplex telegraphy at the same time. Indeed it seems possible that the present Wheatstone system could be operated over the line in conjunction with the alternating current messages.

The use of the alternating current as a means of sending intelligence in connection with the fact that a message can be sent through condensers, suggests the possibility of using the principles of electric resonance employing circuits having natural periods of their own which will pick out and respond to currents from the line having their own frequency.

A characteristic of the records made by electrolysis is the natural separation of the positive and negative waves of current, which is an advantage in interpretation. This separation is also accomplished in the polarizing receiver by employing two receiver tubes.

A TELEGRAM FOR A PARADER.

"The telegraph messenger," said an old-time messenger boy, "has to deliver messages in many strange places. I saw on the day of the Grant celebration, the delivery of a dispatch to a man in the procession. It might seem as though it would be difficult to find a man in a procession, he being, in such a procession as this, one man among fifty thousand, and it might be difficult under some circumstances, but ordinarily it would not be, for the messenger would in all probability start with a knowledge of the regiment and company to which the man to whom the despatch was addressed belonged, if he did belong to such an organization, and then all that would be necessary would be to locate the organization, a task comparatively easy with the aid of a programme and a little figuring as to how far the regiment would march in a given time.

"This message that I speak of was for a member of the staff of the Governor of Ohio, then riding up Riverside Drive. Its prompt delivery was as simple a matter as rolling off a log. The Governor and his staff were singled out without the slightest trouble by means of their State flag. Without the slightest hesitation the boy tackled the Governor and handed him the dispatch. The Governor saw at a glance that it was not for him and motioned the boy toward his staff. The boy tackled then the first man he met, and that member of the staff indicated to him the member to whom the despatch was addressed. The messenger promptly delivered it. To find the right man he had found it necessary to go to but three men out of fifty thousand."

ELECTRIC TRANSPORTATION

AMERICAN STREET RAILWAY FINANCE.—V.

BY E. E. HIGGINS.

(Concluded.)

THE return circuit has always been a source of weakness in electric railroads. Originally, galvanized iron bonds were put in, but practice soon changed to copper bonds. There has been always more or less corrosive or electrolytic action between the iron of the rail and the bonds, and the bonds have given considerable trouble in their way. They have been recently improved very materially, and now are perhaps of nearly equal efficiency to overhead appliances, but are by no means perfect and are always likely to give trouble. It is probable that the return circuit in most cases cannot be made by bonds alone, but some form of supplementary return wire will be necessary. The original method was to put supplementary wires in the center of the track, and connect them with the different rails, but the practice now is to establish certain centers of current collection as it were, from which centers the current is drawn off to the stations through return feeders carried on poles, or in some cases, underground, where the earth is of a suitable nature.

I think in large systems these return feeders are necessary and should be adopted, and there should be great care taken in making frequent tests to determine the difference of electromotive force between the rail and water and gas pipes which are underneath the rail. The electrolytic action on the gas and water pipes is a serious matter, but it can be cured. The cure lies broadly speaking in the destruction of any difference of potential between the rails and the pipes. The instant you have a difference of potential, you have a flow of current and that flow of current will destroy the pipes. The methods of preventing differences of potential from arising are pretty well known, and consist in localizing it in certain places. The area near the power stations is the most dangerous, and that remote from the power station gives very little trouble. If you provide as nearly perfect bond connection of your rails as can be had, and bind the rails and the water pipes together, where the difference of potential is great or the earth resistance small, there will generally be little trouble from electrolysis.

Underground conduit roads are often urged as a cure for the evils of the overhead system. They certainly are a cure in many respects. None of us like the overhead wires, and we would all be glad to get rid of them. The difficulties in the way are obvious, chiefly in the matter of the initial cost, and consequently of the return on the investment. The open conduit now being put in in this city is probably as inexpensive as any open conduit can be. It is made quite shallow, much more so than cable conduits; it is built from the top down and not from the bottom up, so that it is not necessary to provide the foundations which are found in the old construction, and the conduit is apparently worked with entire success and economy, the initial cost being the principal item against it.

There has been a good deal of talk about closed conduits, and it is certainly true that closed conduits are theoretically very pretty devices, and if we could put aside certain practical disadvantages, we would have something quite interesting. The main disadavantage lies in the installation of 500 to 1,000 pieces of mechanism per mile of track. You have the magnets, armatures and contact points, and to have 1,000 of them for every mile of double track, or even a less number, is to make it almost certain that sooner or later, and probably very frequently, some one, or a number of them, are going to get out of order and give trouble and block the line. There is one thing that the street railway manager is certain about—his line must not be blocked under any circumstances.

Another serious disadvantage of the closed conduit lies in the liability to sweating inside the tube due to condensation of moisture in the atmosphere. It is impossible to keep air out and impossible to make perfect joints where the contacts come, and I am pretty sure that, as a matter of fact, closed conduits would give serious trouble from this and other sources.

The matter of road bed is one of which I shall say very little. The standard construction to-day is with deep girder rails, nine inches where paving blocks are used, and seven and eight inches where other forms of pavement are used, or where paving blocks are of smaller size. With joints of sufficient strength, we hope this construction is going to be good. As a matter of fact, however, I think that the difficulty with these deep girder rails is going to be found at the joints, and less in the pounding of the joints themselves than in flattening out and forming hollows, due to the rails having insufficient carbon. I am not an expert on the subject of rail manufacture, but this thing is certainly true, that steam railroads are specifying higher percentages of carbon than they have ever done before, and are consequently getting rails which are harder and ought to withstand wear better. It is true that we can go still higher in carbon in street railroad rails than the steam railroads can, as far as the liability to accident is concerned, which is one of the limiting features in steam railroading. Steam railroads cannot afford to have a rail break; it means usually an expensive accident, and a tremendously expensive accident if it is a passenger train. Electric railroads have no such limitations. There is no serious liability to an accident on account of a broken rail. The rails are imbedded in the pavement and cannot move upward or sidewise to any material extent.

I believe firmly that street railroad managers ought to investigate very carefully the results obtained with rails of different percentages of carbon and other elements and take into account in general all the features of rail composition so as to get a strong, tough, hard rail, and something that will not "squash" from softness, as many of the rails are doing.

There are any number of different kinds of joints. The ordinary channel plate joint has been found to be too weak if less than thirty inches in length, and thirty-six inches, and even greater lengths are put in by conservative roads. Cast welding and electric welding are in use to some extent. Cast welding is the living hope of a great many roads, not only in new construction, but in bringing up the joints of old construction. We do not know enough about it yet to predict surely what the results will be. There are many patent joints, some of which are good, and some are worthless.

The special work is always an important feature of track construction, an extremely expensive feature, and one which ought to be considered with great care to have the rails and grooves fit the wheels. That is to say, the wheels and the track in general, and the special work in particular, ought to be determined upon in view of their mutual relations. It is something which is not done to any adequate extent, and street railway companies are discovering this to their cost, and will continue to do so if they do not make a radical change. Where wheels grind out special work, or special work breaks wheels, something is wrong.

The rolling stock of America is, I suppose, better than that of any country in the world, and is really well constructed. The cars are lighter, more elegant and their lines are laid out with the idea of getting great strength with the least weight. As far as the seating arrangements are concerned, it is difficult to see any improvement from the point of view of the public. Some of the long double truck cars are as comfortable and easy to ride in as can be desired.

The trucks are an interesting portion of the rolling stock, and there is, of course, a large variety of them. The style of the old horse railway truck, which was followed for a short time with electricity, was to fasten the car bodies directly to the axle boxes. The independent motor truck was then developed and is in exclusive use to-day. With single truck cars, one of the grave difficulties is the oscillation of the car body, particularly when speeds are considerable, and this oscillation is prevented in many cases by the extension of the spring base to a considerable portion of the entire car length. Sometimes, however, unless the spring is carefully graduated, there are difficulties introduced in a peculiar jarring motion of the car, which is disagreeable to the passengers, and great care must be taken in the manufacture of trucks to avoid this.

Hand brakes, air brakes, electric brakes, mechanical brakes, all have their place and all are being experimented with, with a good deal of care to determine some means of keeping down the accident account. It is hard to tell where the best results will come. There is much to be said in favor of each, and all must hope that the very distressing accidents which occur at times will in some way be prevented, both because of the street railway companies' exchequers and on the score of general humanity.

I must omit discussion of the electric equipment apparatus, as it is far too broad a one to undertake at this late hour.

REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.—II.

BY HAYWARD COCHRANE AND E. J. SWARTOUT.

In Fig. 4 is shown a Pullman motor car, representing a leading type of such apparatus for high speed work. The windows are so designed as to make the car convertible to meet the requirements of the seasons.

The arrangement of partitions should be about as shown on the plan Fig. 5 for suburban and small cross-country roads where the motor car is used for baggage, express, mail and smoker. For a road operated by direct current, it would be a nice arrangement to have the lights, and possibly the heaters, in each car fed from independent groups of storage cells. In case the train became stalled from failure of power circuit, the lights at least could be kept on for a considerable length of time, probably until the power circuit was put into working condition again. By charging batteries in series and connecting lights to groups at lower voltage there would be greater safety in controlling them and they would be less subject to flickering than in the case of present manner of connecting. By having skilled motormen, a saving in energy used to accelerate trains could be effected and the item of depreciation of rolling stock reduced to a minimum.

The speeds attained by elevated and ordinary suburban trains is about 30 to 35 miles per hour maximum, which is doubtless high enough for frequent stopping. For express suburban service, however, considerably higher speeds, say, of 40 to 45 miles per hour, might be advisable. For suburban service it would seem best to use elevated or partially elevated track in city limits, with no grade crossings, and a third rail trolley, but for the suburbs to have the overhead trolley, since it would be impracticable to use the third rail where there were street crossings at grade.

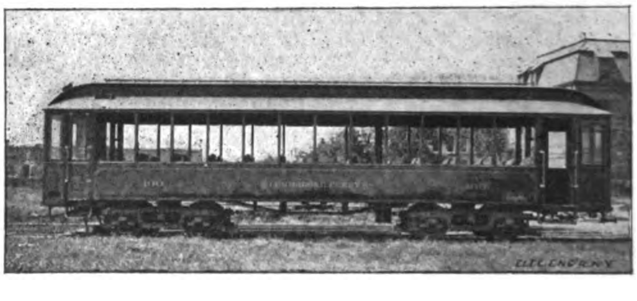
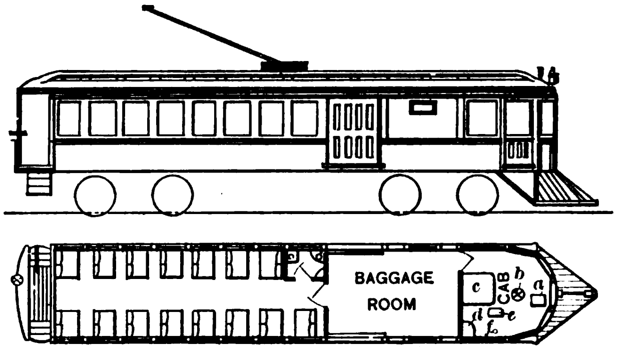


Fig 4.

We are informed by the Walker Manufacturing Company that one of their 32-ton motor cars equipped with four 50 horse-power motors hauled six open coaches, each of 10 tons, at a speed of about 30 miles per hour, the total load upon the motor car and coaches being 670 persons. An ordinary trolley with No. 00 trolley wire was used and gave very satisfactory working. The total weight of empty motor car and coaches was 184,000 pounds, and assuming 150 pounds per passenger the total load was 105,000 pounds, or a load per car of 15,000 pounds. The total train weight would, therefore, be 284,000 pounds on 142½ tons. Assuming a tractive power of 27 pounds per horse-power of motors or 5,400 pounds for the four motors, the tractive power per ton of train was 37.8 pounds, or a little in excess of that for the largest Rock Island train, while the adhesive power was 14,400 pounds, or 166 per cent. of the tractive, or a trifle in excess of that for the Rock Island locomotive or the elevated railway motor cars.

For heavy suburban services, assume a train of five closed coaches hauled by a motor car equipped with 250 horse-power nominal capacity, either four motors of 62½ horse-power, one to each axle, or two motors of 125 horse-power linked to pairs of axles, so as to obtain the full adhesive weight of the motor car, all its weight then being upon the drivers and, therefore, effective weight. If closed coaches of 32,000 pounds were used, five loaded coaches would weigh 210,000 pounds or 105 tons, but the six loaded coaches of the Walker train weighed 103 tons, assuming 1-7 of the total number of passengers to be in each coach. We may therefore assume for a heavy closed car train of five coaches a motor car of about 35 tons, or 70,000 pounds, this, plus a load of 10,000 pounds, or five tons makes a total train weight of 145 tons. Assuming an approximate tractive power of 27 pounds per horse-power, gives 6,750 pounds as the tractive power of the suburban motor car. Assuming an average weight of motor car of 37 tons, we have an adhesive power of 16,650 pounds, or 146 per cent. of the tractive power.



Elect. Eng'r., N.Y.

FIG. 5.

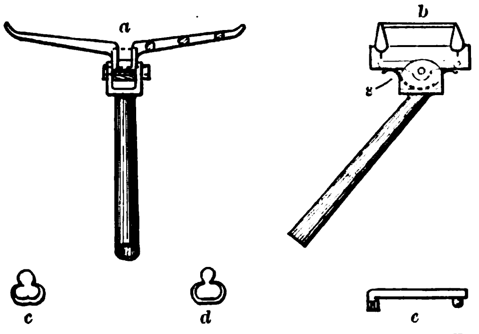
With a direct current power system working at 500 or 600 volts pressure, say, 600 volts (which would probably be best for any ordinary length of suburban road of about 15 miles, not over 20,) a current of about 440 amperes would be required for the full rated capacity of the motors. On starting the train, a much larger current would be called for under ordinary conditions, a current which would be excessive for passing through such contact surface as would naturally obtain with the trolley wheel. To obviate this difficulty, we suggest the use of a trolley shoe substantially as shown in Fig. 6 (a and b); the shoe is shown separate at e. If this shoe were of metal, the trolley wire shown at c and d might have a soft steel shield rolled upon it to take the wear; or if the shoe were made of a mixture of plumbago and carbon, the plumbago would act as a lubricant and the ordinary hard drawn copper trolley wire could be used. The holder of the shoe can be made very light and provided with arms, as shown at a, which are intended to extend only high enough at the sides to catch the trolley wire whenever by accident the shoe might leave it. The upward pressure of the shoe need be no greater than that now employed in the case of the trolley wheel. The shoe is designed to be about 7 inches long and wide enough to follow any ordinary curvature in the trolley wire. The shoe holder is pivoted at right angles to the trolley wire and rests against a half-elliptical spring, s, which allows the shoe to fit to the wire while the angle which the trolley pole makes with the wire may vary considerably. The contact surface between the wire and the shoe is so much greater than with the trolley wheel that a much greater current can pass with no increase in sparking.

For short cross-country railroads of 30 to 60 miles length with light traffic and for long trunk line roads, it would seem almost out of the question to use the direct current system. The ideal for such lines would be the alternating current complete from generating station to car axle. At the present time, however, there seems to be no practical method of operating such a system. In order, therefore, to operate successfully such roads, taking into consideration the cost of installation and interest thereon, one of two lines of engineering should probably be proceeded upon. In either one the use of the alternating current at a pressure of 10,000 to 20,000 volts with step-up and step-down transformers for transmission from a central generating station to substations at intervals along the line, for roads 30 to 100 miles long would be used. One plan would be to place at each substation static and rotary transformers which would furnish direct current to The controller lever (Fig. 3), is shown as having a catch or dog which engages with notches in a quadrant. Looking from the pivot of the lever as shown, the narrow notches at the left are for varying the field strength of the rotary transformer when the motors are in plain series connection. The first wide notches are for making the changes in the commutations of the motor field windings, the motors still being in series. The set of narrow notches is for varying the field strength of the rotary transformer when the motors are connected in plain multiple. The second set of wide notches at the right are for making the changes in the commutations of the motor field windings, the motors being connected in multiple. In stopping the train, the controller could be arranged so as to break the current over a large number of points simultaneously and instantaneously.

By placing both static and rotary transformers in the substations, the cost of copper for sub-feeders at 500 volts for a road of any considerable length would be enormous; besides, there would be extra cost for attendance at substations, and in considering such an outlay, the probable business to be done by the road would have to be carefully estimated. For heavy trains and very high speeds, moreover, Mr. Wm. Baxter, Jr., estimates that electric locomotives should have a maximum horse-power of at least 1,250. This, on a 500-volt circuit, would call for more than 2,000 amperes and would necessitate an extremely heavy overhead construction if a trolley were used. If the third rail system were used there should be no street crossings at grade, and in countries where snow falls there would be an endless amount of trouble at times with the third rail on account of drifting. By placing the rotary transformers on the locomotives and having a pressure on the trolley wires of 1,000 to 2,000 volts, it would be necessary to insulate specially the conductors leading from the trolleys to rotary transformer from the frame of the locomotive, which fact would almost prohibit the use of the rails as one side of the circuit.

The tri-phase alternating system seems to be better suited to this class of work than the single or two-phase system. because it would save about 25 per cent. of the copper necessary for the former system. The trolley wires and feeders could be of comparatively small cross section, so that the overhead construction need not be extremely heavy, though it would of necessity be quite complicated. While the double and triple trolley system would have many objectionable features, yet they seem to offer at the present time about the best solution for the conducting system of long distance electric traction. In planning the static transformer substations it would be well to install at alternate stations a duplicate or relay transformer bank so that in case any working transformer bank became disabled it could be cut out and the sections of the road not over 15 miles long at a pressure of 500 to 700 volts and use a single trolley and rail-return circuit.

The other plan would be to have the substations further apart than in the former case and to install in each one a bank of static transformers which would deliver an alternating current of 1,000 to 2,000 volts to double or triple trolley wires of small cross section; then to have upon each motor car or locomotive a rotary transformer of a capacity ample for any demand made upon the motors, which would receive direct current from it at 500 volts pressure. The efficiency of fully loaded static or rotary transformers is high, and is very good at medium loads.



Elect. Eng'r., N.Y.

FIG. 6.

By using this system also, a special method of control might be employed. In connection with series motors, use the series-parallel commutated field method as previously herein suggested, and if greater ranges of speed were desired it might be practicable to vary the field strength of the generating side of the rotary transformer by means of a rheostat.

relay cut in temporarily. The pole line should consist of iron pole construction, and the erecting and spacing of distances should follow the plan of the best street railway installation, except that specially designed double insulating trolley wire hangers and feeder wire supports should be used. The locomotive should be provided with an electric brake as well as an air brake for very high speed service as an extra factor of safety; a brake similar to that of the Sperry design might be employed.

The arrangement of the locomotive cab for a combination baggage and smoking car is shown in plan view in Fig. 5. The rotary transformer, c, is shown slightly to the left of the center line of car and at the rear of the cab opposite the motorman's seat. The latter, d, is close by a sliding window similar to that of a steam locomotive. The controller, f, is at his left and slightly to the front and close to the rotary transformer. The air brake valve, f, is in front of the motorman and close to the side of car. The hand brake, b. is close to the controller at the front of car. The air pump, a, is in front and slightly to the right of center line of car so as to counterbalance, with the weight of controller and rheostat frames, which are not shown, the position of the rotary transformer.

For heavy trunk line work an independent locomtive should be used in which case the rotary transformer should be placed at the middle, and the air pump and rheostat frames disposed so as to counterbalance the weight of the controller which could be at one side. By not using the rails for one side of the power system, an electric block signal system could be employed which could automatically stop a train in block No. 1 if block No. 2 were not clear.

Each train should be provided with a hand telephone, and the line supplied with a metallic circuit with branch blocks about eight to the mile so that disabled trains could easily get assistance from the nearest station, using the batteries at that station for telephoning. Terminal facilities in large cities could be supplied by 500 volts direct current on the single trolley or third rail system, and if tracks were partially or wholly elevated, as they should be, this plan would work very nicely.

THE BEAUTIES OF THE ECKINGTON AIR MOTOR CAR.

By T. P. KANE (Washington, D. C.)

WHILE the experiments made in Washington during the past several weeks have tended only to strengthen my belief that compressed air cannot successfully compete, mechanically or commercially, with electricity as a motive power for surface street railways, Congress having declared that the former shall be given a fair trial on the Eckington line, the system should be earnestly, fully, and fairly tested, instead of the time limited by law for its trial being frittered away by such unsatisfactory and indefinite performances as have been witnessed since the experiment began.

Being curious to know whether, in my estimate of the car on trial, I was blinded by the prejudice which I am charged in some quarters with having against compressed air in any form, I interviewed a number of persons who have ridden upon it, with a view to learn their opinions in regard to it, with the following result:

Mr. S. M. Gaines, of Brookland, said:

"My experience in riding on this air car makes it plain to me that it is not a success, mainly for the reason that it has not sufficient power to ascend even a moderate grade. It seems to me also that the heat produced by the smokestack which runs through the car would be intolerable in summer, and the dust drawn into the car by suction must necessarily be very disagreeable to passengers. Taken altogether, the car seems to me to be a very crude experiment."

Mr. L. O. Murray, a student at the Catholic University, said: "I have ridden on the car several times, but have had quite enough of it. I always wait now for the horse car, preferring to sacrifice a few minutes of times in traveling by slow horse than to reach the city in a cloud of dust, and in odors that remind one of an engine room when the cleaning process is in full blast. The smoke and odor from the fire which the car carries, together with the dust which it sucks up through the grating in the floor over the fire, makes riding on it so disagreeable that I have abandoned its use entirely. I do not see how a car with all the disagreeable conditions displayed here can ever be satisfactory to the public."

Mr. R. R. West of Brookland said: "I have been on the car a number of times. My judgment of it is that it cannot be considered a success, except so far as it seems to be able to make a good speed on the level. The heat, for one thing, from the smokestack is very disagreeable on a warm day. I had occasion to sit beside this pipe one morning when the car was crowded, and found it decidedly uncomfortable. I should think this feature of it would make it a very unpleasant car to ride in in summer. Another disagreeable feature of it is the odor which arises from the fire underneath the floor and the cloud of dust which it seems to draw up through this opening when the car is in rapid motion. I am not favorably impressed with the car."

Mr. W. P. Armstrong, of Brookland, said: "I have not been a frequent rider on the car, and do not consider myself competent to pass judgment upon its merits. I have noticed, however, that there is considerable heat thrown off from the smokestack in the car, and not a very pleasant odor escapes from whatever sort of fuel is used for the fire which the car carries. Smoke and dust seem also to fill the car through this opening in the floor. Taken altogether, I do not think it will prove satisfactory; but, if adopted, might be an improvement on horse service, in so far as speed is concerned, until we can get something better."

Mr. Bernard Waters, of Quincy street, said: "I have not ridden on the car much, because I have not been able to find it. When I have been on it it has had to stop at Quincy street to let me off, and has hardly been able to surmount the insignificant grade at that point leading up to R street. I have watched it go up the hill, and it was as much as it could do to get up, and then only by puffing and snorting like an old freight engine. It is like everything else connected with the Eckington road—no good, and, like that old dromedary they run over a year on North Capitol street, they will use it as long as they can get it for nothing. Instead of giving us a good service, like is used in other sections of the city, I suppose they will try to foist this infernal machine upon us for the next few years as a time-killer. I do not regard the car as a success, and Mr. Schoepf knows it is not."

Mr. T. T. Moore, of 55 R street, said: "I have ridden on the air car whenever I have been able to find it, and I think it is the crudest form of rapid transit I have ever been on. Between the cloud of dust that it seems to move in, the smoke from the fire under the car, the heat from the smokestack in the car, and the odor from the coke that they burn all combine to make it anything but a satisfactory form of rapid transit such as is required by the act of June 10, 1896."

The foregoing are a few samples of a stock of similar opinions which I have collected, but the length of this communication prevents their publication.

My own experience in this car confirms everything these gentlemen say of it. I have seen men on it roll their coat collars up and button it across their bosom to keep out the dust. I have seen ladies use their handkerchiefs to keep the dust and odor out of their noses. I saw two ladies signal the conductor to stop the car, and one of them in passing me said: "Let me off this car or I'll choke to death," and she got off it coughing the dust out of her throat. Another one said: "I can taste the odor from that fire," and no end of complaints and comments can be heard about the heat from the smokestack.

Its operators say the dust is due to the cobblestone pavement on New York avenue, and that any other rapidly moving car would raise the same cloud, but it matters not whether it be on asphalted G street or cobblestoned New York avenue, the experience is just the same.

Receiver Schoepf claims to have been experimenting with cold air when the car got stranded on the Eckington grade, yet he knows full well that at that time the car had on it the same old fire pot and hot smokestack, and that it was impossible for him therefore to pass the air through the coil of pipe to the cylinder without its being heated. He also knows that experiments with cold air have been tried and failed years ago, and that if he had been making an experiment as alleged he would have done it under cover of darkness, as he tried the grade of Louisiana avenue, and has not dared to repeat it in daylight unedr the public gaze. Mr. Schoepf cannot blow hot and cold upon public credulity in that sort of fashion.

BIG TROLLEY DEAL IN ST LOUIS, MO.

The largest street railway deal in the history of St. Louis was completed recently when a controlling interest in the Missouri Railway Company was transferred to parties who represent the Lindell Railway Company. Nearly $2,000,000 is represented in this transfer. The Missouri Railway Company operates three lines—the Olive street cable, the Market street and Manchester electric road and the Laclede avenue electric. Its authorized capital is $2,500,000, of which about $2,200,000 has been issued. The par value of the stock is $100 a share, but it has been selling at $150 recently. The price at which this transfer was made is said to be $165. The bonded indebtedness of the Missouri Railway Company is about three-quarters of a million, and the bonds are above par at present.

ELECTRIC LIGHTING

STEAM HEATING FROM ELECTRIC CENTRAL STATIONS.

BY I. H. BABCOCK.

WE frequently get inquiries from electric station managers in relation to the distribution of their exhaust steam for heating by the Holly system, buit by the American District Steam Company, of Lockport, N. Y. This has been a subject of growing importance since the advent of electricity as a motive power. Every city or village of any importance has its electric lighting plant, or a railway system in which electricity is the motive force. In some instances they are combined. Except in a few cases where water power is available, a steam station is at the foundation of the enterprise. These expensive boiler plants have multiplied rapidly with the growth of the electrical business.

In engine work between eight and nine-tenths of the steam which is generated escapes through the exhaust pipe after doing its work in the engine. This has caused the question to be raised as to whether this waste product might not be used for heating, thereby increasing the profits of the company operating. In gas manufacture, and in oil and sugar refining, the by-products are a vital part of the business, and no concern could successfully compete that allowed these to go to waste. Enough has been demonstrated already to show that the matter of heating by the exhaust from stations is of so great importance that it should be investigated by all companies whose stations are suitably located contiguous to heating territory.

The Springfield, Ill., Electric Light, Heat and Power Company has been operating such a plant for the last six years, and, we are assured, with great success. They have several times made extensions of their heating mains, and claim that they have paid the expense of installing the steam system two or three times over out of the net profits from heating. This company is not more favorably situated than scores of others.

The additional cost of operating is very slight, as the station expenses for labor remain the same, and office expenses are not increased. The coal account is but slightly increased, except that at times some live steam may be required when some of the engines are idle.

Another company in the West is heating in the same way by exhaust from its railway and lighting power station. Ten million cubic feet of space is being heated. Here is what the manager says: "We are operating six high-speed cross compound engines, four 150 horse-power, and two 250 horse-power each; also three 75 horse-power Armington & Sims high speed engines, single expansion. We carry 2 pounds back pressure on our engines for heating in moderate weather, and about 5 pounds in zero weather. We do not notice any difference in the working of our engines on account of the back pressure. We have about 1,000 horse-power in boilers." It will be seen that both compound and simple expansion engines are being used without embarrassment. The testimony here and in other places is to the effect, that, if the boiler pressure is raised by the amount of pressure required in the heating mains, no difference can be seen in the working of the engines.

Where individual steam systems of heating are in use they can easily be connected with the heating mains, and we are informed that scarcely without an exception they at once adopt the district plan. As these small boiler plants are all run at low pressure, the low pressure from the exhaust mains performs the work to even better advantage, because there is a constant supply at all hours. This enterprise is comparatively new with the electrical companies, but it has been adopted already in a good many places, and we think the matter is worthy of the attention of station managers generally.

THE WALKER ARC LAMPS.

FOR some time past the Walker Company, at Cleveland, has been engaged in the development of a complete arc-lighting system, and the first of the details of this system to make its appearance are their new arc lamps, a view of which is given in Fig. 1, which represents the out-door type.

In compliance with the general demand for a short arc lamp, the new Walker lamp is only 34¼ inches long, while the length of a fresh trimming of carbons is 26, thus making the lamp only 8¼ inches, or 32 per cent. longer than the length of carbons employed.

The Walker arc lamp has been designed with the idea of obtaining the steadiness of the rack feed and simplicity of the clutch, the rod being done away with entirely. In its place there is substituted a wheel of small diameter with an accurately turned rim on the edge of which the clutch operates. The carbons are fed by a chain, as shown in Fig. 2, and this chain drives a sprocket wheel, mounted on the same spindle that carries the clutch wheel. Both carbons are fed, and the arc remains practically stationary. Another improvement is the connection of both carbons positively with their sources of supply by means of flexible cables.

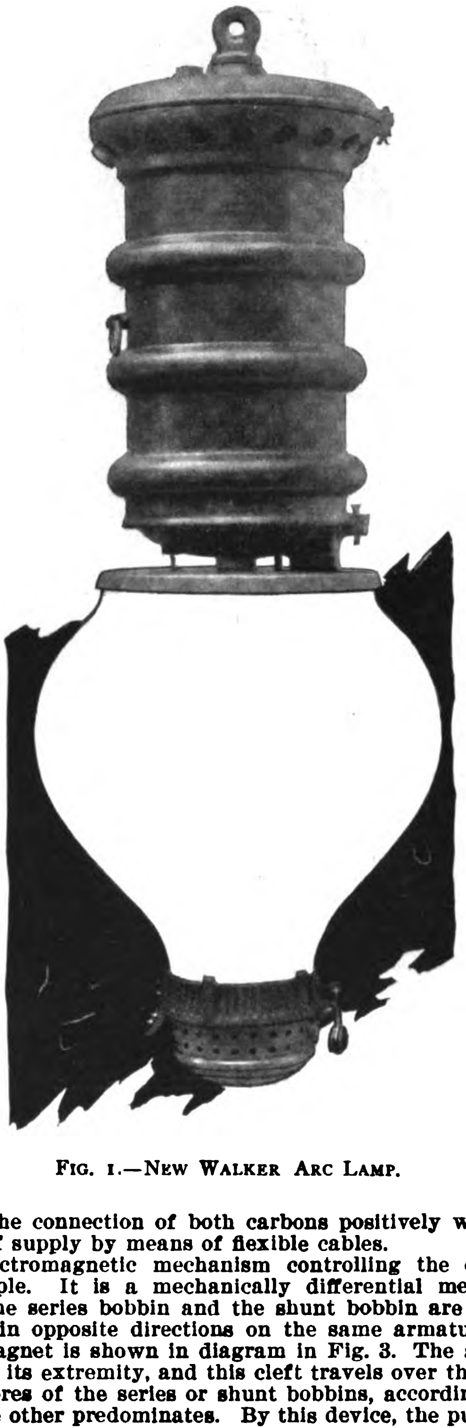


FIG. 1.—NEW WALKER ARC LAMP.

The electromagnetic mechanism controlling the clutch is very simple. It is a mechanically differential mechanism, that is, the series bobbin and the shunt bobbin are separate and pull in opposite directions on the same armature. The electro magnet is shown in diagram in Fig. 3. The armature is cleft at its extremity, and this cleft travels over the wedge-shaped cores of the series or shunt bobbins, according as the one or the other predominates. By this device, the pull on the armature is made uniform throughout its travel, and there is no need of weights or springs.

The electrical connections of the lamp will be understood from Fig. 3. When the lamp starts, there are across the terminals three paths, and two that are important. One is a resistance of about 1 ohm as shown. This resistance performs an important office that will be presently considered. The second path is through the carbons, which are together, via the series coil. The third is the shunt bobbin, but at the start the current in this part is too small to be considered. The resistance is of such proportion that enough current passes through the series coil to start the lamp the moment the armature moves, and when the carbons are drawn apart R is cut out by a special cut-out, which is diagrammatically shown in the figure. The voltage of the lamp rises to its normal value. The shunt coil takes hold and regulates and feeds the lamp in the ordinary way.

There are two distinct automatic cut-outs in the Walker lamp which act under different circumstances. They are both mechanical and one is operated by the same mechanism that operates the carbons and the other by the upper carriage which supports the upper carbon.

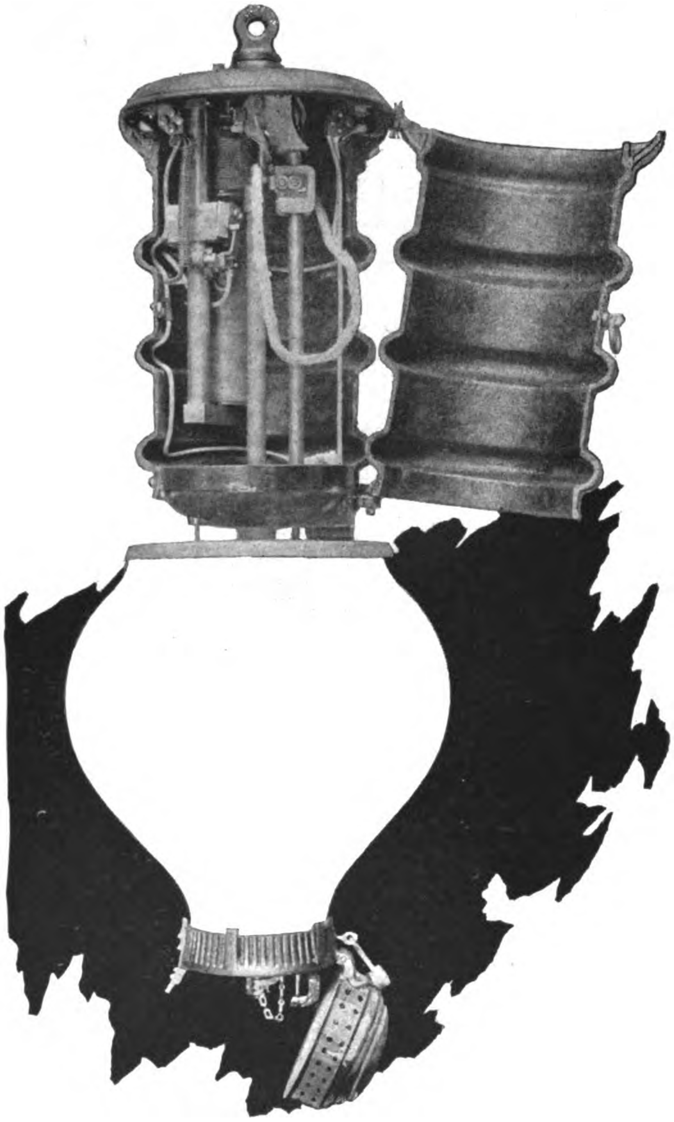


FIG. 2.—NEW WALKER ARC LAMP.

The latter, which is in the base of the lamp, dead short-circuits the lamp when the carbons are burned out, and as stated above, is actuated by the weight of the positive carbon carriage, which descends directly upon it. This cut-out is also moved by a lever from the outside when it is desirable to cut out the lamp for trimming or any other purpose.

The other cut-out has the same functions that the ordinary cut-out in a series arc lamp always has, namely, to provide a shunt circuit for the current in case the carbons stick and fail to feed, or in case either carbon should be broken, or through some accident become unduly separated. It also provides a path for the current when the carbons are consumed, if for any reason the cut-out in the base of the lamp fails to act.

The resistance which is inserted between the positive terminal and this cut-out is for the purpose of shunting sufficient current through the series coil and carbons to start the lamp, and is common to all differential series arc lamps. In the Walker lamp, this resistance is made of especially high resistance wire, having a resistance approximately three times that of German silver, and also having mechanical properties, which are such that it can be heated to redness without affecting it in any way.

The convenience of the Walker arc lamp is one of its main features. Both the carbons are clamped at one end with a universal joint, and are made to nose together by two centering rings, which are as near the arc as is practicable. The upper centering ring consists of a bushing in the base of the case. The upper carbon is contained in the case with the mechanism and feeds out through this bushing. The globe is readily lowered for trimming and is covered with a reflector plate, which performs the double service of arresting the sparks and reflecting the light downward. The carbon dust can be brushed in the dust cap below, which can then be removed and emptied. These features are well illustrated in Figs. 2 and 4. It is important to note also that no part of the lamp frame is alive. The arc is practically stationary, and the

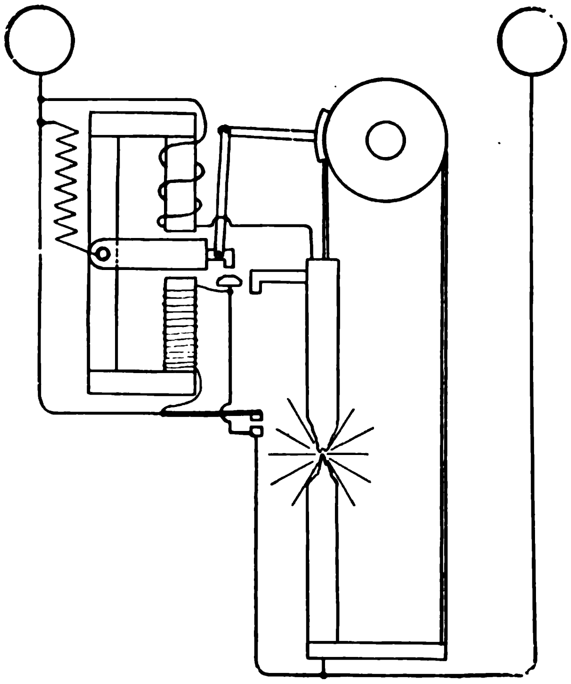


FIG. 3.—NEW WALKER ARC LAMP.

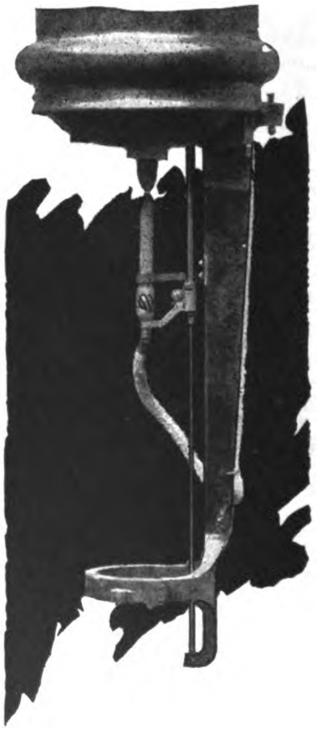


FIG. 4.—NEW WALKER ARC LAMP.

heat on the globe is therefore uniform and not liable to crack it, as is the case with the traveling arc.

The Walker Company also manufacture an enclosed arc lamp. We understand that their new arc machine will be ready for the market soon.

SOCIETY & CLUB NOTES

THE ELECTRICAL ENGINEERS' MEETING AT GREENACRE, ME.

With regard to the proposed meeting of the American Institute of Electrical Engineers at Greenacre, Me., the following details will be of interest:

In 1894, Miss Sarah J. Farmer, daughter of the late Moses G. Farmer, the well known pioneer in electrical discovery and invention, established at Greenacre, Eliot, Me., a unique and interesting movement for the education and elevation of the people. It was not a "Summer School" in the ordinary acceptation of the term; but a place where all the advantages of summer rest and recreation of a rational character could be combined with rare opportunities for the development of the higher nature.

The leading idea of the Greenacre lectures was peace and unity, to be sought through the presentation and comparison of the constructive places of progressive thought in every field of study and investigation. The platform was broadly ethical and purely humanitarian. Physical rest was sought through the quickening and energizing of those spiritual, mental and moral faculties which are too often neglected in the struggle for existence under the high-pressure methods demanded by our modern civilization.

The Greenacre movement was morally a success from the start. Lecturers of the highest ability contributed their services without money and without price. Weary workers with brain and pen found hope and inspiration in the words of life which came from the lips of speakers inspired by the highest ideals, and giving freely of their best thought under the rare influences contributed by the natural beauties of the place and the atmosphere of rest, peace and unconventional social life which prevails at Greenacre.

The little Inn has been taxed to the uttermost each season to accommodate those desiring to avail themselves of the privileges of the place, overflowing into a colony of tents and the neighboring farm houses, and this year necessitating an enlargement of accommodations to meet the increasing demands.

Such speakers as the venerable Prof. Joseph Le Conte, of the University of California, Prof. Amos E. Dolbear, of Tufts College, Prof. Edward S. Morse, of the Peabody Institute, Salem, Mass., Dr. Lester F. Ward, of the Smithsonian Institution, Washington, D. C., Dr. John Fiske, the eminent historian and philosopher, Judge William C. Robinson, Dean of the Catholic University, Washington, D. C., the Hon. Carroll D. Wright, U. S. Commissioner of Labor, the Hon. Neal Dow, the Rev. Dr. Edward Everett Hale, the Rev. William R. Alger, Mr. E. D. Mead, of the "New England Magazine," Mr. Frank B. Sanborn, of Concord, Mass., Dr. L. Dickerman, the Egyptologist, Mrs. Mary A. Livermore, Mr. F. Edwin Elwell, the sculptor, and many others of equal note, have contributed their services at Greenacre, while from distant India the Swâmi Vioekânanda, the Swâmi Sâradânanda and Mr. Jehangier D. Cola, of the Parsi Community in Bombay, have come to emphasize and illustrate the cosmopolitan and unsectarian spirit of the Greenacre assembly.

Last year, this feature of the work took definite shape in the organization of the Monsalvat School of Comparative Religion, perhaps the first educational movement in the world exclusively devoted to the comparative study of religious ideas. The director, Dr. Lewis G. Janes, for many years president of the Brooklyn Ethical Association, and now the director of the Cambridge Conferences, has been identified with the Greenacre work from its first season. Courses of class lectures were given in the history and phylosophy of religion, the Vedanta philosophy and religion of India, the religion of Zoroaster and the Parsis, the religions of China, and unsectarian Christianity. This school will be continued during the coming season, with lectures on Buddhism, Hindooism, and Zoroastrianism, by native teachers, and the history and philosophy of religion and Christian origins by the director.

The Greenacre School of Music, established last year by Miss Mary H. Burnham, of New York, will also be continued next summer in a new building now in process of erection. The general lectures will be systematically arranged for the months of July and August (closing on the second of September) in weekly conferences upon the following topics: Peace and Arbitration, Business Ideals, Education, Evolution, Invention (especially emphasizing the progress of discovery and application in electrical science), Sociology, Psychology, Nature, Art and Comparative Religion. During the last week in July it is Miss Farmer's purpose to commemorate the fiftieth anniversay of her father's earliest work in the electrical field, involving the application of electricity to motor-traction—which has now become such an indispensable factor in the life of our great cities, and in solving the problem of suburban communication. The lectures of the conference during this week will commemorate different phases of progress in electrical science, and there will be an exhibition during July of interesting material illustrating the earliest attempts at motor-traction by means of electricity, and the subsequent evolution of this method of transportation. We understand that Miss Farmer has been assured of the co-operation of the Patent Office at Washington in obtaining material for this exhibit, from which a few early models will be taken. The loan collection will in the main be a graphic one. Any person possessing models, drawings, or any portable material, bearing upon this subject, and willing to permit its use in this exhibition, will confer a great favor upon Miss Farmer by communicating with her as early as possible, at Greenacre, Eliot, Maine.

The American Institute of Electrical Engineers, of which her father was an honorary member, the only American, therefore, elected, has decided to join in this interesting commemoration meeting by holding its annual meeting during the week beginning July 26 at Eliot. New cottages and dormitories are in process of erection, which, with the usual accommodations at the Greenacre Inn, and the fine hotels at Portsmouth and Newcastle, easily accessible by rail and carriage or by a steam launch plying on the beautiful Piscataqua, will afford ample accommodations to all who wish to avail themselves of this rare opportunity.

It is understood that in this noble enterprise at Greenacre Miss Farmer is carrying out substantially a long-cherished purpose of her large-hearted father and her noble mother, his life-long companion and inspirer in all his work.

He entered with enthusiasm into all his daughter's plans with regard to Greenacre and looked forward with joyful anticipation to the opportunity which it would give to call together in friendly conference the older and more experienced members of the electrical profession and the younger men, to whom the science open up such alluring vistas, with the purpose of emphasizing the power which resides in high ideals and impersonal work.

It is a happy chance indeed which permits the electricians of the United States, and their guests from abroad, at the British Association meeting, to participate in this most deserved and appropriate tribute to the memory, achievements and sterling character of one whom they delight to honor as a pioneer and master in the department of applied science to which their lives and labors are devoted.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

It is proposed to hold a subscription dinner, on the occasion of the annual business meeting and election, which occurs on Tuesday, May 18. The price of the dinner has been fixed at $2. In addition to the routine business of the meeting, a paper will be presented by Dr. Alexander McFarlane, and the paper on "The Synchronograph" presented at the meeting of April 21, will be taken up for discussion. It is the intention to call the meeting for 4 p. m., and adjourn for dinner about 7 o'clock.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. G. F. Porter, secretary of the association, says: "A great many inquiries are being received at this office regarding exhibits at the coming Niagara convention. For the benefit of those desiring to make an exhibit,I will state that no exhibition will be held under the auspices of the association; but from the tenor of our correspondence and personal interviews, we learn that many exhibitions will be made by our associate members in the parlors and rooms of the hotel."

NEW YORK ELECTRICAL SOCIETY.

At the annual meeting of the New York Electrical Society, which will take place at Columbia University on Thursday, May 20, some entirely novel features in the development of the thermopile will be demonstrated, with practical illustrations by Mr. H. Barringer Cox.

TELEGRAPHIC HISTORICAL SOCIETY OF NORTH AMERICA.

The third annual meeting of the Telegraphic Historical Society of North America was held in Washington, D. C., on the 5th inst., and the report of the proceedings and the papers presented on that occasion, show that in the short time the society has been in existence, it has become established on a firm and practical basis. Gov. Cornell was president during the first year; Mr. S. H. Kaufman, owner of the Washington "Evening Star," the second year, and at the last meeting the following officers were elected: President, Wm. B. Wilson, Pennsylvania Railroad, Philadelphia, Pa.; first vice-president, I. N. Miller, superintendent Western Union Telegraph Company, Cincinnati, O.; second vice-president, Francis W. Jones, Postal Telegraph Company, New York City; third vice-president, Wm. D. Sargent, Bell Telephone Company, Brooklyn, N. Y.; secretary and treasurer, George C. Maynard, Washington, D. C. Members of executive council: Charles Selden, superintendent Telegraph, B. & O. Railroad, Baltimore, Md.; J. Compton, superintendent Western Union Telegraph Company, Nashville, Tenn.; J. E. Pettit, Postal Telegraph Company, Chicago, Ill.; Wm. H. Young, Western Union Telegraph Company, Washington, D. C.

The society has adopted the novel and very useful method of publishing a book on the "instalment plan," its valuable reports and papers being printed and distributed to members, as soon as they are received, paged consecutively, and when enough mater to form a convenient volume is published, an index is to be furnished and the members will then bind the book to suit themselves.

Among papers already published, the most prominent is entitled "The Electric Telegraph in America," by Thomas D. Lockwood, of which two instalments have been printed, and the third and final instalment was read at the last meeting, and will be issued shortly. This history is written with Mr. Lockwood's usual careful and accurate manner, and will correct many popular errors. There is also a very valuable paper by the late Franklin L. Pope, on the "Genesis of the American Electric Telegraph," in which, that gentleman gives some newly discovered historical information, and corrects a misapprehension regarding statements made in an article written by him, for The Electrical Engineer in 1889, while he was its editor. A most excellent biographical notice of Mr. Pope, with a portrait, is also published.

At the meeting recently held, papers by George Kennan, J. B. Yeakle, Henry A. Reed, Wm. H. Young and Vice-President Miller were presented and discussed. The latter, giving a detailed historical sketch of the telegraph business in Cincinnati and vicinity, from the day the first line reached that city, contained an account of the pioneer work of J. D. Reed, Thomas T. Eckert, L. C. Weir, Dennis Doren, C. H. Summers, Geo. B. Hicks, M. C. Bristol, Anson Stager, S. P. Peabody, Dick Duncan and many other telegraph men who have become famous.

The Historical Society is continuing work of this character, and a number of its members are writing the history of other localities. Their sketches will be added to the society's publications from time to time.

REPORTS OF COMPANIES

BELL TELEPHONE OUTPUT.

The instrument statement of the American Bell Telephone Company for the month ended April 20 is the second largest in the company's history, the largest being a year ago. The net number of instruments put in lessees' hands was 13,181, making 45,579 instruments for four months. The comparative exhibit follows:

Month of April 20.	1897.	1896.	1895.
Shipments	20,426	21,525	18,794
Returned	7,245	6,330	6,253
Net output	13,735	15,195	12,541
Since Dec. 20.	1896-97	1895-96	1894-95
Shipments	73,735	76,518	50,157
Returned	28,156	28,462	25,225
Net output	45,579	48,056	24,932
Instruments in use	818,206	723,032	607,438

ANNUAL REPORT OF THE ELECTRIC STORAGE BATTERY CO.

President W. W. Gibbs has issued the following report to the stockholders of the Electric Storage Battery Co.:

The officers of the company submit herewith statement of the affairs of the company for financial year ending December 31, 1896;

Gross sales		$646,318.62
CONTRA.		
Cost of materials, labor and all factory charges	$362,142.21	
General expenses, including main and branch offices, commissions, legal expenses, taxes and interest.	142,178.09	
		504,320.30
Profit over all operating expenses		$141,998.32
Income from royalty and investments		6,801.28
Total		$148,799.60
Less interest on bonds		13,737.50
Net profit		135,062.10

As a means of comparison with the previous year, the following were the principal items:

Gross sales for 1896	$646,318.62	
Gross sales for 1895	328,231.40	
Increase of 1896 over 1895	318,087.22	or 96.90%
Income outside of manufacturing, 1896	6,801.28	
Income outside of manufacturing, 1895	2,218.48	
Increase of 1896 over 1895	$4,582.80	
Net profit, 1896	$135,062.10	
Net profit, 1895	2,982.40	
Increase of 1896 over 1895	$132,079.70	
Manufacturing cost, 1896	$362,142.21	
Manufacturing cost, 1895	247,938.54	
Increase of 1896 over 1895	$114,203.67	or 46.06%

You will notice that while gross sales for 1896 have increased 96.90%, the manufacturing charges have only increased 46.06%. The percentage of manufacturing cost to total output for 1896 was 56.03%. Same charges in 1895 amounted to 75.54%.

Up to the 31st of December, 1896, there has been expended in various demonstrations and applications of the use of storage battery, the sum of $41,408.75; this will be charged off to profit and loss. This is not a current expense, and it will not be necessary for the company to make any further expenditure in this direction. The various prominent applications of the battery made during the past year have demonstrated its commercial value in every respect.

The general expenses of the company, aggregating $142,-017.09, will not be materially increased if the company's business was more than doubled, in which event it will be clear that the proportionate profit will be largely increased.

PERSONAL

MR. FRANK J. SPRAGUE has received the contract for the equipment of the South Side "Alley" Elevated Railroad, of Chicago, with electric motors. This includes 120 cars, each of which will be equipped with two motors of 50 horse power each, thus making each car an independent unit. The first six cars are to be ready by July 1, and the remainder to follow in short order.

MR. T. A. EDISON has paid a visit to Toledo, O., and to the shops there which make a specialty of ore shoveling and crushing machinery.

MR. D. W. PEABODY has been elected general manager of the Fenton, Mich., Electric Light and Power Company.

MR. S. C. NORMILE has been reappointed superintendent of the Binghamton (N. Y.) Electric Company. He held the position for several years.

MR. D. THOMSON, of the Ithaca (N. Y.) Electric Railway interests, has gone to Hannibal, Mo., representing Eastern capital which has bought up and will extend the street railway system, building a new power house.

MR. J. A. JOHNSON, president of the Gisholt Machine Co., Madison, Wis., who was a member of the delegation that visited South America under the direction of the National Association of Manufacturers, has issued a very interesting illustrated pamphlet on his trip. It is well worth reading, for many reasons. Copies can be had on application to the Company.

MR. P. W. JOHNSON, manager of the Western Union Telegraph Company, at Lynn, Mass., has been making some improvements in the telephone, and is connected with some capitalists who propose to give the city a competing telephone service.

OBITUARY

MR. E. E. WINSHIP, JR., electrician of the light and power plant at Circleville, O., was scalded to death on April 29 by the bursting of a steam pipe.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

By MAX OSTERBERG.

Dynamos and Motors:

DRIVING ALTERNATORS IN PARALLEL.—An editorial notice refers to the new station at Wandsworth, England, where two "Universal" engines driving alternators have been tested together, running parallel. They are single crank engines. The installation is said to be a complete success.—Lond. "Elec. Rev.," March 26, '97.

MULTIPHASE INDUCTION MOTORS.—By A. C. Eborall. Author points out two reasons why multiphase motors have not been more extensively used in England, namely, that the demand for electrical power is very small, and secondly that in England this type of motor has never had a practical trial and consequently not had a chance to show its good qualities. He points out their many advantages and explains in a practical way their working.—Lond. "Elec. Rev.," March 26, '97.

Electro-Chemistry:

ON THE ELECTRICAL RESISTIVITY OF ELECTROLYTIC BISMUTH AT LOW TEMPERATURES AND IN MAGNETIC FIELDS.—By Profs. Jas. Dewar and J. A. Fleming. A course of experiments which was carried on in regard to measuring the resistance of pure bismuth wire when placed transversely in a magnetic field. The following conclusions were arrived at, namely, that the resistance is increased and for every temperature below the normal (20. degs. C.) there is some particular strength of the transverse field which just annuls the effect of cooling and brings the resistance of the bismuth back again to the same value it had when not cooled and not in any magnetic field. There are also several other experiments given accompanied by some curves.—"Electricity," March 24, '97.

Lighting:

FAULTS IN ARC LAMPS AND HOW TO FIND THEM.—The writer describes the different styles of arc lamps and their construction and the different systems which are used, pointing out the difficulties that arise and how they may be overcome. He also described the faults of arc lamps.—Lond. "Elec. Rev.," March 19, '97.

ELECTRIC LIGHTING OF COUNTRY HOUSES.—By A. H. I. Graham.—A detailed description of the different systems employed in private plants and the many different uses electricity is put to.—Lond. "Elec. Rev.," April 2, '97.

HIGH VOLTAGE LAMPS AND CENTRAL STATION PRACTICE.—By G. L. Addenbrooke. Mr. Addenbrooke gives an account of the use of these lamps in central station practice with a list of English stations using them.—Lond. "Elec. Rev.," April 2, '97.

Miscellaneous:

PREVENTION OF ELECTRICAL FIRES.—By F. W. Bathurst. This article is devoted to the subject of the way wiring is done in Europe, especially in England, pointing out the many very bad rules that are enforced and how they can be remedied.—Lond. "Elec. Rev.," March 19, '97.

LIGHTNING RODS.—Major D. P. Heap, U. S. A., points out three qualities which a good lightning rod should possess: Ease of discharge, first-rate conductivity throughout its entire length, and excellent ground connection. He then goes on to show how they should be set and where they should be placed.—"Elec. Rev.," April 14, '97.

Power Transmission:

THE TRANSMISSION OF POWER TO LONG DISTANCES BY ALTERNATING CURRENTS.—By W. B. Esson, M. I. E. E. Paper read before the Soc. of Arts. Author divides the subject as follows:

Generators.	Line.	Motors.
1. Single-phase.	Two wires.	Synchronous or non-synchronous.
2. Two-phase.	Four or three wires.	
3. Three-phase.	Three or four wires.	
4. Monocyclic.	Three wires.	Non-synchronous.

He then goes into detail comparing the relative values of the different types of generators, then discuss the line insulation, and closes the section with a detail of cost of line wire to transmit 300 horse power to various distances at various pressures. Lond. "Elec.," April 2, '97.

Roentgen Rays:

BECQUEREL RAYS.—An article by M. Becquerel in relation to rays emitted by uranium and more especially with their power of discharging electrified bodies, including the uranium which emits them. Uranium discharges electrified bodies at any potential in air. The tests were made by the use of the gold leaf electroscope. The writer proved that the air surrounding the uranium plays a prominent part in these discharges just as does the air traversed by X-rays. The rates of discharge are roughly proportional to the square root of density of the air or their gas. The course of the discharge is very similar to the cooling of a hot body.—From Lond. "Elec.," in "Electricity," March 31, '97.

ROENTGEN RAYS AND THE SOFT TISSUES.—Messrs. Remy and Contremoulin have lately applied the X-rays to anatomical study. With the aid of chemical preparations they have put the muscles, ligaments, and tendons of dead bodies, both of men and frogs in such condition that they have given radiographic images. The muscles are marked by bundles of longitudinal fibers very clearly outlined.—"Elec. Rev.," April 14, '97.

THE TRANSPARENCY OF BODIES TO THE X-RAYS.—By E. Van Ankel in "Journ. de Phys.," with regard to the comparison of transparency of bodies to the X-rays and to heat the experiments of M. M. Meslaus, V. Novak and O. Sulc show that the presence of fluorine, chlorine and bromine and especially iodine in a molecule increases opacity to the X-rays. Certain facts quoted by the author show that the presence of halogens and of sulphur in the molecule increases the opacity both to X-rays and to heat.—"Elec. Rev.," April 14, '97.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 4, 1897.

Alarms and Signals:—

AERO-ELECTRIC WHISTLE. C. R. Alsop, Middletown, Conn., 581,802. Filed July 13, 1895.

A signal consisting of a suitable motor, a worm connected to the shaft, a worm-wheel meshing a lug carried by the worm-wheel, a lever operated by the lug and air pump having a sounding mechanism adapted to be operated by the lever.

AUTOMATIC FIRE ALARM. G. B. Riley, Kahoka, Mo., 582,093. Filed August 19, 1896.

Consists of a sensitive circular spring being such as to readily expand and contract by variation of temperature, whereby the arm contacts, with a point connected with the bell circuit.

Connectors, Conduits and Insulators:—

ELECTRIC CABLE. M. Guilleaume, Mulheim-on-the-Rhine, Germany, 581,715. Filed October 18, 1895.

Comprises one or more insulated conductors embedded in a mass of India rubber, such covering serving to take the place of the heavy lead sheathing usually employed.

Distribution:—

ELECTRIC TRANSFORMER. E. Thomson, Lynn, Mass., 581,873. Filed January 29, 1890.

An ironclad transformer, the laminated iron envelope having its laminae made each of two F-shaped sheet iron punchings fitting together from opposite sides of the coils.

Dynamos and Motors:—

ALTERNATING CURRENT MOTOR. B. G. Lamme, Pittsburg, Pa., 582,132. Filed October 30, 1895.

Comprises an armature having a distributed winding, a starting resistance normally in circuit therewith, a short circuiting device for the resistance surrounding the winding and means for moving the device into and out of direct engagement with the winding.

Electro-Metallurgy:—

PROCESS OF DEPOSITING METALS ON SILVER COATINGS. C. Schwabe, Berlin. Germany. Filed June 5, 1896.

Details of process.

APPARATUS FOR EXTRACTING PRECIOUS METALS. E. Motz, Brewermine, S. C., 582,077. Filed March 27, 1896.

A rotative drum adapted to receive the ore, a core arranged in the drum, metallic plates forming the positive and negative electrodes of an electric circuit and carried respectively on the drum and core, and an electrical connection for the plates on the core.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. M. S. Okun, New York, 581,997. Filed August 30, 1895.

A sliding carbon carrying rod and a carbon carrier at an angle to the rod, the co-operating carbon being held at an angle to the first mentioned carbon, and feeding devices for raising and lowering the carbon rod.

Measurement: -

ASTATIC ELECTRICAL MEASURING INSTRUMENT. A. Raps, Berlin, Germany, 582,090. Filed October 1, 1896.

An astatic galvanometer, a pair of suitable shaped cores made of magnetic unmagnetized metal placed at a greater distance from the stronger magnet of the astatic system than from the other.

ASTATIC GALVANOMETER. A. Franke, Berlin, Germany, 582,120. Filed September 29, 1896.

Comprises swinging system of astatic needles and, attached to it, a second adjustable magnetic system considerably weaker than the first system.

Miscellaneous:—

ELECTRIC CIGAR LIGHTER. H. M. Handshy, San Antonio, Tex., 581,718. Filed August 10, 1896.

Embodies an advertising device to be operated in conjunction with the lighter.

ELECTRIC GAS IGNITER. F. N. Pike, New York, 582,085. Filed July 8, 1896.

Details of construction.

Railways and Appliances:—

ELECTRIC RAILWAY. H. C. Reagan, Jr., Philadelphia, Pa., 581,769. Filed December 2, 1896.

Sectional underground conduit system employing a device operated by compressed air and electric motor for emerging the magnets carried by the car.

RAILWAY. R. C. Sayer, Bristol, England, 581,773. Filed April 3, 1896.

Consists of power conveyors on the rail, radial connectors on the wheel adapted to connect it with the conveyors on the rail, and teeth on the wheel to keep it in position.

CONTROLLER FOR ELECTRIC CARS. A. Schmid and H. P. Davis, Pittsburg, Pa., 582,102. Filed January 17, 1895.

A rotatable contact bearing cylinder, a shaft for rotating it, the shaft being detachably connected with the cylinder, and being longitudinally movable when disconnected.

Regulation:—

CONTROLLER FOR ELECTRIC MOTORS. H. P. Davis, Pittsburg, Pa., 582,114. Filed January 14, 1895.

For controlling the movement of mechanism driven by two electric motors comprising the following steps, connecting the motors in series with resistances, opening the entire circuit, coupling the motors in a parallel with resistances and cutting out the resistances.

METHOD OF AND MEANS FOR CONTROLLING ELECTRIC MOTORS. H. P. Davis, Pittsburg, Pa., 582,115. Filed January 14, 1895.

Similar to above.

ALTERNATING CURRENT REGULATION AND DISTRIBUTION. B. G. Lamme, Pittsburg, Pa., 582,131. Filed March 27, 1893.

Consists in putting into circuit one or more synchronous motors at or near points of translation and varying the counter electromotive force of such motors as to keep the current supplied at a minimum.

Switches, Cut-Outs, Etc.:—

ELECTRIC SWITCH. G. T. Eyanson, Philadelphia, Pa., 581,706. Filed March 21, 1896.

A quick-break knife switch.

ELECTRICAL FUSE CUT-OUT. W. C. Bryant, Bridgeport, Conn., 582,036. Filed March 1, 1897.

Details of construction.

SWITCH FOR ELECTRIC CIRCUITS. A. J. Wurts, Pittsburg, Pa., 582,111. Filed November 14., 1896.

A knife switch having a wedge-shaped blade and a stationary jaw terminal comprising two bundles of conductors.

ELECTRICAL SWITCH. J. A. Spiker, Grand Island, Neb., 582,149. Filed May 14, 1896.

Specially adapted for telegraph systems.

Telegraphs:—

TÈLEGRAPHY. C. F. Eaton, Jr., Santa Barbara, Cal., 581,815. Filed July 18, 1896.

Comprehends the employment of synchronous alternating current motors and instantaneous photography.

TELEGRAPHIC APPARATUS. C. F. Eaton, Jr., New York, 582,157. Filed December 18, 1896.

Utilizes one set of pulsations of an alternating electric current for disclosing the characters at a distant station and the opposite set of pulsations for controlling the pulsations of a local alternating current motor for actuating the several operating parts of the apparatus.

Telephones:—

SELECTIVE SIGNALING CIRCUIT, APPARATUS AND SYSTEM. G. W. Whittemore, J. A. Barrett, Brooklyn, N. Y., and W. M. Craft, New York, 582,107. Filed November 28, 1896.

Adapted for use on party line telephone systems.

LEGAL NOTES

DECISION IN FAVOR OF AMERICAN BELL TELEPHONE COMPANY SUSTAINING LEGALITY OF THE ISSUANCE OF THE BERLINER PATENT.

At Washington, on May 10, the United States Supreme Court gave out its decision denying the motion of the government to have the Berliner patent, No. 463,569, of Nov. 17, 1891, set aside on the ground of unnecessary and improper delay in its issuance, it having been filed in 1877, and further because the company had acquiesced and helped in the delay, in order to defraud the public of its rights.

The suit originated in the United States Circuit Court for the District of Massachusetts, where it was decided in favor of the United States. Upon appeal to the Circuit Court of Appeals for the First Circuit, this decision was reversed, and the contention of the Berliner claimants upheld. From this opinion the United States appealed to the Supreme Court.

Justice Brewer, in beginning his statement, said this was the first case in this court in which upon proofs an application had been presented to set aside a patent for an invention wrongfully issued. However, there was no doubt of the right of the United States to maintain such a suit. The question, therefore, to be decided was whether upon facts disclosed the relief ought to be awarded. He took up the difference between patents for invention and land patents, the principal difference, he said, being that invention patents do not cover something which belonged to the government before it was invented. Hence, in this case, the patent conveyed to Berliner nothing that he did not before have. The patent only gave him exclusive rights for a time as an inducement to make it public. Consequently the government has higher rights in a suit to set aside a patent for land than in a similar suit on a patent for an invention.

Taking up the question of delay in the patent office, Justice Brewer said the application was pending in the department for fourteen years, during thirteen of which the invention was the property of the Bell Telephone Company. Mr. Bell had invented the telephone, and as that patent had expired all the monopoly which attaches to it alone has ceased and the right to use it has become public property. But his apparatus was insufficient for public uses. Berliner's patent supplied the deficiency of existing patents, as he invented something by which, taken in connection with Edison's and Blake's inventions, Bell's undulating current could be made practically available for carrying on conversations at long distances. In other words the telephone used to-day is not only that of Bell, but of Edison, Blake and Berliner as well. Therefore the right to use the Bell patent alone would be a barren one, extending the telephone patent to the life of the Berliner patent.

Some delay was unavoidable in the patent office. An application for patent cannot be considered and determined on the instant. Hence there could be no complaint on the mere fact of delay, though there might be of its excessiveness. But, added the opinion, it mattered not whether the delay be reasonable or unreasonable, if the applicant is not responsible for it. If the fault was that of the patent office the applicant is not held blameworthy, and his legal rights are not affected. He cannot be punished on account of the delay or negligence of the tribunal before which he is presenting his suit.

With reference to the arguments on the subject of the continuance of the telephone monopoly, Justice Brewer repeated that there was no question that Bell's patent had expired, but it must be remembered that Berliner's rights were independent from those of Bell. If there should be a new invention upon the expiration of the Berliner patent the rights of its author could not be abridged to relieve the public. The inventor of the latest addition is entitled to full protection, and if the telephone company buys that invention it is entitled to all the rights which the inventor had. The court, he says, dissented entirely from the views urged by counsel that the applicant for a patent was a quasi trustee for the public, but held that an invention was the absolute property of its inventor. The government in order to make its case must establish affirmatively that the delay in the patent office was caused by the conduct of the applicant. It cannot rest on mere inferences, but must prove the wrong in such a manner as to satisfy the judgment before it can destroy that which its own agents have created. This requirement the government had failed to meet.

Continuing on this point, he said there was no testimony as to any corruption of the officers of the department by the defendants, or any attempt at such corruption. So far, indeed, as was shown, there never was an intimation made to a single official that he could profit by a moment's delay. All thought of wrong, therefore, may be put aside. Counsel for the government had tried to show that the fact that the applicants were not active in their prosecution was an evidence of fraud in view of the vast value of the invention, but this argument did not counteract the fact that there was no request for delay, but, on the contrary, the applicants had made at least one urgent request for action. Something more than the mere assertion of counsel was necessary to meet this fact. He considered at some length the charge of existence of a tacit understanding between the officials of the patent office, the People's Telephone Company, and the Bell Company that the patent office proceedings in the Berliner application should await determination of the litigation between the two telephone companies, involving the validity of the Drawbaugh patent, owned by the People's Company, but even if this was so, it did not anywhere appear that Berliner was a party to such an understanding. The difficulty was that the assertion was not proved. Indeed, Justice Brewer asserted that a case is seldom presented in which there is such a total failure of proof of wrong.

He said further that the testimony showed that the examiners in the patent office had acted in good faith, whatever is to be said of the wisdom of the course pursued by them. They supposed they were acting in compliance with the rules of the office, and out of proper regard for conflicting interests. It was not strange, when there was so much litigation, controversy, and uncertainty, that there should be delay in settling a minor matter in the patent office until there should be a final decision of the primary rights. It was easy to say that there should have been prompter action, but a wisdom born after the event is the cheapest of all wisdom.

The conclusions of the court on this branch of the case were:

First—That before the government is entitled to a decree canceling a mechanical patent, on the ground that it has been fraudulently obtained, it must establish the fraud by convincing testimony.

Second—That an applicant for a patent cannot be held responsible for the dilatory acts of patent office officials, unless the delay is brought about through his corruption.

Third—The evidence in this case does not tend in the least degree to show any such corruption.

Fourth—If the circumstances do not show that the delay on the part of the officials was wholly justified, they do make it clear that it was not wholly unwarranted.

Of the contention that a "patent isued Nov. 2, 1880, upon a division of the original application, covers the same invention as that covered by the patent in suit, and exhausted the power of the commissioner as to that invention," he said the patent of 1880 was for a receiver, while that of 1891 was for a transmitter. It was claimed that the two inventions were one, but the decision of the patent office was against this contention, and this judgment could not be reviewed in the present suit.

Remarking upon another feature of the case, the Justice said that, taking into consideration the influences under which the suit was started, there were indications that the purpose of striking down this patent was to give value to others, and that private competitors of the Bell Company are seeking to inspire a rival, not for the public good, but for the promotion of their personal interests.

He said that Congress had established the patent office, and had thereby created a tribunal to pass upon all questions of novelty and utility, and had given to that office exclusive jurisdiction in the first instance, with specifications of circumstances under which they might be reviewed.

It would seem that the government should be as firmly bound by the decision of its own tribunal as individuals. There was nothing inconsistent, he said, between this view and that propounded in the case of the United States versus the Bell Telephone Company. There might, he concluded, have been an error on the part of the officials as to the existence of power or a mistake in the instrument itself, sufficient to justify a decree canceling the patent. Also, the deviation of the proceedings between the application and the patent may be such as to justify the interposition of the Court of Equity; but it was not intended that the courts of the United States, sitting as Courts of Equity, could entertain jurisdiction of a suit by the United States to set aside a patent for an invention, on the ground of error of judgment on the part of the patent officials. Hence this question was not now open for consideration.

Judge Harlan dissented from the opinion. Judges Gray and Brown, it was announced, took no part in the case.

The claims of the patent are as follows:

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase or decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly-held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephonic transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephonic transmitter, a vibrational plate provided with one or more apertures, as and for the purposes set forth.

6. A speaking-telephone transmitter comprising a diaphragm or disk sensitive to sound-waves, combined with a rigidly-held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

WESTERN UNION AND RAILROAD WIRES.

Rush Taggart of New York, solicitor for the Western Union Telegraph Company, in the United States Court at Omaha, on May 2, asked for leave to make supplementary filings in the case of the United States against his company and the Union Pacific Railroad Company in the matter of separating the telegraph business of the defendants. The question before the court is the entering of a decree, in obedience to the mandate of the United States Supreme Court, divorcing the Western Union from the Union Pacific and compelling the latter to operate a telegraph line of its own for commercial purposes. The court took the matter into consideration.

It is the conjecture that the defendants are seeking only for time, hoping to defer the entering of the decree until after the contemplated sale of the Union Pacific, when possibly the necessity for the decree may be avoided by the ratification of the old contract by the new company and the making of a new contract.

THE STOCK MARKET

LARGER VOLUME OF TRADE.

As far as can be ascertained the volume of trade in many lines is larger, but spring business is still a disappointment. It is thought that this is due to tariff uncertainty more than anything else. The crop outlook west is encouraging.

In Wall street there has been a decided stir over the alleged rupture, or want of cordiality, between Mr. George Gould and Mr. Russell Sage—another case of the young Emperor and his Bismarck. The effect of these rumors on Western Union is plainly seen in sales of 89,037 shares with a decline to 75 and closing at 76. General Electric is almost stagnant, only 1,427 shares being sold, around 31. American Bell Telephone was also dull with sales of 864 shares and a decline to 221½ from 223 the previous week.

COPPER.—Sales are reported of Lake Superior ingot at 11 cents, electrolytic wire bars at 10¾ on actual sales, and 10½ for casting stock.

ELECTRICITY IN THE ARGENTINE.

The export department of one of the leading electrical companies has, according to its managers, shipped more electrical machinery and apparatus to Buenos Ayres during the last month than in any other previous month in the record of the company. It is due to the activity in which electricity is being used in the Argentine. In electrical engines of the smaller sizes, together with dynamos, the shipments reached $32,000. In other apparatus for electrical uses their sales to Buenos Ayres, not only for that city but for distribution throughout the republic, were $64,000. German and English manufacturers are endeavoring to capture some future orders by giving unusually low prices, and it is quite likely that in electrical sundries their efforts will meet with some success, but it is doubtful that in dynamos and engines much will go to the other side.—N. Y. "Jour. of Commerce."

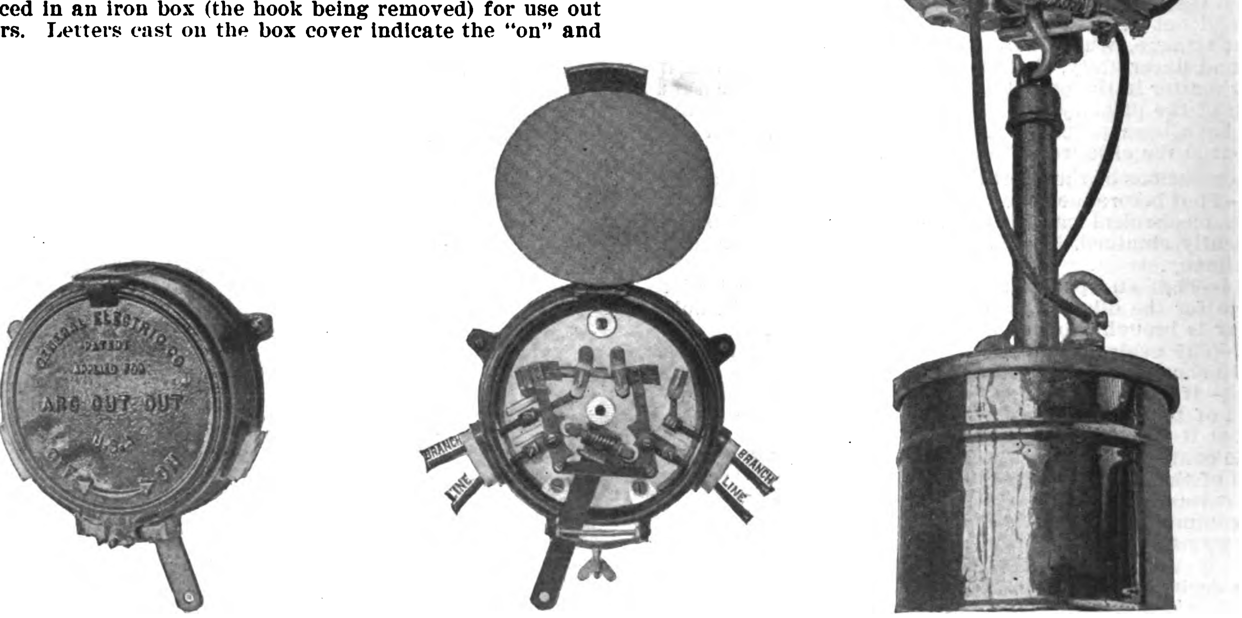
TRADE NOTES & NOVELTIES

G. E. PORCELAIN CEILING BOARD AND ARC CUT-OUT.

THE accompanying engravings illustrate two important adjuncts for use with arc lamps; the arc ceiling board and arc cut-out. Early practice allowed the use of wood in the construction of these appliances, but experience has shown the wisdom of making them entirely of incombustible material.

The bases are made of best quality of glazed porcelain and cast brass is used for connection parts. The lamp is suspended from a hook in the ceiling board and the lamp leads are attached to easily accessible connectors in the manner shown. The arc cut-out is a substantially built, quick break, double-pole, double-throw switch, making an absolute cut-out on both sides of the lamp circuit. A cam and spring action make it impossible to hold the switch at any intermediate point between "on" and "off" so that the current is never open on the line.

This cut-out may be used as a ceiling board, in which case a hook for hanging the lamp is attached to its center, or it may be placed in an iron box (the hook being removed) for use out of doors. Letters cast on the box cover indicate the "on" and "off" positions of the switch. These appliances are made by the General Electric Company of Schenectady, N. Y.



FIGS. 1 2 AND 3.—G. E. PORCELAIN CEILING BOARD AND ARC CUT-OUT.

SHEEHAN & HEWITT.

Sheehan & Hewitt is the name of a new electrical engineering firm which has been formed with offices at No. 14 South Water street, Newburgh, N. Y. Mr. William M. Sheehan, the senior member of the firm, has been in the electrical business for years, having been electrician and manager of the old Newburgh Electric Light and Power Company for some years. Later he established and managed the Hyer-Sheehan Electric Motor Company, from which firm he withdrew about a year ago. Mr. Hewitt is a graduate of Dartmouth College, where he took the degree of Bachelor of Science. Later he took a two years' post-graduate course at Cornell University under Prof. Ryan, and received the degree of Master of Mechanical Engineering. For the past two years Mr. Hewitt has been with the Hyer-Sheehan Motor Company, but retired from that firm May 1. The new firm will do engineering and construction work, paying especial attention to electrical work. They have already received some good contracts, and their extensive acquaintance and knowledge of their business would bespeak for them a large measure of success.

WESTERN ELECTRIC FAN MOTOR.

The handsome fan motor catalogue recently issued by the Western Electric Company has now reached its third edition. The Western Electric Company claim to be the largest manufacturers of fan motors in the United States and every one interested in fan motors should have one of their catalogues. The Western Electric Company guarantee their motors. Before shipping each motor is thoroughly examined, and every 110-volt motor is tested upon 220 volts, every 220-volt motor is tested upon 500 volts, and every 500-volt motor is tested with 1,000 volts. The demand for high class motors is met in these standard designs.

AMERICAN ELECTRIC TELEPHONE CO.

The American Electric Telephone Company, South Canal street, Chicago, report that their business is very good, and now that they are settled in their large new quarters they are in a position to supply all orders entrusted to them with the utmost promptness. Their new Express switchboard is the latest departure in that part of a telephone outfit, and they claim that it is the most rapid switching device ever constructed. Each drop and jack is self-contained in a hard rubber case, and can be removed and replaced in the board in the space of one minute without disturbing a single connection, and each drop indicates whether a line is working properly. For their new American solid back amplifying transmitter, they claim that it is the most powerful that has been produced. It is especially built for long and severe lines, and is said to be unequaled for volume of voice transmission, distinctness of articulation, exact reproduction of articulate sounds, and durable qualities. The American Electric Telephone Company have an attractive exhibit at the Tennessee Centennial Exposition, Nashville, Tenn.

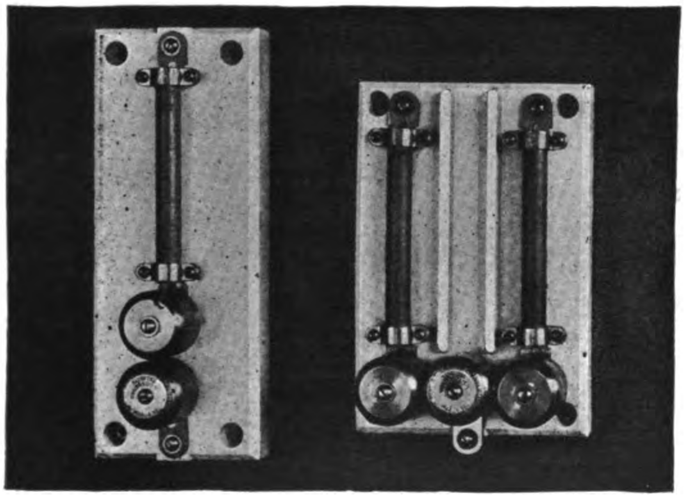
GOOD SALES OF RIDGWAY ENGINES AND DYNAMOS.

The Ridgway (Pa.) Dynamo and Engine Company report the following orders, all received within the past few weeks: One 12 x 23 x 18-inch compound condensing engine, for Ithaca Street Railway Company, Ithaca, N. Y. (second order); one 8 x 10-inch automatic engine, direct connected to a 25-k. w. Thompson-Ryan generator, for the Hart Memorial Library, Troy, N. Y.; one 15 x 16-inch engine, for the Southwestern Coal and Improvement Company, Parsons, Kan.; one 11 x 12-inch engine, for the Keystone Coal mining Company, Lawsonham, Pa.; two 14 x 14-inch engines, direct conected to two 75-k. w. Thompson-Ryan generators, for Cambridge Springs Company, Cambridgeboro, Pa.; two 15 x 16-inch engines, direct connected to two 100-k. w. generators, for the Metropolitan Theatre, Buffalo, N. Y.; two 250-horse-power engines, for the Berwind-White Coal Mining Company, Osceola Mills, Pa.; one 9 x 8-inch engine, direct connected to 20-k. w. generator, for the North Texas Bank Building, Dallas, Tex.; one 6 x 6-inch engine, direct connected to 8-k. w. generator, for the Coronado Apartment House, New York; one 80-k. w. belted generator, for the American Bridge Company, Chicago, Ill.

THE WIRT ALTERNATING CURRENT SHORT GAP LIGHTNING ARRESTERS.

A CAREFUL record of burn-outs due to lightning discharges discloses the fact that they invariably occur in connection with lines protected by arresters with long spark gaps or in electrical apparatus having poor insulation. Most of the electrical apparatus designed for operation on 1,000 and 2,000-volt circuits will barely stand a high potential test of 4,000 volts between the windings and frame of the machine. Arresters therefore, for use on these circuits should require a low potential to cause the current to pass across the spark gaps, separating the line from the ground connection.

The Wirt alternating current short gap arresters have been especially designed to operate effectively with very small gap spaces. The arrester for 1,000-volt circuits has but one spark gap of 1-32 inch between two metal cylinders 2 inches in diameter and 2 inches long, as shown in Fig. 1. One cylinder is connected to the overhead line and the other to the ground and a low non-inductive graphite resistance is placed in circuit. The combined action of the metal cylinders and non-inductive resistance prevents the heating of the cylinders when the lightning discharge passes across the gap making the gas which would enable the alternator to maintain the arc. The arc itself is extinguished by the reversal of the alternating current. This arrester is, therefore, not an arc rupturing device, but actually prevents the formation of an arc, the action being dependent upon the cooling effect of the large metal cylinders, which effect is increased by the introduction of a non-inductive resistance, and not upon any non-arcing property of the metal itself.



FIGS. 1 AND 2.—WIRT ALTERNATING CURRENT SHORT GAP LIGHTNING ARRESTER.

The arrester for 2,000-volt work, Fig. 2, has two gaps of approximately 1-32 inch and a low non-inductive resistance. This arrester will not hold a short circuit when connected directly across a 2,400-volt alternating current line, but will hold an arc when tested on a 500-volt continuous current line. This proves clearly that the reversal of the alternating current itself extinguishes the arc.

The Wirt arresters are designed for use on alternating current circuits at practically any potential, the standard list including an arrester for 15,000-volt lines. For circuits above 2,000 volts the standard 2,000-volt double-pole arrester has been adopted as a unit, several of these being connected in series for high potential work.

Arresters of this type have been adopted for the protection of the power line connecting Niagara Falls and Buffalo, at the power house of the Niagara Falls Power Company. An exhaustive test was recently made to determine the proper number of gaps and resistance for a 11,000-volt, 5,000-horse-power line. The arrester under normal action only showed a small arc about as large as a pin head between the cylinders. After many successful tests, the proper number of gap spaces was ascertained to be 14, with a wide margin of safety. The gap spaces are each 1-32 inch.

Arresters of this type are now standard with the General Electric Company, for all alternating current work, and a large number are already in service protecting long-distance transmission power lines having a working voltage as high as 15,000 volts.

WHAT IS SAID OF THE BERLINER DECISION.

As The Electrical Engineer goes to press, it is in receipt of the following telegram from the American Electric Telephone Company, of Chicago, as to its view of the Berliner decision: "It is simply a moral victory. The Berliner patent now adjudged as owned by the Bell Company has expired and never was valid. As it stands, it is very weak and can be easily beaten if suit is ever brought by the Bell Company, which is improbable. The Supreme Court decision on the question of fraud will be used by the Bell Company to dignify the patent and to further intimidate capital. Some people would stop eating bread if the Bell Company claimed a patent on flour. We will sell more apparatus and build more prosperous telephone exchanges than ever."

ADVERTISERS' HINTS

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, O., are selling 10, 16 and 20-candle-power lamps in barrel lots capped with Edison or Westinghouse base at 17 cents, and other bases at slightly differing prices.

THE C & C ELECTRIC COMPANY, New York, advertise their new six-pole generator in sizes of 30 kilowatts and upwards. It is made with all parts interchangeable, self-aligning and self-oiling bearings.

THE BUTLER HARD RUBBER COMPANY, 33 Mercer street, New York, the well-known manufacturers of hard rubber goods of every description, are making a specialty of Kiel's patented battery cells.

A. K. WARREN & CO., 451 Greenwich street, New York, advertise dynamo and motor brushes and illustrate them very handsomely. These brushes are made on economical principles and the waste is reduced to a minimum which amounts to nothing.

THE WESTERN ELECTRIC COMPANY, New York and Chicago, have a large variety of fan motors in their '97 models. They are wound for three speeds and are guaranteed to be as represented.

THE BRYANT ELECTRIC COMPANY, Bridgeport and Chicago, advertise "Paiste" switches at greatly reduced prices.

K. McLENNAN & CO., Marquette Building, Chicago, publish a fac-similie of the label which appears on all packages of Gale's commutator compound of which they have sold a great quantity to well pleased customers.

THE ELECTRICAL EXCHANGE, 166 South Clinton street, Chicago, advertise a fan motor at $11 which they claim to be of the highest grade and the lowest priced.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, are furnishing "Electro-Chemical" lamp coloring, which they say is quite as effective in use as genuine colored glass. They carry it in stock in green, blue, red, orange and frosting. One pint is sufficient for 200 lamps.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., have an iron roof for sale. It was originally designed for an iron foundry, but owing to the failure of the purchaser it is now offered at a bargain and is admirably adapted for any building for manufacturing purposes where a fireproof roof is desirable.

D. H. KULP, Marietta, Pa., advertises special facilities for manufacturing and financial aid for proper articles.

QUEEN & CO., Inc., Philadelphia, have brought out a self-regulating X-ray tube.

J. JONES & SON, 67 Cortlandt street, New York, manufacture panel boards, switches and switchboards. In their new panel board the number of joints is reduced to a minimum, is better in appearance than the old style and lower priced.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., guarantee the standard of their apparatus, which they manufacture in large variety for all telephone uses.

THE CENTRAL ELECTRIC COMPANY, Chicago, are reminiscent of the time "when we were idle boys," and as usual present a moral applicable to busy men.

THE WILLIAMSPORT WOODEN PIPE COMPANY, Williamsport, Pa., are always ready to supply wooden creosoted conduit in any quantity. There is over 500 miles of it in use in Philadelphia alone. Besides this they do a large business in octagonal poles.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., advertise their non-condensing compound engines and claim it to be the only compound engine which can be run non-condensing with economy.

THE BURR & HOUSTON COMPANY, 39 Franklin street, Brooklyn, N. Y., furnish gray iron castings for all electrical and machinery purposes.

NEW YORK NOTES.

COMMERCIAL CONSTRUCTION COMPANY, 1 Madison avenue, New York, have the contract for installing the new Bay Shore Electric Light Company's plant at Bay Shore, Long Island, N. Y. This contract includes the entire equipment—engines, boilers, dynamos, wiring, etc.

CHARLES ARTHUR HAGUE, 39 Cortlandt street, New York, is busy as consulting and designing engineer on several large plants which are now in process of construction. Mr. Hague installs and guarantees complete electric light and power plants as well as soliciting business as consulting and designing engineer.

HENRY F. NOYES, solicitor of patents, 35 Liberty street, New York, reports a good business. A larger number of applications for patents have been made the past three weeks than any time previously.

ELECTRICITY IN BELTS.—Some time since an engineer in a large factory called the attention of a visiting expert electrician to the electricity in a big driving belt, and was quite surprised when the expert informed him that the electricity was caused by the belt slipping. The expert added that it was simply a wasting of power and could be prevented by applying Dixon's Traction Belt Dressing, made by the Joseph Dixon Crucible Co., Jersey City, N. J. This dressing was applied and the electricity disappeared at once. Electricity in belts is not only a waste of power, but is also an element of danger of fire.

AMERICAN ENGINE COMPANY, of Bound Brook, N. J., have just begun shipment of their new direct-connected generating plants, in which the American-Ball engine is combined with their new line of six-pole generators. They are now installing a 75 kilowatt plant at 7 East Seventeeth street, New York, in the building of Deitsch Bros., and a 35 kilowatt plant in the building of the "Evening Wisconsin," of Milwaukee. In addition to this they have orders from the Philadelphia "Enquirer" for a 100 kilowatt plant; the Buffalo "Evening News" for a 35 kilowatt plant; the Phelps' Publishing Company, of Springfield, Mass., two 35 kilowatt plants; the New York "Tribune," a 75 kilowatt plant, and the World's Dispensary Medical Association, of Buffalo, a 25 kilowatt plant.

McLEOD, WARD & CO., 27 Thames street, New York City, report that they are quite busy with electric construction work. Among the many contracts recently awarded this firm may be mentioned those from the Central Railroad of New Jersey for five ferryboats and the steamers Monmouth, Sandy Hook and St. John's; the new Henry Heide candy factory, and F. L. Stetson's country residence at Ringwood, N. J.

WESTERN NOTES

SARGENT & LUNDY, Monadnock Building, Chicago, have, it is understood, closed arrangements to represent the C & C Electric Motor Company, in their territory. They will concentrate their energies in the motor line on pushing the well-known C & C power specialties, etc., and expect to make a fine showing.

H. B. CAMP & CO., of Aultman, O., have received the contract for the underground conduit for the Delaware and Atlantic Telegraph and Telephone Company of Wilmington, Del. The conduits will be terra cotta, laid in concrete, six feet deep in the soil, manholes at street corners. There will be four, six or ten ducts, according to location.

PHILADELPHIA NOTES

F. E. BAILEY & CO., of Betz Building, Philadelphia, who represent the Armington & Sims Engine Company, Providence, R. I., have closed among others the following contracts: For the Edison Electric Illuminating Company, Bellefonte, Pa., one 130-horse-power and one 150-horse-power Armington & Sims engines, to be fitted with new regulator. For the Midvale Steel Company, Philadelphia, one 170-horse-power engine of the new self-oiling type, fitted with new regulator. For the Altoona Electrical Engineering and Supply Company, Altoona, Pa., one 130-horse-power new type special railway engine with new governor. Also contract for a complete electric light and pumping plant for the Country Club at Harrisburg, Pa.

NEWTON MACHINE TOOL WORKS, Twenty-fourth and Vine streets, Philadelphia, Pa., report an increasing business. They are running full time with a large force. During the past month they have received an order for a heavy milling machine equipment for a Japanese railroad shop; a large duplex milling machine for the French government; vertical milling machines for Fraser & Chalmers, London. A few domestic orders include two rail ending machines for the Pennsylvania Steel Company, a large universal cold saw cutting off machine for the Lassig Bridge Company, Chicago, and one for Post & McCord, New York, besides many other orders for cold saw cutting off machines and heavy milling machines.

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The Electrical Engineer.

Vol. XXIII. MAY 19, 1897. No. 472.

THE HARMFUL EFFECTS OF THE X-RAY.

BY DR. F. S. KOLLE.

THE editorial in the last issue of The Electrical Engineer on Mr. Tesla's investigations of the harmful effects of the X-ray is a very timely contribution to the literature of the subject.

It seems to be a peculiar fact that these harmful results or effects are kept from the eyes of experimenters, whereas in my estimation they should be recorded for the benefit of all. Even Tesla reluctantly cites a case of dermatitis, as having occurred in his laboratory. If we cannot receive the valuable inferences of such experimenters as Edison, Tesla, Thomson, etc., then we cannot expect to advance in perfecting this scientific discovery. It should therefore be the duty of every one to record such effects from time to time, as he deems valuable, without further consideration or question whether or not such report might harm or decrease the revenue, derived from the new art. It is self-evident that we must all profit thereby in the end.

Tesla divides the effects of the rays into four divisions, namely, thermal, electrical, electro-chemical and mechanical.

The thermal effect he believes to be shown by the injurious results produced, resembling exposure to heat; although no idea of the degree of heat of the particles is given, yet he says: "If we consider the probable velocities only, they correspond to temperatures which may be as high as 100,000 degrees Centigrade." That this thermal property exists, is certainly shown by the heat effects, such as reddening, pain and even blistering, when a part of the body is injudiciously brought too near an active tube. If this is true, then we are at a loss to demonstrate the transference of the temperature by any present known method.

2. That the rays exhibit certain electrical properties is readily shown by their power of discharging electrified bodies, in an exceedingly short space of time. I consider this in favor of the theory of Tesla that the rays owe their property to minute material particles. This electrical property might have some influence on the skin or part of body exposed. If these local currents are so strong or destructive they certainly resemble the high frequency current effect of Tesla, as no actual shock is experienced by such currents, yet these direct currents of extremely high potential show no hurtful action on the body.

3. If we are to believe that the rays exterior to the tube are made up of material particles of whatever nature, then it is possible that these particles may carry with them or are composed of an electro-chemical substance, and here Tesla holds that with the rays coming from a tube, whose reflectors or impact plate were made of aluminum, no hurtful effects were noted, claiming just the contrary for tubes containing platinum electrodes. This is certainly a most interesting study, and need not necessarily surprise us. I have rarely used focus tubes whose impact electrode consisted of aluminum. The tubes as used in my laboratory contain the usual concave mirror of aluminum and the platinum plate. The fact that the one is dangerous or more so than the other, can only be ascertained, in my belief, by such men as Tesla, Edison, Thomson, etc. For such study, and to develop sufficient evidence, large and complicated apparatuses are required which few are fortunate enough to possess. The usual outfit, that is, one that will answer all purposes medico-surgically, need be put of from 12 to 14 inches spark capacity, and with such apparatus it would be quite impossible to obtain such results as Tesla gives us.

4. The theory of material particles holds good in the mechanical effects produced. It is quite likely that particles of whatever nature violently thrown against each other or the tissues of the body, must necessarily produce heat which may be sufficient to create tissue change. From the above conclusions of Tesla, we must always consider his theory of the nature of the rays, one or the other of his classifications would hardly hold, if other theories be advanced. Yet all these are plausible, and further results are eagerly awaited, as light in darkness, by thousands of experimenters. That the harmful action of the rays have been exaggerated, may be said to be true, when we consider the number of amateurs working in this enchanting art; most, with the exception of very few cases, would hardly have come to the ears of the eager public, who, believing all and considering none, only too readily condemn the entire work. And no wonder! It is but a short time ago I received a communication from Germany, where iodoform had been mistaken for pieces of glass in a man's arm and two operations were undertaken to remove same, where none actually existed. The radiogram showed a foreign body, but this happened to be the dressing applied to the wound in the arm. Such mistakes would not occur if responsible men undertook the work.

As the first experimenter in Brooklyn, and since February 4, 1896, I have had but one case of irritation of the skin and one of alopecia or baldness, resulting from exposure to the rays, during which time I have used tubes daily for hours at a time. The case of dermatitis, otherwise known as inflammation of the skin, was of mild type and under proper treatment abated in 12 days. The case of resulting baldness which is believed to be the first recorded in the world, was fully described in a previous number of The Electrical Engineer, and even here a complete recovery followed.

Yet, I have been called upon to treat numerous cases for other experimenters and in each case I was satisfied that the result was, to a great extent, due to too short a distance between the tube and part exposed. In fact, I have recently seen a case where a large gangrenous piece of the integument had to be removed. Such discharging and blistered wounds make up a great number of these painful affections. That they do not respond to treatment as quickly as diseases of similar nature, produced by other causes, is not true. No one would expect skin to grow under a layer of fine and gangrenous material. Instead, the acrid discharge retards and aggravates the conditions. Proper treatment is required to obtain a happy result.

But all this is not preventive. What shall be done as a prophylactic measure to protect the patient from such effects? Simply study your apparatus, know what it is capable of doing, know from experience the distance your tube should be placed from the body, know its value in emanations, and you will experience little trouble. A further preventive to protect the parts, as I have said in former papers, is the use of an unguentum, in the form of lanoline or vaseline, applied to the skin of the part to be exposed. This protects it from the powerful action of the ozone produced, which is known to be a powerful destructive agent of organic material. I have never felt any ill effects from the ozone generated by an induction apparatus; in truth, I feel better now than ever, and a slight post pharyngeal catarrh has disappeared during the last few moments of experimenting.

Moist dressings protect the parts as well as an ointment; this accounts for few bad effects in tissue by hospital radiographers, where injured members are usually dressed with moist dressings. Tesla uses a thin sheet or netting of aluminum connected to a condenser or the earth, as a collector of the electrical effects of the rays, being placed between the tube and the part exposed. That the interposition of such a metal products, can be readily felt by the amau-radiscope which I have used in the experiments with the blind (N. Y. Med. Journ., Jan. 16, '97). By using such screen the peculiar strain felt in the region of the frontal lobes of the brain is not felt as much as with the usual fluoroscope. I believe the marked anæsthetic effects noted by early experimenters, were due to the continued and monotonous vibrations of the rheotome and need not necessarily be accredited to the rays, although the highly vibrated etheric waves may have some appreciable effect on the auditory nerve.

Distance and time of exposure need careful study, and I would advise all beginners rather to increase the time than to shorten the distance and less harmful results will be attained. Until we receive further convincing proof of preventives the above precautions can be relied upon with comparative safety.

216 Seventeenth street, Brooklyn, N. Y.

X-RAY PICTURE OF AN ADULT BY ONE EXPOSURE.

BY WILLIAM J. MORTON, M. D.

AT the request of the editors of The Electrical Engineer I gladly furnish details in regard to the X-ray picture here reproduced in the hope that the applications of the X-ray in surgery may be aided.

The subject was a woman, 30 years of age, five feet four inches in height and weighing 120 pounds. She was in perfect health, well developed and muscular and particularly so about the hips. An emaciated subject from the hospital would no doubt have been much easier to picture, but the object was to demonstrate the applicability of the X-ray to the average person and to the entire organism as a complete whole, in cases where it is medically important to obtain such a view.

As is well known, X-ray pictures of the various portions of the skeleton, taken at successive exposures and patched together as well as may be, have been published, but besides the laborious nature of this method the chief objection to it has been that the parts on the different points do not in any sense accurately fit together. So far as is known to the writer, this is the first X-ray picture at one exposure of an adult skeleton.

The apparatus employed was that with which I have worked from the first (except when using a static machine), namely a 12-inch induction coil whose primary was supplied from the 117-volt Edison current of the street mains and "made" and "broken" by means of a break wheel causing about 5,000 breaks per minute. Both condenser and blower were employed to keep down the spark on the break wheel. At a revolution of the break wheel of 5,000 per minute, the coil affording a free discharge of sparks across a five-inch air gap, the number of amperes flowing through the primary circuit of the coil was 3 6-10 and the voltage at the terminals of the primary was 75. The Crookes tube employed was an ordinary focus tube; its vacuum at the start corresponded to a spark of two inches and gradually rose until at the end it corresponded to eight inches. The platinum anode was run at continuous red heat. The distance of the tube from the sensitive film was 4 feet 6 inches. The tube was run the first ten minutes steadily; then the current was turned off several times during a minute to allow it to cool. The total time consumed, including stoppages to take the picture, was 30 minutes.

A sensitive film 6 feet long by 3 feet in width, furnished by the Eastman Film Company, of Rochester, N. Y., was employed. Its development by the Eastman Company was procured by the firm of E. B. Meyrowitz, of this city, who also rendered other aid in regard to the preliminary mounting of the film. In making the attempt, I had hoped to be able to use two or more tubes at the same time, but preliminary experiment developed two obstacles to this course; the first was that each tube occasioned independent pictures whose outlines did not coincide and the second was the impossibility of keeping any two tubes, whether connected in series or in parallel, up to an equal degree of work. When in parallel, the current would quickly switch into one or the other in spite of artificial heating or cooling; when in series the tube with lowest vacuum limited the degree of current.

The resulting negative would have been better if longer exposure had been given, particularly about the region of the hips, but in this connection it is to be kept in mind that this region in ordinary subjects is extremely difficult to portray under the best of circumstances.

Granting that the intensity of the X-ray diminishes inversely as the square of the distance, it should take about twenty times as long to get a picture when the tube is 4½ feet from the sensitive plate, as it would when 1 foot from it. On the other hand, it was necessary to place the tube at least 4½ feet away to avoid the distortion corresponding to the casting of long shadows.

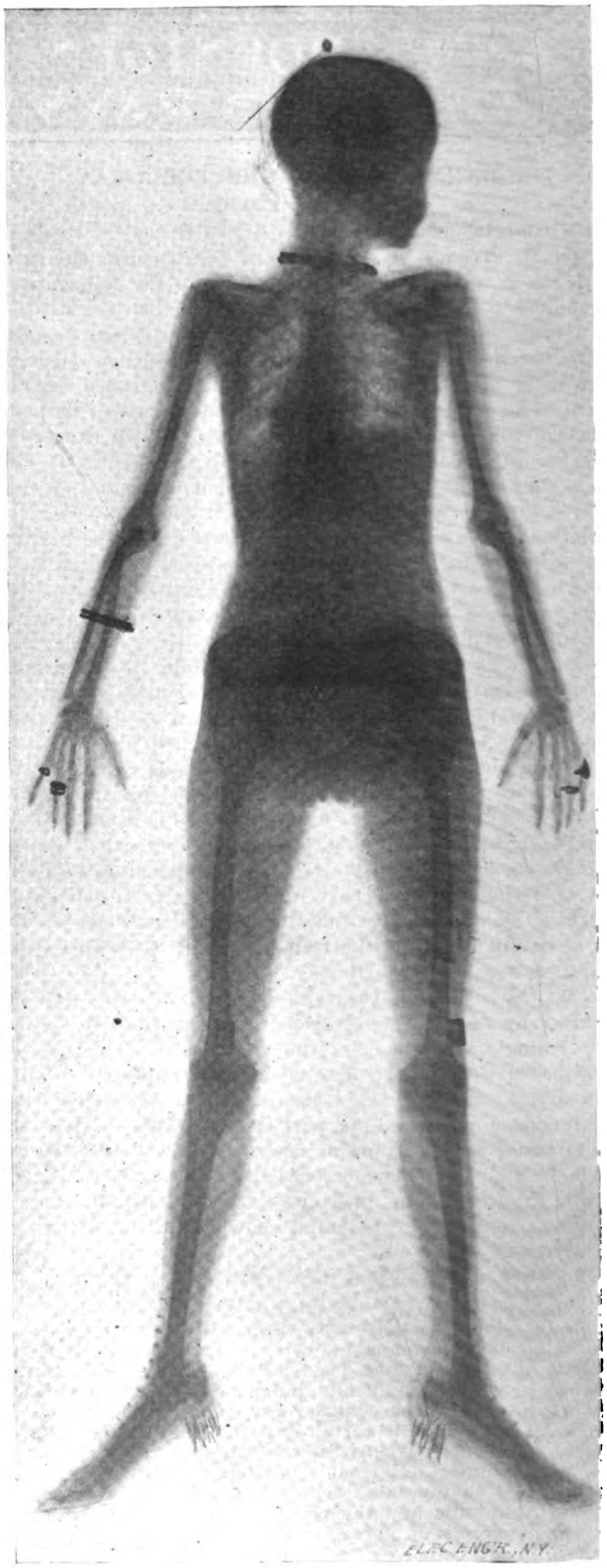
The degree of success attained in this experiment points to the conclusion that we may soon see Röntgen pictures of the entire adult skeleton at one exposure become a part of the ordinary curriculum of X-ray work in our hospitals as an important aid to diagnosis.

A ROENTGEN RAY TUBE WITH AUTOMATICALLY ADJUSTABLE VACUUM.[1]

BY H. LYMAN SAYEN, of Queen & Co.'s Laboratory.

THE most important and yet the most imperfect piece of apparatus that is necessary for the production of X-rays is the Crookes tube. It consists fundamentally of a cathode capable of focussing a stream of "radiant matter" upon a platinum plate, the whole being enclosed in a properly exhausted vessel.

Since the announcement of the focus tube in March, 1896, there have been few changes in the material arrangement of these parts. Many attempts, however, have been made to remedy one great defect which is inherent to Crookes tubes, and that is the gradual rise in vacuum subsequent to their constant use. I will briefly describe some of these methods and endeavor to show why they are inefficient.



ROENTGEN RAY PHOTOGRAPH OF COMPLETE SKELETON MADE WITH SINGLE FILM, 3 x 6 FEET, EXPOSURE 30 MINUTES. TAKEN BY DR. W. J. MORTON.

Many makers provide their tubes with a little bulb opening into the main tube and containing potassium hydrate or other material which is capable of giving off gas on being heated. When the vacuum gets too high, a spirit lamp is placed under the bulb and a small quantity of vapor is given off which lowers the vacuum the desired amount. It has further been suggested to use a resistance coil around the bulb and to regulate the heat by means of an auxiliary source of current.

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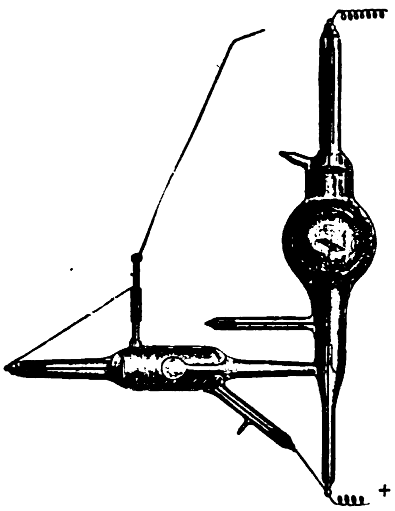
[1] Abstract of a paper read before the Electric Section of the Franklin Institute, Philadelphia, April 27, 1897.

Another scheme as suggested by Dr. William J. Morton, of New York, is to seal a small incandescent lamp on the main bulb, the two bulbs opening into each other, and to bring down the vacuum by passing an auxiliary current through the lamp filament.

Siemens & Halske, of Berlin, have recently put on the market a Röntgen ray tube in which the vacuum is adjusted in a most ingenious manner. A small bulb containing an internal electrode to which external connection can be made, is connected to the main tube. This bulb contains phosphoric vapors which have the property of condensing when traversed by an electric current. To raise the vacuum the electrode of the bulb and the cathode are connected to the induction coil. Warming the bulb causes the phosphorus to revaporize and lower the vacuum.

In all these schemes the vacuum may be varied over wide limits, and the life of the tube is increased to an indefinite extent, but as they all depend on the skilful manipulation of the operator, it is seldom that they accomplish the desired result. The vacuum in a Röntgen ray tube can only vary over very small limits, and being also dependent on the temperature of the tube, it is in a very unstable position. That is, if a tube starts to heat when running, the vacuum lowers and the tube takes more current due to the increased conductivity of the gas therein, lowering the vacuum still more, while a reverse condition of affairs takes place if the tube cools. So it will be seen that it is very difficult and often impossible to keep the temperature of the tube and to manage the regulating device to produce the desired result. One way of using these devices is to lower the vacuum the desired amount and keep it low by running with the platinum hot enough to keep the vacuum down.



Queen & Co.'s Adjustable Vacuum Tube.

The ideal regulating device should possess the following qualities: First; it should act immediately. Second; it should be independent of the temperature of the tube. Third; it should keep the vacuum where first put.

Having in mind the difficulties mentioned and the qualities desired, Messrs. Queen & Company authorized me to proceed in their laboratory with a series of experiments which have resulted in the device which I will now describe.

A reference to the illustration will make the operation of this device clear. A small bulb containing a chemical which gives off vapor on being heated and reabsorbs it when it cools, is directly connected to the main tube and surrounded by an auxiliary tube which is exhausted to a low Crookes vacuum.

In the auxiliary tube the cathode is opposite to the above mentioned bulb, so that any discharge through it will heat this bulb. This cathode is connected to an adjustable spark point which may be placed at any desired distance from the cathode of the main tube. The main tube is exhausted to as high a degree as possible in the first place while running hot, and the chemical in the small bulb is rid of enough of its gas to insure its remaining high at all ordinary atmospheric temperatures.

In operating, the induction coil is connected as usual to the main bulb. On starting the coil, the vacuum of the main tube being high, the resistance is also high and the current takes the path of the least resistance through the auxiliary tube, thereby heating the chemical in the small bulb. This will continue for a few seconds until a sufficient amount of vapor has been driven into the main tube to permit the current to go through it. After this only an occasional spark will jump across the spark gap to maintain the tube at the same vacuum. The vacuum may be set high or low by placing the spark point a considerable distance from or close to the cathode of the main tube.

I have here before you on the table a tube of this pattern connected to a large induction coil specially constructed by Queen & Company for Röntgen ray work. The coil gives a 14-inch spark and runs in a most quiet manner on the 110 volt circuit. By means of a resistance in the base I can regulate the current in the primary to any amount desired up to the limit of the coil. This fluorescent screen, behind which I have placed a thick book, will show any difference of penetrability of the Röntgen rays due to difference of vacuum.

On starting the current you see the main tube remains dark and the spark jumps across the spark gap. Almost immediately the large tube lights up. It is now possible to increase the current, and you can see that it is possible to get the platinum anode brightly incandescent without lowering the vacuum in the least, as shown by the brilliant fluorescence on the screen. I shut off the current and bring the spark points together; on starting the coil the main tube lights up at a very low vacuum; so low that there is no fluorescence produced at all.

The tube has now the characteristic appearance of running on an alternating current. The reason for this is that the resistance of the tube is so low that the secondary of the coil is practically short circuited, and by its mutual induction, decreases the self induction in the primary, allowing the current to rise more quickly on the make, producing considerable current in the secondary in the reversed direction. This effect is not so noticeable on battery circuits because the impressed electromotive force is not so high on the make. I will not run much current through the tube at this point, because it blackens the bulb considerably, due to disintegrated platinum when the platinum becomes cathode.

If I put a short spark gap in series with the tube and secondary you will notice that the alternating effect disappears and it is now perfectly safe to increase the current. I should advise all experimenters who desire to keep their tubes from blackening, that in using tubes where the platinum is the anode (and with the platinum the anode we get undoubtedly better X-rays), to use a similar spark gap in this manner. The sparking distance should be greater than the coil will spark on the make, and it is especially desirable where it is necessary to run on low vacuum with 110 volt primary.

On separating the spark points, you see the vacuum rises slowly in the main tube until the spark prefers to jump across the gap. The tube now runs quite steadily without flicker, a small intermittent spark being sufficient to keep the vacuum down.

I will now connect the coil to the heating tube only and run it lightly for a few seconds, so as to drive considerable gas into the main tube. On connecting again to the main tube it will be noticed that the vacuum is so low that the gas is simply a conducting stream between the terminals such as we recognize in a tube exhausted to a couple of millimeters of mercury.

Supposing we assume, after Crookes, that the vacuum necessary to produce X-ray effects is about one-millionth of an atmosphere (this is a low enough assumption at any rate); this bulb then contains enough gas to fill this whole hall at that high vacuum, so that the life of such a tube, barring misuse, should be practically unlimited. From even this most severe treatment, the tube rapidly recovers and is now working in its normal state.

I will conclude my paper this evening with a brief summary of the advantages which I think a tube of this kind possesses over the ordinary type. First, adjustable vacuum. It may be set at any vacuum desired, from one so high that no current will penetrate it, to one so low that the current would rather go through the tube than jump over a parallel spark gap of one-half of an inch. In a radiograph of the hand, for instance, it is desirable to use a low vacuum to secure the necessary contrast between bone and flesh, while in locating foreign metallic bodies in dense tissue, it is desirable to use a high vacuum. Second, automatic regulation. At whatever vacuum it is set it will remain so long as the coil is running without any attention whatever from the operator. Third, it will stand considerable energy without decrease of vacuum, consequently shortening the time of exposure necessary.

Prof. Arthur W. Goodspeed, of the University of Pennsylvania, has taken his best radiograph of the hip in three minutes with one of these tubes; he has also taken an excellent one in one minute. Dr. Wm. M. Sweet, with the tube adjusted at high vacuum, has located foreign bodies in the eye, the pictures being taken perpendicularly across the head with an exposure of thirty seconds. Fourth, a long lease of life.

X-RAY PALPITATIONS.

Paris doctors declare that X-rays produce violent palpitations of the heart. Drs. Seguy and Quenisset have experimented on their students and on themselves, and declare that when continued the palpitations are unendurable. They stopped them by placing a metal plate between the heart and the rays. They advise people who are not in perfect health to keep out of the way of the X-rays, or, at any rate, to protect their vital organs against them.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—X.

APPLICATION OF STORAGE BATTERIES TO ISOLATED PLANTS.—Continued.

BY JOSEPH APPLETON. (Copyright, 1897.)

Having thus stated the various functions of storage batteries as applied to isolated plants of the second class, we will now consider the methods of installation.

A somewhat different problem has to be solved in the installation of storage batteries in isolated plants of this class to that met with in the first application. The control or regulation of the discharge could be effected in the same manner, either by cutting out counter cells, or cutting in end cells as the voltage falls, but the same method of charging, namely, running up the voltage of the dynamo to the required point is not feasible, as the current required for charging the battery is only a portion, and usually a very small one, of the output of the machine.

To adopt the same method would mean that the entire output from the dynamo has to be generated at the higher voltage, that is, 110 to 150 volts, according to the conditions of charge, while the portion required for the load would have to be reduced to the normal working pressure of 110 to 115 volts. This would have to be done either by counter cells, which, besides being uneconomical, would be troublesome on such a large scale, or by end cells, which method is not recommended on account of the injurious effect which would result from the large current necessarily passing through them.

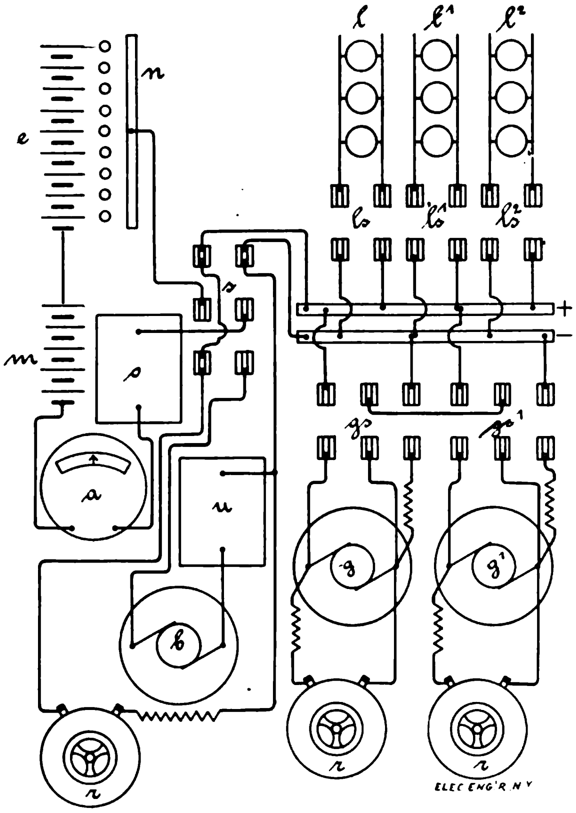


FIG. 34.—DIAGRAM OF CONNECTIONS FOR CHARGING WITH BOOSTER.

g, g1, Generating Dynamos; l, l1, l2, Lamp Circuits; m, Main Battery: e, End Cells; n, End Cell Switch; b, Booster; o, Overload Switch; u, Underload Switch; s, Double-Pole, Double-Throw Knife Switch.

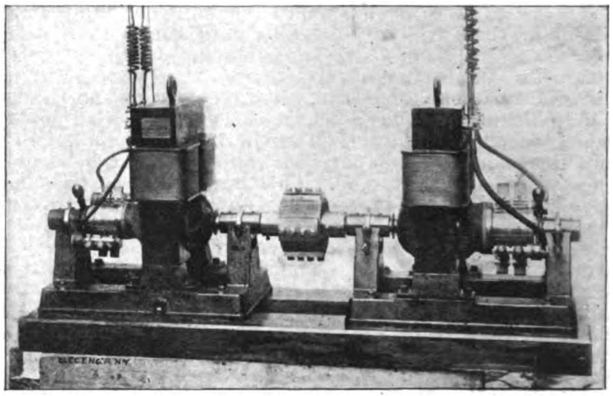


FIG. 35.—MOTOR DRIVEN BOOSTER.

One method occasionally used, but not the best, is to divide the battery into halves, and charge them in multiple, a resistance being used to cut down the voltage and regulate the charging current. The objections to this method is the necessity of some arrangement to regulate the charge through each of the two halves, and the loss in the resistance required for cutting down the voltage. For example: A battery of 60 cells on a 110-volt circuit would be divided into two groups of 30 cells each in multiple; the greatest voltage required for charging them would be 30 x 2.5 = 75 volts, leaving 35 volts or more to be absorbed by the resistance. The current would be twice the normal charging rate of the cell, there being two groups in multiple. This method is very uneconomical, but is sometimes used when the amount of current required for

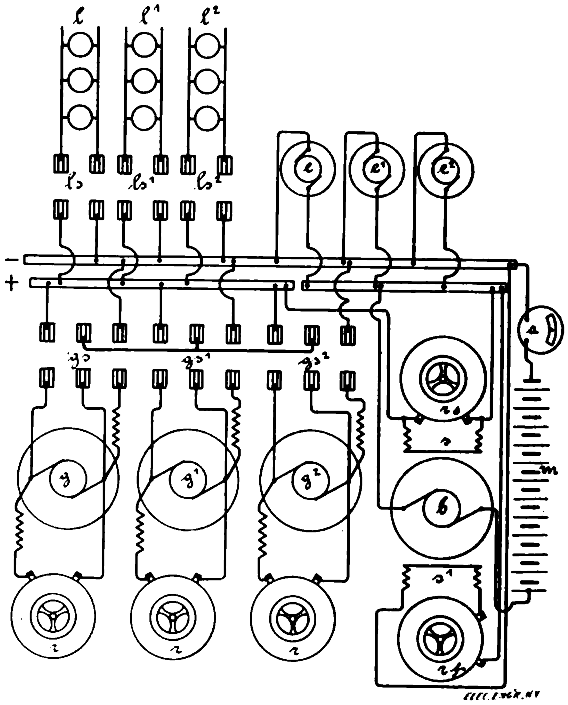


FIG. 36.—DIAGRAM OF CONNECTIONS FOR DIFFERENTIAL BOOSTER.

g, g1, g2, Generating Dynamos; l, l1, l2, Lamp Circuits; e, e1, e2, Electric Elevators; m, Battery: b, Differential Booster; s, Series Winding on Booster: s1, Shunt Winding on Booster; rs, Adjustable Shunt Across Series Winding; rf, Rheostat in Shunt Field.

charging the battery bears a very small proportion to the total output, and the loss is therefore hardly noticeable.

The best and most efficient method is to employ a small and supplementary dynamo or booster, so called because its function is to raise the voltage of the current required to charge the battery. The connections of this arrangement are shown in Fig. 34; the combination is really a small dynamo run in series with the main generators, but connected only to the battery circuit, and having a capacity only of the current required for charging the battery, and a voltage varying from 10 to 50 volts. This booster may be either motor or belt driven. Fig. 35 illustrates a motor driven booster in compact and convenient form. The field of the booster is separately excited from the bus bars of the installation, so that a steady field may be obtained independently of the varying voltage required from the machine. The voltage is raised by means of a rheostat in the field circuit.

At first sight this method may appear complicated and expensive, as it necessitates the use of another generator, but when it is considered that its capacity is very small, having a maximum voltage of only 50 volts, and the current capacity equal to the charging rate of the battery, this objection is easily dispelled, especially when the perfect flexibility of the system is realized.

When a storage battery is used for regulating the load in a generating plant in the case of elevator or similar service which is entirely fluctuating, a differential booster is used. The function of this machine is to control the working of the battery so as to meet the sudden fluctuations of the load; that is, to charge the battery when the load is light and to make the battery discharge when the load becomes heavy, thus keeping the load on the generating plant constant.

Fig. 36 illustrates the connections of this system. The booster in this case has two field windings, a series and shunt, which oppose each other, the shunt field magnetizing the booster so that it will generate current in the direction for charging the battery, and the series field magnetizing it in the opposite direction to assist the battery in discharging. The series winding is connected in the circuit which supplies the fluctuating current, as shown. When the load in this circuit is light the series field is weak and is overpowered by the shunt field which charges the battery. When the load is heavy the series becomes strong and overpowers the shunt field, causing the battery to discharge. By this means the generators can be run at a steady load, the entire fluctuations being taken care of by the battery under control of the booster. A rheostat in the shunt field, and a shunt across the terminals of the series windings, provide the necessary means of adjustment required to meet all the conditions of service.

This method of operation is ideal, as it enables the battery to act as a reservoir automatically and yet without any complicated relays or apparatus liable to get out of adjustment, depending entirely on the regulation due to changes in the magnetic field of the booster. With a properly designed and adjusted combination of this sort the voltage on the system can be kept constant in spite of the varying load, and the load on the generators maintained at a steady and economical point.

LIGHTNING EFFECTS AND THEIR RATIONALE.

BY FRANCIS W. JONES (Elec. Engr., Postal Telegraph Company.)

I HAVE observed in the accounts of the death or injury of persons by lightning for several years that lightning very frequently tears off the shoes and frequently throws them quite a distance. What is the rationale of this?

We are so well informed about X-rays and other abstruse phenomena that surely this strange freak of electricity can be explained. I inclose a few cases in point that at present seem well enough authenticated, as unchallenged, newspaper records:

1891.—South Sterling, N. J.—Gussie Ryan was killed by lightning, clothing torn from body and rubber shoes burned from her feet.

1892.—July 25th, Ottumwa, Ia.—Mrs. Fielder was injured, clothing torn from body.

1893.—Tinton Falls.—Mrs. Daniel Polhemus killed, buttons torn from her clothes and shoes torn from her feet.

1894.—August 3d, Sachuset Point, R. I.—Benjamin Anthony, wife and 3-year-old boy were struck by lightning in a carriage. Nearly all of Mrs. Anthony's clothes burned from her body. Mr. Anthony's rubber boots were melted from his feet.

1894.—Pinkney, Mich.—Boy 14 years old had his feet completely shattered.

1895.—April 10th, Port Jervis, N. Y.—Young child of Mrs. Kaas was struck, tearing off a shoe.

1895.—June 3d, Plowville, Berks Co., Pa.—Webster Ziegler killed while sitting in an arm chair on porch of hotel. His shoes were torn from his feet.

1895.—Red Hook, Brooklyn, N. Y.—Jeremiah Donovan killed; left sleeve of shirt torn to shreds, trouser leg torn away and both shoes ripped from his feet. The upper part of the left shoe had been cut off and the leather of the heel burned away, leaving only the shoe nails. The inner side of right shoe cut and burned.

1897, May 1, Lexington, Ky.—Mrs. Nanie Williams, wife of Howard J. Williams, a well-known farmer of Garrard County, was struck by lightning and instantly killed. She was sitting in front of the fire when the bolt struck the chimney, ran down it, and caused her death. The current entered her body immediately over the heart. It passed out into the floor, tearing a shoe from her foot.

TELEPHONY AND TELEGRAPHY

THE SYNCHRONOGRAPH.—A NEW METHOD OF RAPIDLY TRANSMITTING INTELLIGENCE BY THE ALTERNATING CURRENT.—III.

(Concluded.)

BY A. C. CREHORE AND G. O. SQUIER.

THE LINE.—It is generally understood that the line limits the speed of telegraphy. The limit is usually reached because of the distributed electrostatic capacity of the line rather than its resistance. The influence of the distributed capacity is to change the form of the wave as well as reduce its amplitude.

In order to test this system over as long a line as was available, the land telegraph and telephone lines upon the military reservation at Fort Monroe were joined in series, making about thirteen miles of iron wire having a resistance of 320 ohms. Not only was no difficulty experienced in transmitting and receiving messages over this line, but resistance was introduced making about 1,500 ohms total including the polarizing receiver coil of 390 ohms. This trial was at a frequency of about 200 complete periods per second. With the chemical receiver a coil of 10,900 ohms was used in the laboratory and the record was plainly received at a frequency of about 545 complete periods per second.

Conclusion.—When the extent of the transmission of intelligence at the present time is considered, and the direct influence which this service has upon the development of the world's progress, any proposition which promises to increase its efficiency should be received with consideration.

To better comprehend the volume of this service it is of interest to observe the statistics on the subject. These have been prepared from the United States mail service, the Western Union Telegraph Company, and the American Bell Telephone Company of the United States, and are exhibited in graphical form in Fig. 12.

It is noticed in general, that there is an increase in all departments of the intelligence transmission service from the earliest dates. The number of pieces of mail sent during 1896 was 5,693,000,000 which is the greatest amount ever sent in a single year. The greatest number of telephone messages on record for a single year is 757,000,000 in 1895. The largest number of telegraph messages was sent in 1893 and amounted to 66,000,000. Thus the greatest number of telegraph messages as compared with telephone messages is in the ratio of 1 to 11½. The greatest number of pieces of mail is in the ratio of 86 to 1 as compared with telegraph messages, or in the ratio of 7½ to 1 as compared with telephone messages. It is also seen that the cost of the mail service of the United States in 1896 was $90,626,000, or about $1.25 per capita. The greatest receipts for any year of the American Bell Telephone Company were in 1895 $16,400,000, about 25 cents per capita, while the greatest receipts of the Western Union Telegraph Company were in 1893 $24,978,000, about 35 cents per capita.

It appears, therefore, that the people of the United States pay for a telegraph service of about one-eighty-sixth the amount, about one-fourth of that paid for the entire mail service of the United States. It also costs one-and-a-half times as much for telegraph service as for the telephone service, although the number of telephone messages is about eleven-and-a-half times as great.

A conclusion to be drawn from the above general data seems to be that the people are willing to pay more in proportion for a kind of service like that of the telegraph than any other. From the point of serving the people, as well as from a business standpoint, it appears that improvement in this class of intelligence transmission is at present much to be desired. The present state of the art of telegraphy points to improvements along the line of automatic machine transmission.

It is of interest to inquire what effects a system of telegraphy capable of sending continuously 3,000 words a minute would have on the existing methods. To take a single example of the business between New York and Chicago, where about 40,000 letters are carried daily, it would require but two lines in continuous operation to handle the entire business. At present it takes three days to receive a business reply between New York and Chicago. This transmission by machine telegraphy could be accomplished easily the same day. It is thought that an effect of this would be to increase business transactions to such an extent that the total volume of intelligence transmitted would be augmented, rather than to diminish the business now done by existing methods.

The class of business which such a system would probably at first obtain would be the less urgent telegraph business of greater volume, such as the Associated Press dispatches and newspaper press reports.

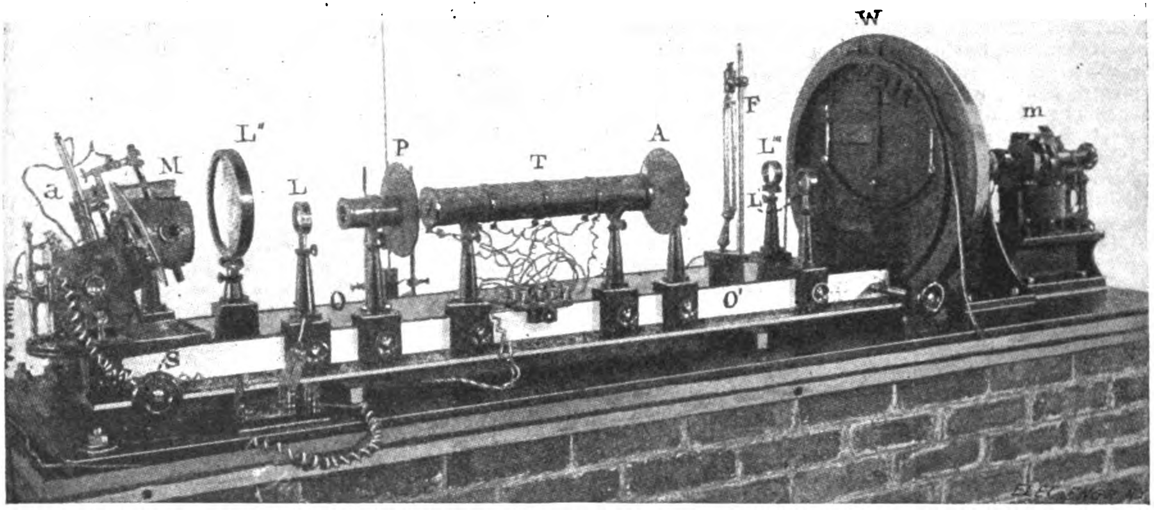


FIG. 11.--THE POLARIZING PHOTO-CHRONOGRAPH.
W, Wheel Holding Photographic Plate driven by motor; F, Arc Lamp; P, Polarizer; T, Tube; A, Analyzer.

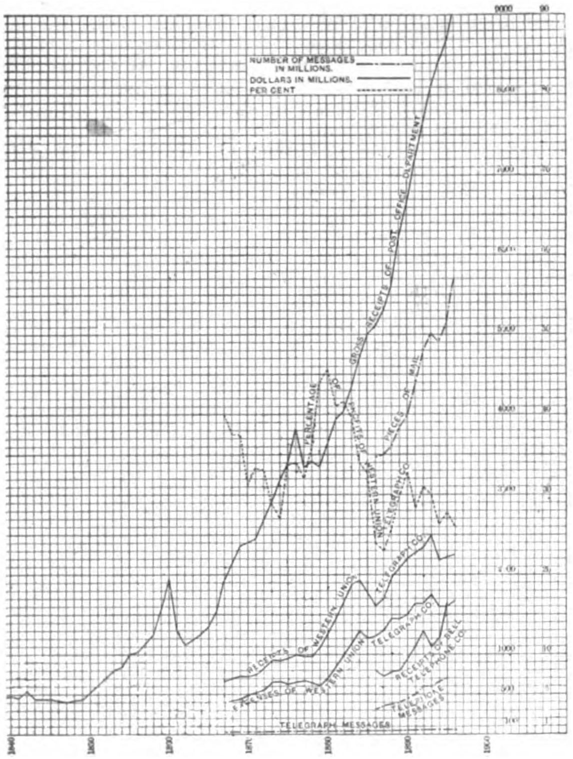


FIG. 12.

In addition to the above it is practicable to employ the line for a system of the ordinary quadruplex telegraphy at the same time. In trial experiments in the laboratory, particular instructions were given to the operator of the Morse instrument to observe if possible when messages were being sent by the alternating current, and absolutely no effect was detected.

A telegraph office of the future will probably present a different appearance from that which may now be seen in any of the large cities. At present in operating the Wheatstone system in this country, sending to long distances at the rate of 150 to 200 words per minute, both those who prepare the sending tape and those who translate the receiving tape are employés of the telegraph company and are near the sending and receiving instruments. If it requires about ten men to prepare tape, and as many more to translate it for a single instrument operating at 150 words per minute, it will require twenty times this working force for one of the rapid machine transmitters. Evidently changes would be required in the present methods to handle this business.

It is thought that a telegraph company of the future will fulfil a somewhat different function from the present ones. The company will own its wires and rights of way as now, but the tendency of the offices proper will be to transmit and receive letters already prepared rather than to undertake the preparation of the letters as well. The income of the company will be derived from the rent of its lines at a fixed price per minute, or a fixed price per hundred words. The service of the telegraph office then becomes like that of the post office, its duty being to receive and deliver letters already prepared, as the post office does. The difference between the two offices is in the manner in which this is accomplished. The telegraph office becomes a post office which employs an electric current in a copper wire to carry its letters instead of a railroad train.

It would be to the interest of such a company to seek that class of less urgent business now done by correspondence, rather than the class handled by the present telegraph companies, where the highest speed of delivery is expected. If one trunk line becomes established between large business centers, it will draw business from a surrounding area. For instance, if a line were established between New York and Chicago, and a person in Albany desired to communicate with Chicago or points beyond, it would be quicker to send the letter to New York for transmission over the trunk line to Chicago, and then by rail to its destination, than to send directly by rail from Albany. With a few trunk lines in successful operation it would not be long before they would be multiplied.

It is understood that these telegraph letters are sent by mail in envelopes in the usual manner, except that the envelope contains the prepared message ready to be sent through the transmitter, and thus the telegraph office becomes relieved of the preparation of the letters which is not strictly a part of its business. When the system comes into general use, business offices will have their own perforators, and it will become necessary for the operator to learn the telegraph alphabet as part of his preparation as a stenographer and typewriter. The opportunity to obtain a cheaper rate for prepared letters will act as an inducement to those employing a stenographer to add a perforator to their offices.

In the limited use of rapid automatic intelligence transmission at present, the sending and receiving records are made upon prepared paper in the form of tape. In the larger volume of business which is being considered here, it does not seem certain that tape would be the best form for the sending and receiving paper. It would be an advantage to have the letters received upon sheets of paper with the dots and dashes arranged in parallel lines.

Another point which must be considered is whether, with these systems, the induced currents from neighboring wires along the line or from any other cause will affect the legitimate signals materially, as has been at times the case with the Wheatstone system. In reply to this it can be said that these receivers for telegraphy are not necessarily more sensitive to small currents because they are rapid. On the contrary, they may be made to require as much current as is found desirable to rid them of the effects of outside influences, and at the same time retain the property of quick action in response to currents of the proper magnitude. In this connection it may be said that the utility of a single line wire becomes so great that more attention will be given in the future to the line construction and maintenance. If millions of dollars are invested in the construction of a single railroad, is it not as necessary to make the telegraph lines which carry important and profitable business as perfect in their construction?

The telegraph line of the future will comprise substantial poles carrying a few copper wires worked to their full capacity for transmitting electric signals. The cost of maintenance of such a line when once constructed will be little more than for an ordinary iron wire now used, while its carrying capacity for intelligence at 3,000 words per minute simplex will be about equal to 160 wires used for hand transmission simplex. By duplexing the line, the carrying capacity is doubled and becomes 6,000 words per minute, which is about equal to 160 wires worked duplex, or to 80 wires worked by hand quadruplex.

It is thought that the influence which the inauguration of a telegraph letter system would have upon the existing telegraph and telephone business would be to increase rather than diminish it. Each of these services has its own special field of usefulness but little affected by the others. A new field would be occupied rather than an old field supplanted. The present telegraph and telephone would still have their natural field of operation, even though the best hopes for a telegraph letter service are realized.

A single line capable of sending 6,000 words per minute between New York and Chicago, becomes a different kind of investment from a long distance telephone line where the number of words per minute with the fastest rate a speaker can talk is very slow in comparison, and the charge is $9 for five minutes' use of this line.

The application under government control of a rapid system of correspondence transmission such as has been outlined, operating in conjunction with the present postal system, by supplementing and relieving their service could hardly fail to prove of benefit to the people of the United States. This comes within the proper duty of the Post Office Department, and would be under the direct control of the Postmaster-General. The simplification in operation and expense which would result from uniting directly with the general post offices of large cities the telegraph letter service would soon be realized by the people and a better service insured.

The persistent efforts of Mr. Delany and the great system which he has developed are well known, and the ideas which he has advanced in regard to the applications of rapid systems are in the main in accordance with those stated herein.

A CLEVER PEN PICTURE OF HENRY C. PAYNE.

IN the Madison, Wis., "Journal" is a neat pen sketch, by Mr. H. Taylor, of Mr. Henry C. Payne, of Milwaukee, the well-known National Republican Committeeman and active manager of various electrical enterprises in Wisconsin, who was named recently for Postmaster General, and will probably be asked to take some other important office, perhaps a foreign mission:

"There was a good chance to see Henry C. Payne at his best before the Senate Committee on Corporations Thursday afternoon. He was arguing for the Bell Telephone Company as against its newer rivals. The 'Hypnotizer,' the Milwaukee 'News' styles him, and surely a 'more courteous self-poised, deferential, persuasive gentleman never pleaded for 'vested rights.' Mr. Payne does not storm or browbeat; he talks on in a quiet, reasonable way that would even undermine the judgment in a bad cause (if he could argue a bad cause) and when he does wax earnest, the style and voice indicate genuine indignation within. Few speakers so understand the possibilities of the human eyebrow. It is more expressive sometimes than a gesture. An interruption that seems to be unanswerable is met by a gentle, inquiring, almost pleading uplift of the eyebrow, while the busy brain behind hastens its resources. Again, Mr. Payne makes a clinching good point that must sink deep into the memories of the committeemen. Most speakers would show exultation. Not so Mr. Payne. He lets his hearers make the discovery! It is his part only to allow his eyes to fall to his notes carelessly, almost coyly. It is immense. Once only did he strike out to hurt, when a representative of a rival concern in the western part of the State interrupted him with a question as to how Mr. Payne's company spent its earnings. 'I should call the question impertinent coming from you,' replied the Milwaukee magnate. There was mingled rebuke and pain in the delicate, withering retort, and the face of the speaker indicated a hurt feeling, but no anger. The 'et tu Brute' of Julius Cæsar could not have been more pathetic and freer from bitterness. There was even a polite smile breaking later and the interrupter soon sought the floor to make amends. Mr. Payne makes no enemies needlessly, even at a time of such friction. And it would be unjust to impute nothing but adroitness to this Milwaukeean of marvelous executive ability. Henry C. Payne is a great man. He has a large heart and masterful brain."

THE NEW HEADQUARTERS OF THE N. Y. & N. J. TELEPHONE CO., BROOKLYN, N. Y.

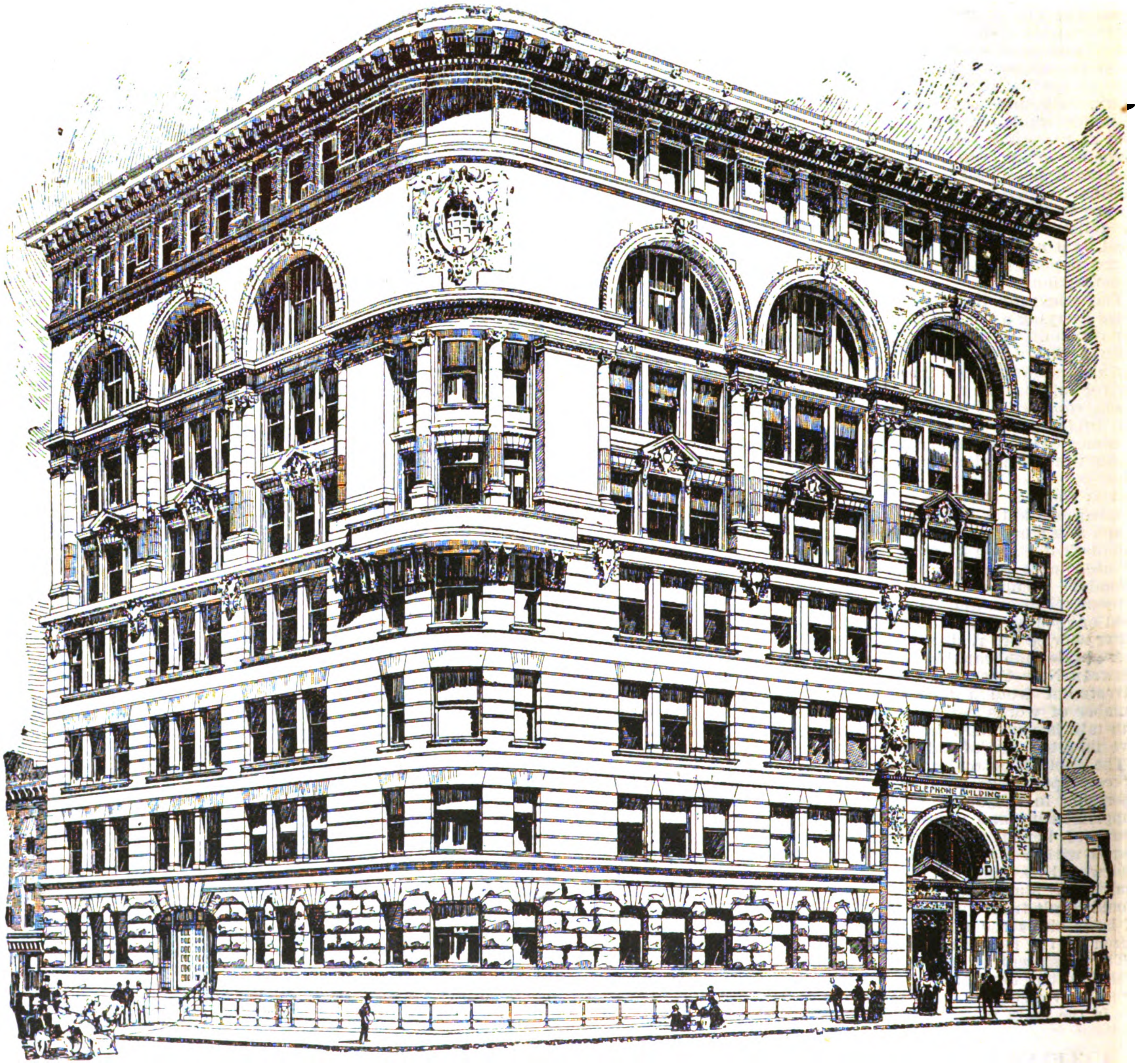
A SPLENDID addition to the notable buildings of Brooklyn will be that of the New York and New Jersey Telephone Building, which by next spring will be occupied by that company as the third step in its advancement from the beginning in 1883. The design of the structure is by R. L. Daus, the well-known Brooklyn architect, who has within a few years designed a number of buildings which are ornaments to the neighborhoods in which they stand.

The new telephone building will occupy a plot of ground on the northeasterly corner of Willoughby and Lawrence streets, with a frontage of 108 feet on Willoughby street and 100 feet on Lawrence street. It will consist of a basement and eight stories and be constructed by the most improved method of modern steel frame construction. The foundations are formed of heavy masses of concrete, some 4 or 5 feet thick and covering 50 to 60 superficial feet. On these concrete blocks are systems of heavy iron beams forming a grillage for the foundation of steel posts, extending through the entire height of the building. The floor construction is partly formed by hollow fireproof flat arches and partly of the Columbian fireproof construction. Dark blue Indiana limestone will form the lower two stories and pearl gray brick and terra cotta will be the principal material of the upper stories. The design is in the style of the Italian Renaissance and is one of great simplicity and dignity. This building will be one of the handsomest structures in Greater New York. It will be equipped with the most improved system of plumbing. Careful provisions have been made to supply the building with its own fireproof system. Two hydrants in the building are so situated that they can be used by the fire department to throw a stream 250 feet high, protecting both the building of the telephone company as well as adjoining buildings. Particular care has been bestowed upon the planning of the heating and ventilating of the building. One of the essential requirements of the operating room being its perfect freedom from dust, it was found necessary to bring the air from a shaft twenty-five feet above the roof to the basement, where it is screened through many layers of bolting cloth. The air will be supplied with the necessary degree of moisture, and by a system of fans distributed throughout the building. Exhaust ducts and powerful fans will expel the vitiated air and discharge it above the roof. The building will cost in the neighborhood of $300,000 and the telephone company paid about $55,000 for the land.

The New York and New Jersey Telephone Company was organized in 1883 and for five years occupied offices at 397 Fulton street, moving from there to its present quarters on Smith street in the summer of 1888. The charter of the company covers the territory of Long Island, Staten Island and the northern half of New Jersey. It had in 1883 2,339 subscribers from 30 exchanges, 1,656 of which were in Brooklyn, Williamsburg and Greenpoint. At the present time the company supplies service to over 16,000 subscribers from 86 exchanges. It has 21,642 miles of wire, 16,779 of which are underground and 4,863 aerial, in Brooklyn alone.

In 1884, a year before the subway laws were passed, it began the work of putting its wires underground. The last report of the subway commission, October 31, 1896, showed that the telephone company in Brooklyn had 11,655 miles laid underground. The mechanical operations of the company are in charge of J. C. Reilly, general superintendent, and F. W. Conn, assistant superintendent in charge of the Long Island construction.

The officers of the company are: President, Charles F. Cutler; vice-president and general manager, W. D. Sargent; secretary, Joel C. Clark; treasurer, Henry Sanger Snow; executive committee, Charles F. Cutler, Joseph P. Davis, W. D. Sargent, Joel C. Clark; directors, Charles F. Cutler, Alexander Cameron, Joseph P. Davis, Charles A. Nichols, Hugh Kinnard, William D. Sargent, David B. Powell, George H. Prentiss, Joel C. Clark, Felix Campbell, Edward J. Hall and Henry Sanger Snow.



The New Exchange Building of the New York and New Jersey Telephone and Telegraph Co., Brooklyn, N. Y.

THE BOUGHTON TELEPHOTOS, invented by Mr. C. V. Boughton, of Buffalo, and described some time ago exclusively in The Electrical Engineer, is being tested by the government with a view to its adoption by the U. S. Navy for men-of-war.

MECHANICAL

THE PRINCIPLES AND CONSTRUCTION OF WATER WHEELS.—II.

BY W. E. WINES.

THE three forms of water wheels most extensively used before the introduction of the turbine were the overshot, the undershot, and the breast wheel. The construction and operation of the overshot wheel is clearly shown in Fig. 2. Water from the head race flows into the buckets at the upper part and turns the wheel by virtue of its weight until discharged into the tail race, falling a total distance h. The general expression for the efficiency when applied to this wheel becomes

$$1 - \frac{1}{2}\frac{h_0}{h} - \frac{h_1}{h}$$

This shows that one-half of the entrance fall and the entire exit fall are lost; as it is possible to make both h and h_1 very small the theoretical efficiency of the overshot wheel may be very nearly unity, and its practical efficiency ranges from 70 to 90 per cent.

One of the greatest sources of loss is the spilling of the water from the buckets before they reach the bottom; but in times of drought when the water supply is scant the buckets become only partly filled, the spilling is reduced, and the efficiency is consequently increased. This is one of the greatest advantages of overshot wheels and in this particular they stand out in marked contrast with turbines, the efficiency of the latter falling off as the water supply is reduced.

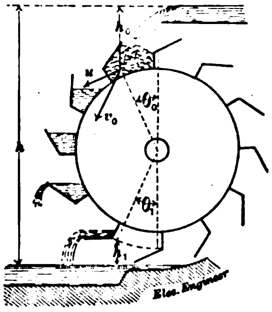


FIG. 2.—OVERSHOT WATER WHEEL.

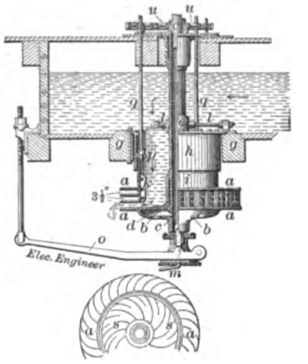


FIG. 4.—FOURNEYRON OUTWARD FLOW TURBINE.

The diameter of an overshot wheel should be as nearly as possible equal to the head and when a rather high head is to be utilized this necessitates a wheel of enormous size and weight. The largest overshot wheel in use at present is located at Laxey, on the Isle of Man. It is 72 feet 6 inches diameter, develops about 150 horse power, and has an estimated efficiency of 65 per cent. A Pelton wheel of equal capacity working under the same conditions would be only about 6 feet in diameter and would have an efficiency of 85 per cent. The relative sizes of an overshot and turbine of equal power, working under the same head is shown in Fig. 3.

The undershot wheel has plane, radial vanes which dip into the water flowing through a more or less confined channel beneath it. The vanes being plane, only the impulse of the water is utilized and the theoretical efficiency is consequently only 50 per cent.; the actual efficiency varies from 20 to 40 per cent.

In the breast wheel the water acts partly by impulse and partly by weight. Water enters the wheel about on a level with the shaft, and is confined to the buckets by means of the curved breast which covers about one-fourth of the circumference. The efficiency of the breast wheel ranges from 50 to 80 per cent.

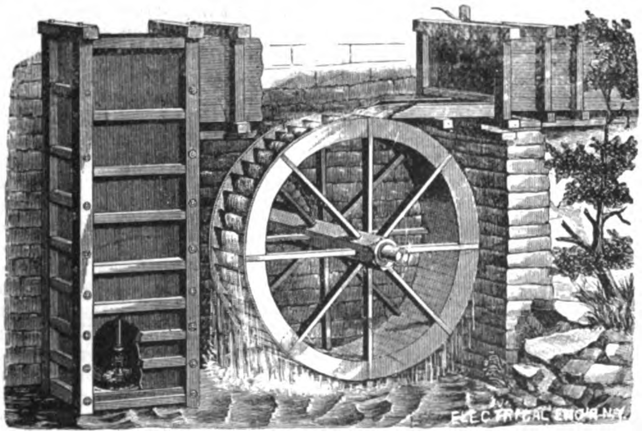

ELECTRICAL ENG'R N.Y.

FIG. 3.—COMPARATIVE SIZE OF OVERSHOT WATER WHEEL AND TURBINE.

The turbine, both in construction and operation, differs radically from the wheels already described. The wheel proper consists of curved vanes or buckets to which the water is led through suitable fixed guides in such a manner as to act upon the entire number of buckets at the same time. If the water flows from the axis outward the wheel is called an outward flow or, from its inventor, Fourneyron turbine; if the water flows from the outer circumference toward the axis it is termed an inward flow or Francis turbine; if the water flows through the wheel parallel to the axis it is known as a parallel flow or Jonval wheel.

The speed of the wheel is regulated by controlling the amount of water passing through it, the arrangement for effecting this being technically known as a gate. Gates are of two kinds, cylinder or register. A cylinder gate has the shape of a hollow cylinder or pipe which is placed between the guides and the wheel proper and may be moved parallel to the shaft, thus varying the cross section of the passages between the wheel and the guides. If the guides themselves are capable of a slight motion by which the size of the water passages between them may be varied the arrangement is termed a register gate. It is similar to an ordinary hot air register.

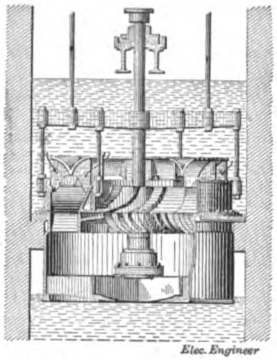


FIG. 5.—JONVAL OR PARALLEL FLOW TURBINE.

An outward flow turbine designed and built by Fourneyron is shown in Fig. 4. The upper view is half elevation and half vertical section; the lower view shows a horizontal section through the guides and buckets. The wheel proper a a has a dish-shaped bottom b b which is rigidly fastened to the vertical shaft c which passes through the sleeve e. Water enters as shown by the arrows and passes through the guides s and the buckets a (shown in the horizontal section), the direction of its motion while passing through the wheel being from the axis outward. The amount of water used is regulated by means of the cylinder gate i. Vertical rods q q are bolted to lugs p on the inside of the gate. The upper ends of these rods are threaded and are screwed into the gears u u; these gears are rotated by means of the pinion w and the gate is thus raised and lowered.

A type of Jonval or parallel flow turbine manufactured by R. D. Wood & Co., is shown in vertical section in Fig. 5. The water enters as indicated by the arrows and after passing through the guides enters the wheel proper, its course being parallel to the axis of the wheel. The guides and buckets are very clearly shown, as is also the cylinder gate, which is raised and lowered by the two small vertical rods parallel to the shaft.

The component parts—wheel, guides and gate—of an inward and downward flow turbine, built by Alcott & Son, are shown in Fig. 6. When the wheel is set up ready for use it is placed inside the gate. The gate is capable of rotation about a vertical axis, this motion serving to vary the amount of water supplied to the wheel and hence regulating the speed. In order to supply water to all the buckets at the same time it is placed in a flume and completely submerged, the water being supplied through a penstock.

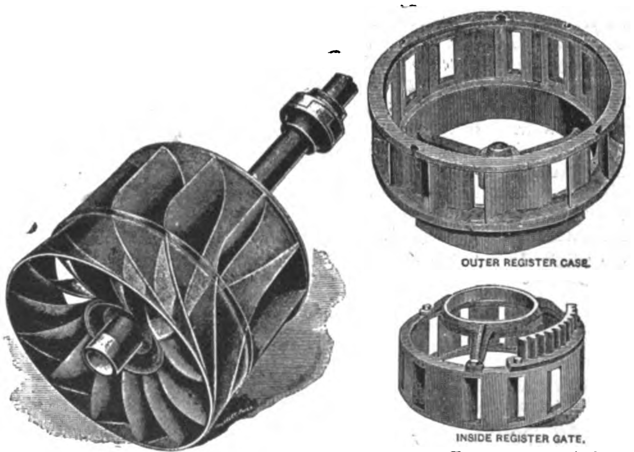

OUTER REGISTER CASE.
INSIDE REGISTER GATE.
THE RUNNER.
ELECTRICAL ENG'R. N.Y.

FIG. 6.—ALCOTT INWARD AND DOWNWARD FLOOR TURBINE.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. O. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico	per year.	$3.00
Four or more Copies in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies		.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, MAY 19, 1897. No. 472.

SCOPE OF THE BERLINER PATENT DECISION.

THE Supreme Court has rendered its judgment in the suit of the Government against the Bell Company, for the annulment of the Berliner patent, and its dictum, given in these columns last week, is that no fraud was proved against Berliner in his proceedings in the Patent Office, that therefore, the patent must be considered as issued in due form and hence rightfully in the possession of the inventor and his assignees. As to all other points brought forward by the government the Supreme Court flatly refused to consider them, following a time-honored custom which has already caused much impatient grumbling. The nature of the decision has very naturally caused widespread satisfaction and dissatisfaction, but far from causing dismay in the camp of those opposed to the Bell Company, it seems rather to have brought joy to their hearts. As a matter of fact, the Supreme Court decision relieves the Bell Company of the onus of fraud, but also now places upon it the onus of proving its right to the exclusive use of the Berliner transmitter by an infringement suit brought in the regular way. The decision leaves open all the usual defences against the validity of the patent, many of which have been brought to light in the discussions of this patent. For instance, it is held questionable whether the Berliner patent granted in 1891 is a valid patent in view of the fact that in 1880 Berliner obtained a patent on identically the same apparatus but with different claims. In the cultivator case (Miller vs. Eagle Manufacturing Company), the Supreme Court decided, under similar circumstances, that the second patent was invalid. In the opinion of one of the foremost patent lawyers in the country, it may be doubted whether the courts would find that the 1891 Berliner patent is for the same invention as that described in Berliner's original application filed in June, 1877. At the start the application described a transmitter having platinum electrodes—an evidently inoperative device for a variable contact transmitter—while by a series of amendments it was made to describe an instrument having carbon electrodes and operating on the microphone principle. It is one of the fundamentals of the patent law that variations of this kind will not be tolerated, especially when their effect is to include meritorious inventions made between the filing of the original application and the grant of the patent. The Berliner patent, No. 233,969, of November 2, 1880, above referred to, was a division of the original application of June, 1877. This patent describes and illustrates the same devices as the Berliner patent of 1891, just adjudicated by the Supreme Court, but the claims cover the use of the apparatus as a receiver. This 1880 patent expires this year and after November 2 the anomalous condition of affairs will exist that the use of a Berliner microphone transmitter applied to the ear will be lawful, while if applied to the mouth it will be an infringement. Of course the Berliner microphone is absolutely valueless as a receiver and no one would think of using it as such.

So far as we can gather, it is also open to doubt whether the courts would sustain the Berliner patent based on the useless transmitter having platinum electrodes as covering the subsequently invented and highly meritorious transmitter provided with carbon electrodes. It will be remembered that in the litigation on the Sawyer and Man patent, the claim was for a carbon for incandescent electric lamps made from fibrous vegetable material, and on this claim it was sought to enjoin the manufacture of the Edison lamp having a bamboo carbon. Sawyer and Man, in their patent, referred to paper as an illustration of their fibrous vegetable material from which the carbon could be made. The Supreme Court decided (following Mr. Justice Bradley, who decided the case below) that because inventors had discovered the utility of one material, they could not cover a subsequently discovered and different material, simply because their material was capable of being described in language which embraced the later material. The reason which led the Supreme Court to apply this principle to the Sawyer and Man patent was that paper carbon had a very small degree of utility, while bamboo carbon was highly useful. The same reason may be held to be applicable to the Berliner patent, and the courts might very possibly say that because Berliner's useless platinum electrodes are capable of being described in language broad enough to include the subsequently invented and highly useful carbon electrodes, is no reason for interpreting Berliner's claim to cover anything more than a telephone with electrodes of platinum or some equivalent material, which carbon certainly is not.

Undoubtedly many other defences against the Berliner patent will be brought forward by the opposing telephone interests. Among others, it has been suggested that foreign patents were granted to Berliner, which have expired and carry with them the United States patent, but we have not as yet seen any definite proof of the statement.

RECENT X-RAY PROGRESS.

FAR from falling off, the interest in the study of the results obtained in X-ray work is constantly increasing. Indeed scarcely a week passes but some improvement in the methods and apparatus employed for the production of X-rays is brought forward, or the list of successful applications broadened. The Electrical Engineer has tried to keep pace with this progress, and its pages have from week to week borne testimony to the richness of the soil first broken by Prof. Röntgen. The most noteworthy achievement in X-ray photography which has yet come under our notice is the recent work of Dr. W. J. Morton, who has succeeded in obtaining a full-size picture of the human skeleton on a single photographic film. The reduced reproduction of this film, printed elsewhere in this issue, gives but a faint idea of the actual photograph.

As regards the apparatus for the production of the rays probably the most work has been done with a view to the securing of permanency and reliability in the X-ray tube itself, and it may be fairly claimed that at the present time the most improved tubes cause the X-ray worker practically none of the inconveniences that were observable with the original tubes employed. It is now admitted that an X-ray outfit has come to be indispensable to the surgeon. But with its benefits has come also the necessity for greater precautions than have heretofore been observed in the use of Röntgen ray apparatus. The cause and nature of the X-ray burn, so called, has been the subject of special investigation. But here also experience has clearly defined the danger limits. Mr. Tesla's investigations in this direction, noted in our last issue, have called forth an interesting communication from Dr. F. S. Kolle, who has done much intelligent work in Röntgent ray photography, and who shows that X-ray burns do not differ from the usual irritations of the skin, and that they readily yield to proper treatment. We have also received a communication from a high electrical authority, commenting on Mr. Tesla's work, and pointing out that Mr. Tesla in his recent contribution to this subject has taken an entirely different stand from that which he seemed to have established some time ago. Thus he formerly claimed that the injurious effects pertaining to the use of Crookes tubes were due to electrostatic effects, and not to the X-rays, or were due to the production of ozone by electrical discharges around the tubes, and that the X-rays themselves were not to be considered as the really injurious agency. According to the same authority, Mr. Tesla has hardly put forward enough experimental evidence to make it essential to abandon the use of bulbs containing platinum, and more particularly as he does not show how a properly constructed Lenard tube can be made. It is not easy to join a piece of aluminum to a piece of glass in such a way that the joint will be maintained under the highest vacuum, and under the changes of temperature. The expense of such structures would also be far greater than that of the ordinary platinum tube, and besides it is not believed that platinum is by any means an essential metal to be used as a target, but that any heavy metal, such as tungsten, uranium, molybdenum or iridium will answer.

Viewed from a broad standpoint we believe that we shall hear very little about X-ray burns in the future, for X-ray apparatus has been now so well developed and the time required for exposure to obtain good pictures has been so reduced that the effects heretofore noted are not produced. The surgeon who operates with an outfit requiring more than a few minutes exposure, except in very extreme cases, would be considered as incompetent as one who would attempt to operate with a dull knife, or without the usual antiseptic precautions indicated by modern medicine.

THE THIRD RAIL EXPERIMENTS AT HARTFORD.

FORCED by the competition of parallel trolley lines, the New York, New Haven and Hartford Railroad some time ago took the bull by the horns and introduced electric service on a part of its lines, the first experiment being carried out on the Nantasket Beach branch of its system. This section was the first steam road of this kind equipped with the third rail, and, encouraged by the results, the same company has now equipped another section of its road between New Haven and Berlin, Conn. The experiments upon this road made last week show that the speeds obtainable were as high as, if not higher, than those which could be reached by means of steam locomotives. All this, of course, has created quite a furor among the readers of the daily newspapers, but to those who have followed the course of events in electric railroading for the last few years this achievement will cause no surprise. The event is, nevertheless, of considerable importance as foreshadowing the possible, and, indeed probable, future change in the method of operation of present steam roads. If merely for the sake of argument, we acquiesce in the opinion of steam railway managers, that through business will for an indefinite period continue to be performed by steam locomotives, we nevertheless believe that enough has already been demonstrated to show that local traffic is gradually but surely drifting in the direction of electric traction on present steam roads. The paralleling of trolley roads has already cut very seriously into the receipts of steam roads from this class of traffic, and if the business is to be held by the steam roads they must furnish equal accommodations with the present trolley road—in other words they must be converted into trolley roads. The ready manner in which this change can be carried out by means of the third rail is self-evident, and we expect to see a great deal of this class of work done in the near future. Looking further, however, it must be apparent that a section or division of a road electrically equipped for local traffic must by the sheer force of circumstances and economy in operation be finally forced to abandon the steam locomotive entirely. With the evidence before them that the highest speeds are attainable by electricity, and that it possesses other advantages and benefits, we venture to say that the through electric trunk line is not so far off as steam road managers may honestly believe it to be. We will go even so far as to venture the assertion that steam roads will in the course of time actually be forced to adopt electricity, for the reason that the first road so equipped will attract towards itself such a volume of patronage that competing lines will be forced to offer equal advantages if they would hope to maintain their business. From whatever standpoint we view the subject, the conclusion forces itself upon us that electricity must finally become the motive power of all railways. Far from sharing the opinion of the present steam railroad managers, that electricity will entail additional operating expenses, we believe the contrary to be true. But even if such were the case, the difference between the two cannot be so great as to cause its entire rejection. The problem here involved, it must be admitted, is not a small one, indeed it is one of the greatest possible moment to the national economy, but it is rapidly nearing its solution, and the outcome will be watched with more than general interest by the railways and travelers alike.

MUNICIPAL GAS A SAD FAILURE.

A SPECIAL committee of the Pennsylvania State Senate has just submitted its report on the working of the departments of the City of Philadelphia. The report embodies many interesting figures, the only inference from which is that there is scarcely a single branch of public service that would not be better attended to and less expensive to the city in private hands. The data on the municipal gas works will serve, however, to point the moral and adorn the tale. The gas works of the city are valued by the Mayor at $30,000,000, and it is said that $25,000,000 has been offered for them. The report says they could be easily duplicated for half the smaller sum, so that the remainder must represent what we will call the franchise; and the committee says very lugubriously: "It would seem, therefore, proper that the City of Philadelphia should realize upon this franchise while it yet exists, and before private gas companies, gasoline lamp companies and electric lighting companies occupy so much of the field as to render the franchise of but little value, or else invest the money necessary to render its work efficient and profitable; that it is better to lease or sell the works while they are yet valuable than to wait until their main value is destroyed by competition, fostered and maintained by inadequate management."

One of the witnesses estimated the loss to the city every year from this big investment at not less than about $700,000 per annum, and the report says: "The cost of manufacturing gas at the city's works is undoubtedly excessive, and the amount received by the city from the sale of the residuals much less than it ought to be. The analysis of the accounts published in the reports of the bureau, as made by one of the witnesses, whose technical training and large experience in the conduct of successful and profitable gas companies is universally recognized among those familiar with the business, shows that the cost for labor in the city's works is about three times what it should be, the produce being only about 10,000 cubic feet per day per man instead of 30,000 feet, which is the result in properly organized works. The excess of cost to the city for this item alone is about $225,000 per year." It is no wonder that the city does less than half its own lighting, and buys more than one-half of its gas supply from a local company which sells it gas at 37 cents per 1,000 cubic feet.

Philadelphia has been discussing the advisability of having its own electric light plant! Surely such figures as these should stand in the way and prevent further waste of public money. The report intimates that things would go better if the management were entirely divorced from politics. That we can well believe. It is often intimated that politics also have a great deal to do with lighting contracts to private companies. That is doubtless true. But the politics are necessarily minimized after the contract is let, whereas, from all we have ever been able to find out, the politics of a municipal plant come into full play when it gets going, and is one more "piece of pork." That is the mischief.

TROLLEY ROAD REWARDS OF MERIT.

WASHINGTON, D. C., sends the dismal and astounding story of the discharge of an excellent car conductor, on the complaint of senile Senator Hoar, because he ventured to treat that aged statesman as an old man in need of help when getting into the car. Of a truth, the polite conductor often does not know what to do, especially when his amiability is rewarded by his prompt dismissal. It is not always so, and the steady advance of street railway companies in the material recognition of the good behavior of their employés, is bearing excellent fruit. Out in San Francisco, as on the New York Central, the men of the San Mateo trolley road are decorated with medals and good conduct stripes, and get money rewards withal. E. H. Bohle, the winner of the first prize as a conductor, getting a badge and $12.50, never had an "oversleep" or a complaint from passengers. Iver Jones, first among the motormen, gets the badge and $40. He has never had an accident in five years, and therefore, with a humor that is distinctly Bret Harteian, is always placed in charge of the funeral car when burial parties are taken out. Since the road introduced its merit system, complaints and accidents have greatly fallen off. But the road is lucky in not carrying cranky Senators as passengers.

CHICAGO EDISON EARNINGS.

THE report of the Chicago Edison Company, published on another page, makes a good showing, one in fact that might be considered remarkable in view of the severe depression undergone for some time past by the metropolis of the West. There is a gain of 9 per cent. in the gross earnings, and the increase in business is the equivalent of 34,408 lamps of 16 candle-power. The net profit is also larger in spite of the larger amount necessary for the bonds and for the dividends. Two things are evident; first, that the company has been very prudently and skillfully managed, and next, that the company has but barely begun to enjoy the returns possible from its admirable equipment, described in these pages not long since. The company has put itself in the best possible shape to benefit by the returning conditions of prosperity, which, evident already in other cities, will be sure to show themselves in a marked degree before long in buoyant Chicago. Such figures as these, coupled with those of New York, Boston, Brooklyn and Philadelphia, go to demonstrate very strikingly also the staying power and great permanent earning capacity of the modern central station when operated not merely to supply one form of light, but to serve as a reservoir of current for all manner of uses.

ELECTRIC TRANSPORTATION

THE COLUMBIA ELECTRIC MOTOR CARRIAGE OF THE POPE MANUFACTURING CO.

At the invitation of the Pope Manufacturing Company, of Hartford, Conn., we were given an opportunity to witness an exhibition of, and to thoroughly inspect, the new electric motor carriage designed by that company, a view of which is given in the accompanying engraving, Fig. 1.

The present vehicle, we may premise, is not by any means a recent or experimental creation. As a matter of fact, the Pope Company began experimenting in the line of developing a horseless carriage nearly three years ago. Shortly afterwards, a fully equipped factory was allotted for this work, and the Motor Carriage Department of the Pope Manufacturing Company was formally organized. Their investigations and experiments were by no means confined to the field of electricity, but several types of automobile vehicles were built, with the idea of testing every device or mechanism available, then known to the art, besides applying to their experiments the knowledge and investigations of their own experts and inventors.

The motor carriage driven by a gasoline engine, which crude and experimental as it is, and unsusceptible as it is of operation in unmechanical hands, is still the most common type. However satisfactory or otherwise the operation of the gasoline carriage may be in the hands of experts, it is considered as yet neither a practical nor safe device to put in the hands of an inexperienced operator. This, coupled with its ready liability to derangement and its very objectionable æsthetic features, led the Pope Company, while energetically pursuing their investigations in that line, to suspend any attempt to market a vehicle of this type until these very serious objections have been overcome. That the advent of a popularly operative gasoline or other similar motor carriage is near at hand, they have every reason to doubt. At present its very objectionable unæsthetic features of noise, smell, smoke, vibration and heat are especially noticeable in the crowded streets of a city, and were a matter of comment on the part of all recent visitors to the celebrated Parisian Champs Elysees.

The electric carriage, with its almost noiseless action and perfect ease of control, certainly comes very near to being the ideal horseless carriage. At all events, it stands to-day the only carriage which the company's experiments indicate to be available for popular use.

The first experimental electric carriage built by the company was put in commission over a year ago, and since that time has been in constant use, having made a mileage of about 3,500 in and around the City of Hartford. It has been driven over all kinds and conditions of roads and through deep mud and snow. It was given into the hands of people without the slightest mechanical training or previous experience. Even the most unskilled, after a few words of explanation, were able to control and steer the carriage with perfect safety and ease. During this long period of use and even abuse, it never met with an accident serious enough to be taken home by any other power than its own.

On this experimental vehicle are modeled the present carriages. They embody the well tested scheme of construction and equipment of their forerunner with such improvements as have been suggested by its use. They are designed for two occupants, and have the general appearance of a Stanhope phaeton.

The power is supplied by chloride storage batteries of the type best adapted to meet the required conditions of greatest efficiency with least weight and consistent with reasonable life. These can be charged from any 110 volt direct current circuit, such as is used for lighting in most factories, private plants and most towns of any considerable size.

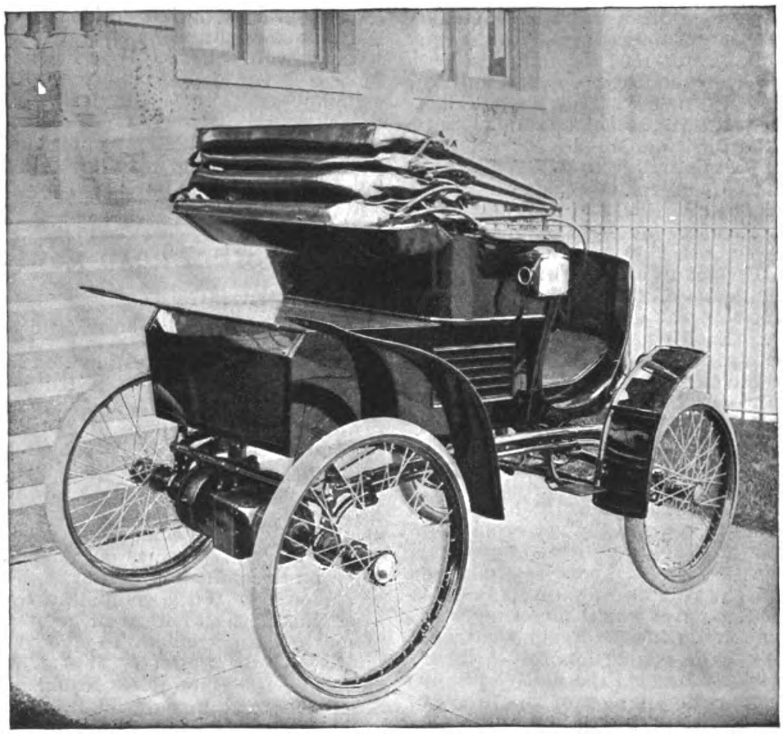


Fig. 1.—The Columbia Electric Motor Carriage, Built by The Pope Manufacturing Co., Hartford, Conn.

The normal power of the carriage, or that required to drive it at a speed of 12½ miles per hour on a level asphalt pavement is 18 amperes at approximately 80 volts. This is an output of the batteries of 1.93 horse-power. The efficiency of the motor is 80 per cent., and assuming that the loss in the gearing of the carriage is 10 per cent., makes the total efficiency of the motive mechanism 70 per cent. This means that with 1.93 horse-power going in from the batteries 1.35 horse-power, practically 1⅜ horse-power, is being exerted at the rim of the wheel.

The motors are built for a normal load of 2 horse-power. Their specifications called, however, for them to stand an overload of 100 per cent., or 4 horse-power for one-half hour without injurious heating. The capacity of the batteries is 70 ampere hours at a discharge rate of 25 amperes. This means that 25 amperes discharge be maintained for 2.8 hours, which on ordinary roads could be expected to propel the carriage between 30 and 35 miles, according to the number of stops made and the conditions of the grading of the road. The actual weight of the batteries is 350 pounds. There are 44 cells, which enables them to be directly coupled to the 110 volt continuous current circuit for charging purposes.

The weight of the finished carriage has not been obtained, but from the weight of the rough carriages it is probable that this weight will be 1,900 pounds. The weight of the motor is 129 pounds. The motors are of Eddy make.

As the carriage is intended to be placed in the hands of the general public, special provisions have been made for preventing damage to batteries from careless handling, and also to prevent waste of current; for this purpose an automobile cut-out is provided that cuts off the current on the completion of the charge.

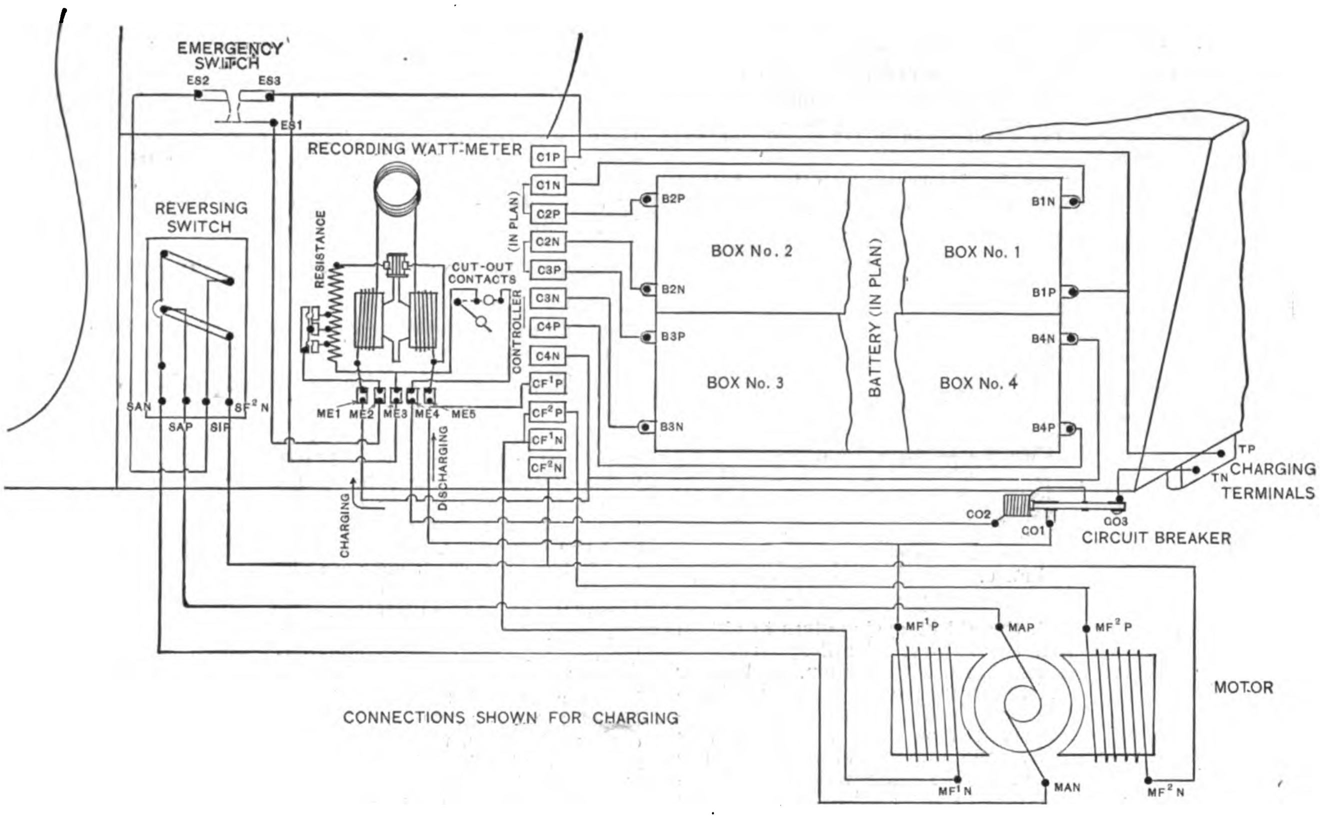


Fig. 2.—Wiring Diagram of Columbia Electric Motor Carriage.

On the diagram, Fig. 2, the cut-out is shown at C. O. 2, C. O. 1 and C. O. 3. The recording watt meter which actuates this cut-out is shown under the title "Recording Watt Meter," and its object is to show at all times the condition of charge of the cells.

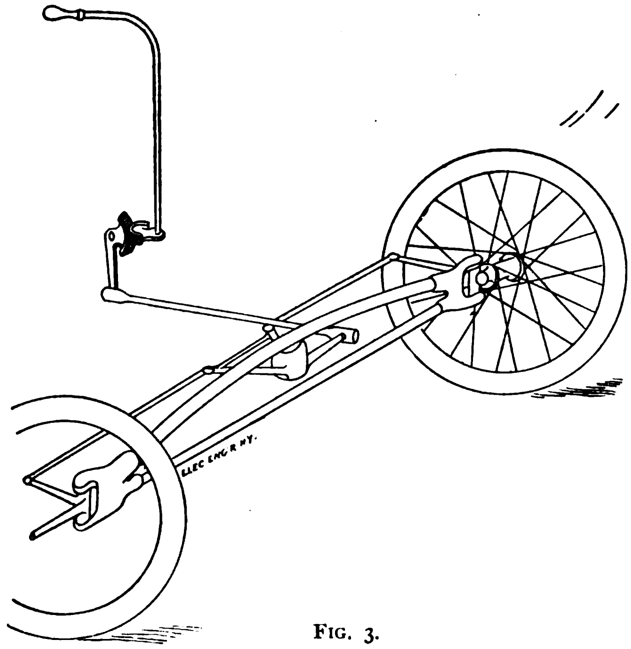
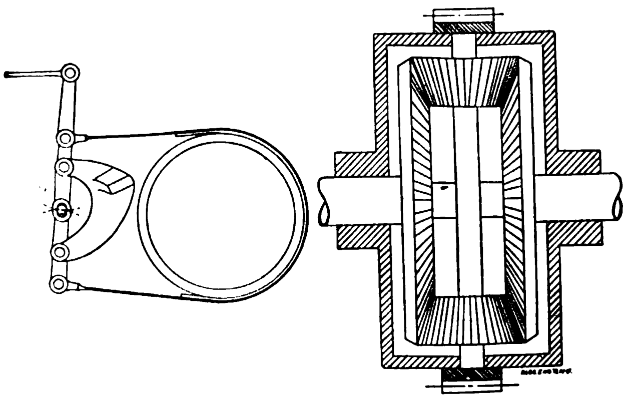


Fig. 3.

The connections are so made between these two devices that when the charging current enters the carriage the wattmeter runs backward at a speed lower than what would be the case with the same current during discharging. This provides for the loss in efficiency in the battery. Thus, when the indicator finger on the motor has returned to the "full' position on the dial it is plain that slightly more current has gone into the battery than was taken out. Two small contacts after the manner of the ordinary electric alarm clock are provided at the "full" position so that when the finger reaches this point the circuit is completed through the electro-magnet of the cut-out which actuates and permits of the main switch of the carriage being thrown out. Thus by simply inserting the charging plug in the carriage and closing the main switch, no attention whatever is required until it is desired to next use the carriage. The recording watt meter is of a special type made especially by the General Electric Company.



Figs. 4 and 5.

The reversing switch, shown under the title "Reversing Switch," is not put in the controller on Columbia carriages for the reason that in some cases it is possible for an excited person during an emergency to quickly draw the controller from full speed ahead to backing. This plainly would be liable to cause serious results. In its stead a special reversing switch is put in which is operated by the heel and which makes it practically impossible for an unthinking or careless person to reverse the current in the motor when the carriage is going at high speed ahead.

The emergency switch is a small plug conveniently near the seat, which an operator can always pull out in case of any accident to the motor which would prevent its being stopped.

All battery connections, and, for that matter, all connections throughout the carriages which have to be manipulated in any way are made of two different size holes, all of the positive holes being the larger. Thus no negative plug can be inserted in a positive hole or any positive plug inserted in a negative hole. This is another feature of "fool-proofness" which makes it impossible to make any wrong connections.

The expense of charging where the current is taken from the city mains is estimated not to exceed 50 cents. If the carriage owner possesses a private electric plant, the cost is much less, and under favorable conditions would not exceed ½ cent per mile.

In this connection it may be interesting to record that before venturing to produce electric carriages for sales purposes, pains were taken with the aid of cyclometers to obtain the best data possible upon the subject of mileage requirements of private citizens, surgeons, expressmen, and other constant users of vehicles. Some idea of the periodical expense of running a carriage whose mileage cost of operation is known, may be derived from the fact that this investigation indicated an average mileage of about 18 per day, and with one exception, a maximum mileage not exceeding 25. That exception was in the case of a veterinary surgeon who had a large country practice.

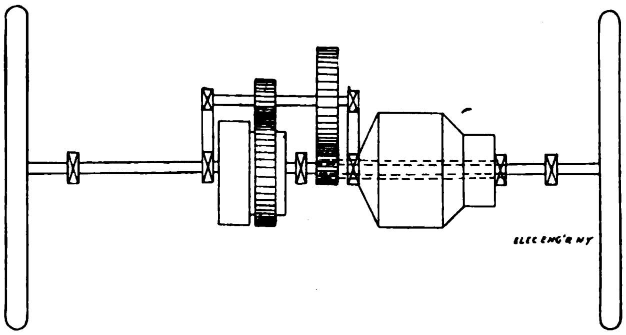


FIG. 6.

The Pope carriages are designed for a maximum speed of between 14 and 15 miles per hour on good roads. There are also three lesser speeds, one of twelve, one of six, and one of three miles per hour. All these speeds can be obtained backwards by a very simple manipulation, and the carriage is steered with the greatest ease and a minimum of muscular effort by means of the steering apparatus shown in detail in Fig. 3. There is a powerful foot band brake, Fig. 4, which can be quickly and effectively applied, and a warning signal is provided of distinctive and powerful, though agreeable tone.

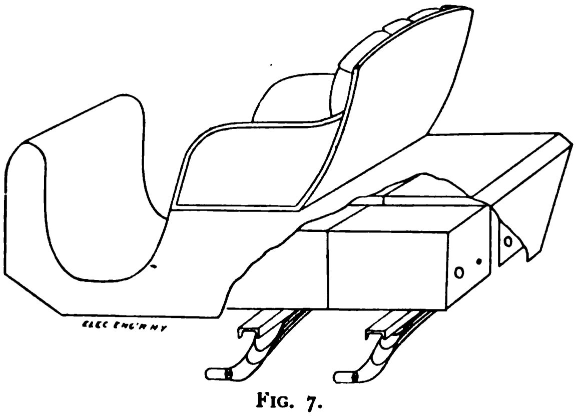


FIG. 7.

The engraving, Fig. 6, shows a plan of the rear axle illustrating the relative arrangement of the motor and driving gear. Fig. 5 shows the special balance gear, and Fig. 7 illustrates the method of supporting the batteries on springs.

When leaving the carriage standing in the street or elsewhere, one can, by taking out the emergency plug, which is of a size to conveniently go into the waist-coat pocket, make it impossible for any one, not possessing a similar plug, to use the carriage. The connection is broken by removing this plug, so that the carriage cannot again be moved by its own power until the plug is replaced.

The wheels are fitted with ball bearings, which are also used elsewhere throughout the carriage wherever of possible advantage. The tires are three-inch pneumatic, of especially durable construction, and are practically non-puncturable under any probable conditions. The construction, material, and dimensions of these tires, which are the well-known Hartford single tubes, lend materially to the care of running and relieve the structure of many shocks which would otherwise tend to reduce its life.

The frame is of special steel tubing, manufactured and tested for this particular purpose. All details of construction are worked out to provide the greatest strength with the least sacrifices of lightness and elegance. Such parts of the running gear as would be exposed under the carriage are covered with neat housings to prevent the entrance of mud or dust. In short, the carriages have been built on strictly bicycle lines.

SENATOR HOAR AND THE POLITE CONDUCTOR.

Senator George F. Hoar always was a peculiar man, and advancing age emphasizes rather than mitigates his aberrancies from normality. Our attention has just been called to a remarkable episode in which he took part last December. It deserves a brief recital as casting considerable light on the veteran statesman's character. It seems that one day after the Senator had completed his exhausting labors at the capitol, and was on his way home, he signaled to a street car that was passing the corner of Pennsylvania avenue and Sixth street. As it stopped for him he endeavored to step aboard, and the conductor, noticing that the would-be passenger was an obviously decrepit old man with snowy hair and obliged to lean heavily on a stout cane, grasped his arm and endeavored to assist him to the platform. Instantly there was an explosion of anger. The Senator resented the silent insinuation against his agility. He tried to strike the conductor with his cane, and when prevented by the other passengers from doing this began a violent tirade against the man's officiousness that lasted for ten minutes. Next day Senator Hoar visited the company's office, reported the conductor's name and number, and demanded his discharge. The man declared that he had simply tried to give assistance to a man who needed it, but he was suspended for thirty days. At the end of that period he was permanently discharged because he had been overheard commenting bitterly on the Senator's action. Since then he has been unable to get employment on any line in Washington, though he is a man of excellent reputation and long experience. All the people who saw the encounter with the Senator say that the conductor's behavior was irreproachable from the beginning to the end of the exciting episode. Among these witnesses is the Rev. Dr. Powers, pastor of the Vermont Avenue Christian Church.—New York "Times."

THE THIRD RAIL EQUIPMENT OF THE N. Y., N. H. & H. RAILROAD BETWEEN NEW BRITAIN AND HARTFORD, CONN.

THE New York, New Haven and Hartford Railway directorate has made another advance in the application of electricity in the operation of its road, in the electrical equipment of its line running from Berlin to New Britain on the New Haven system, Hartford Division, and from New Britain to Hartford, on the New England system, Springfield Division. The first electric car was officially run over the electrically equipped track on the 11th inst. by Col. N. H. Heft, the chief of the electrical department of the N. Y., N. H & H. R. R., in the presence of the president, C. P. Clark, Vice-Presidents Hall and Mellen; the directors and other prominent officials of the New Haven and New England systems.

This section is the longest section of any railroad in the world, hitherto exclusively operated by steam locomotives, to be equipped for electric traction. The total distance is 12.3 miles, divided in two parts. The first running from the power house at Berlin, the second extending from New Britain to Hartford. The road from Berlin to New Britain is single track; from New Britain to Hartford double track, the east-bound track only being devoted to electric service. In the operation of this road the electric trains will run from Berlin to New Britain and back. The trains from New Britain to Hartford and back run as a separate service, the change of cars being made at New Britain.

This important system differs in its electrical equipment from that at Nantasket in that the trolley system of contact is not used. That adopted is the third rail system, the conductor or third rail being laid along the center of the track between the running rails.

The power station of the New York, New Haven and Hartford Railroad is No. 3, that at Nantasket being No. 1, No. 2 being the power station at Stamford, Conn., from which the local trolley line is supplied with current. Power station No. 3 is a brick and stone building, two stories high, divided by a central wall into two parts—boiler room and engine room. In its present condition it forms only about half of what the station will ultimately be. The north side is closed in by boards. At what will be the center of the front wall of the completed building is a bay in which the switchboard is erected. The present length of the building is 113 feet 3 inches, its depth exclusive of the bay, 102 feet 5 inches, and height to ridge pole 65 feet. It is divided by a 26-inch brick wall into two parts, the front part facing the railroad is the engine room. The rear contains the boiler equipment.

The boilers are ten in number, each of 300 horse power. They are tubular boilers built by E. Kendall & Sons, Cambridgeport, Mass., and are set in two batteries of five each. In the construction of the boiler front a new method, devised by Col. N. H. Heft, chief of the electrical department of the consolidated road, who has carried out the entire electrical installation, is followed. The entire boiler front is capable of being taken down without disturbing the rest of the boiler setting, the front being bolted to a plate attached to the dividing wall instead of to the wall itself.

There are two feed water pumps, either pump being capable of supplying water to both batteries at once. The piping from the boilers is in duplicate and will be covered with non-conductive covering. The flues enter a brick stack 125 feet high, located immediately in the rear of the center of the present building. The coal used is known as locomotive sparks, the burning of which has given considerable satisfaction at the Stamford station. The coal is taken directly from the tracks in the rear of the station and is emptied into a large bin running along the back of the building.

The engine section of the building is divided into two stories, the upper one of which will contain the engines and dynamos. It is lighted by windows both in front and at the side, and is very high, spacious and well ventilated. One engine is in place, the foundations are in for another, and a third will be added as soon as demand warrants. The projected extension of the building will hold three more, and as each engine will have a capacity of 1,200 horse power the total capacity of the station when completed will be 7,200 horse power nominal, which can readily be raised to 12,000 horse power. The engine at present in position is a Greene-Corliss improved cross-

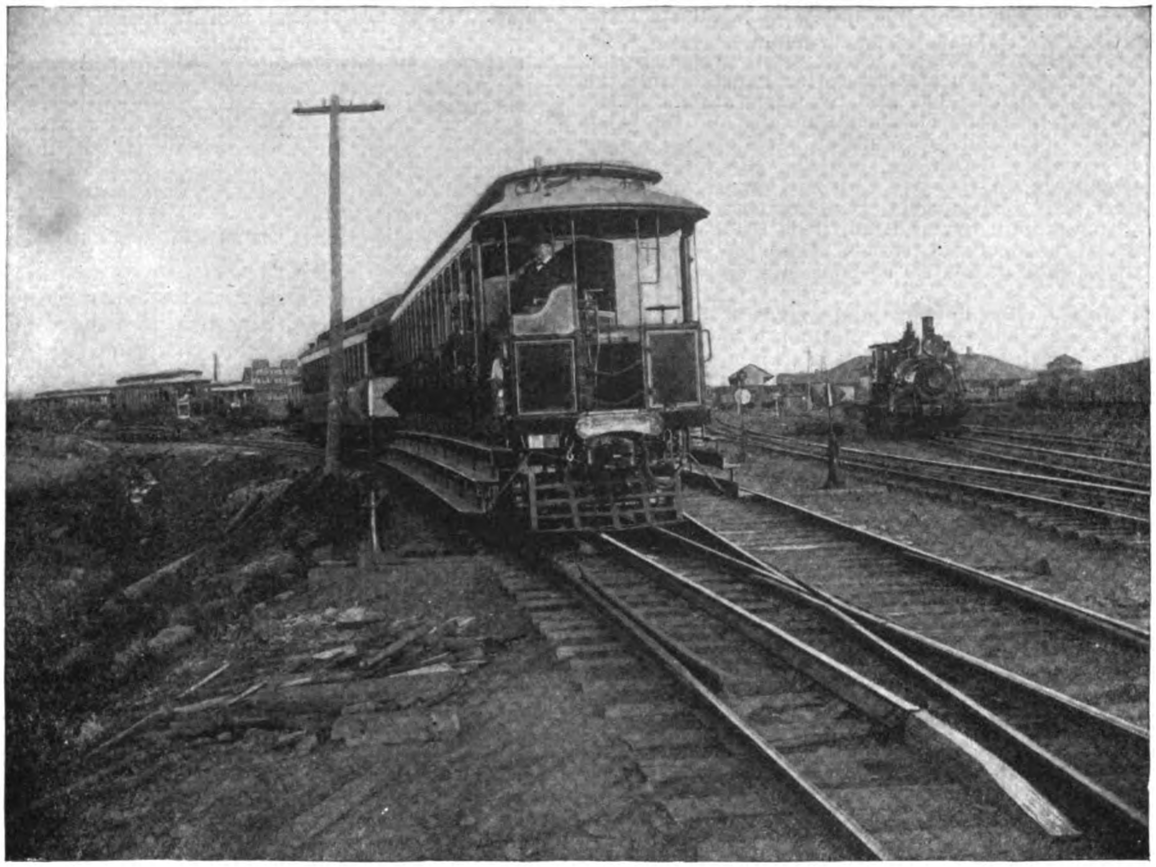


FIG. 1.—TRAIN, ONE MOTOR CAR AND ONE PASSENGER COACH, N. Y., N. H. & H. R. R.

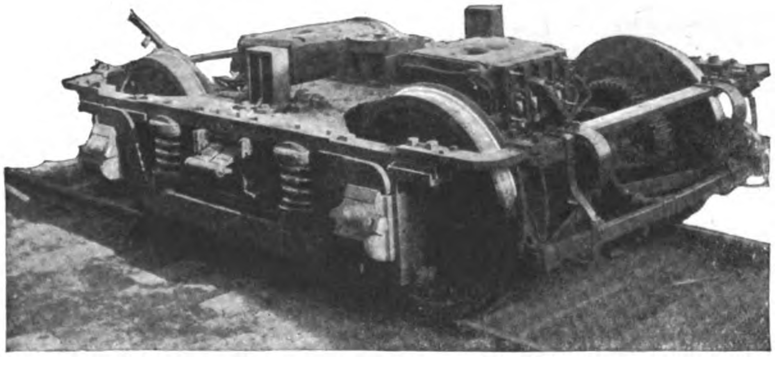


FIG. 2.—TRUCK OF MOTOR CAR WITH TWO G. E. 2,000 MOTORS.

compound, condensing, built by the Providence Steam Engine Company. It is rated at 1,200 horse power nominal, with dimensions 28 x 48 x 4 feet stroke, running at 100 revolutions per minute.

To the engines is directly connected a General Electric Company standard 10-pole 850-kilowatt generator of the ironclad type, with the method of construction of which our readers are familiar. The dynamos are over compounded and furnish current at 600 volts, no load, and 650 volts full load. The switchboard in the bay is of the G. E. standard panel type, built up of seven panels, four of which are at present blank. Of the three equipped, two are generating panels, while the third is a totalizing panel. The first two carry automatic circuit breakers with magnetic blow-out, ammeter and the usual generator panel equipment, the totalizing panel carries a form G Thomson recording wattmeter, showing the total output from the generators. A traveler with two cranes, one of 35 tons, the other of 5 tons capacity, runs the length of the engine room. It was built by the Berlin Iron Bridge Company, which furnished the steel roof trusses. From the switchboard run four cables, each of 850,000 circular mils cross-section to the third rail.

The third rail is similar in shape and weight to that used on the stretch of track between East Weymouth and Nantasket Junction on the South Shore branch of the Plymouth Division of the N. Y., N. H. & H. R. R. R. In cross-section it resembles a flattened "A" and weighs 93 pounds to the yard. It is laid upon blocks of wood impregnated with insulating material. The blocks are only about one-half as high as those used at East Weymouth, allowing 1⅝ inches from the eave of the third rail to the tie, and in some places only 1½ inches. This reduction in the height of insulating block is due to the fact that no greater height could be allowed in view of the height of the service rails.

The top of the third rail is about 1 inch higher than the level of the tops of the running rails. The conductors are bonded, not by the ordinary leaf or stranded copper bond, but by plates of sheet copper ⅛ inch thick, 12 inches long and 4½ inches wide. These are fastened to the underside of the third rail joints by means of a drop-forged iron angle-plate bolted by 16 bolts, 8 for each copper plate, on each side of the third rail joint, the nuts being outside the rail. Each bond has a capacity of about 900,000 circular mils. The total bond at each joint having about twice the carrying capacity of the rail itself, while its measured resistance is less than equal length of the 93-pound third rail. One of the most striking facts in this installation is the absence of feeders, entire dependence being placed on the carrying capacity of the well-bonded rail.

On the Berlin branch are four grade crossings. On the New Britain and Hartford line there are 18. At all of these crossings the third rail is omitted, the circuit being continued underground by stranded bare copper cables of 500,000 circular mils and in some cases 850,000 circular mils. These cables are first drawn into creosoted wooden conduits filled with an insulating material made of petroleum residuum and asphalt. They are then laid in creosoted wooden troughs in turn filled with the same compound and then boxed over and buried. The broken ends of the third rail are fitted with wooden inclines or approach blocks to allow the shoe to rise upon the rail without danger of catching and breaking.

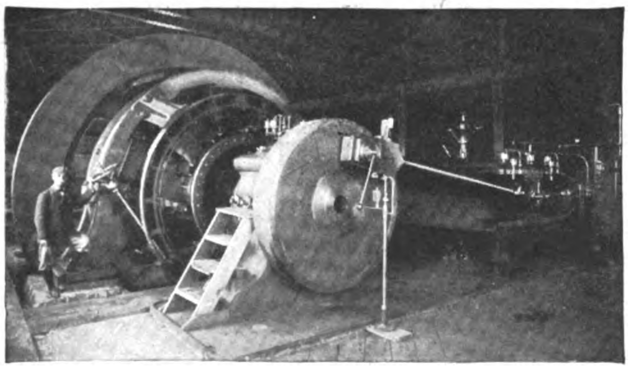


FIG. 3.—850 KILOWATT DYNAMO DIRECT CONNECTED TO 1,200 H. P. ENGINE.

The motor equipment will consist at first of five motor cars. These are open cars 50 feet in length used last season at Nantasket but deprived of the trolley. Each car weighs about 32 tons. Each is equipped with two G. E. 2,000 motors and two "L" series parallel controllers. The car cut-out is a K automatic circuit-breaker fixed beneath the hood. Each motor car is fitted with air brakes, two gongs and a chime whistle.

Air for the brakes and whistle is furnished by a vertical double cylinder air pump driven by a motor automatically controlled by special switch which is opened when the pressure in the main tank reaches 90 pounds and closed when it falls below that.

Contact is made with the third rail by means of sliding shoes. These are of cast iron 12 inches long and 4 inches wide, weighing about 20 pounds. They are suspended by two links from a casting fastened to a beam set immediately beneath the king pin of each truck, connection between motor and shoes being made by flexible cables. The distance between the two shoes is about 33 feet.

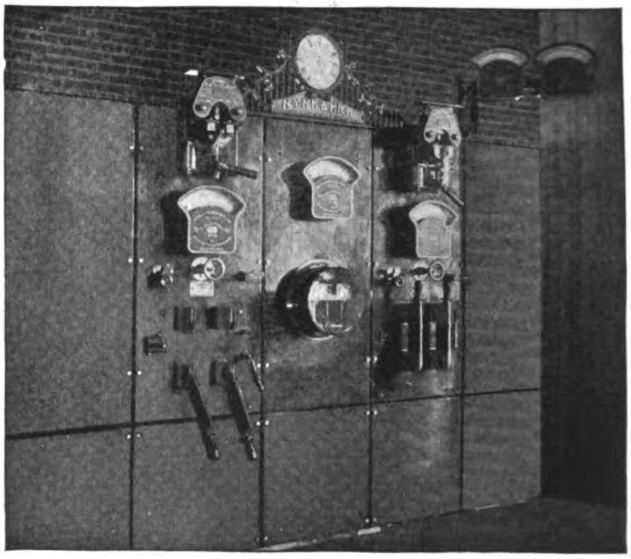


FIG. 4.—SWITCHBOARD.

Many of the grade crossings are wider than this and to avoid carrying the train over the crossing by momentum another shoe is fitted to each truck of the second car of the train, a connection running from this shoe to the motors. Thus by the time the last shoe has left the third rail at one end the first shoe is in contact with the next section of the rail.

The question of the safety of the public was not the least important which demanded the attention of the officials of the New Haven Road. In order to protect people from their own carelessness or absence of mind, the greatest precautions are taken. At Berlin and Hartford stations, the third rail section is fenced in on both sides. At New Britain, where the lines of the New Haven and New England systems converge, in addition to the fence, a method which almost amounts to interlocking is adopted. In the "Y" formed at the convergence of the roads, is the switchman's tower. From the section of the rail entering the station cables run underground to a switchboard in the tower, for which the third rail may be connected to or disconnected from the circuit. As the train comes to a stop in the station, the third rail is cut out, and is not thrown into circuit again until the outgoing train is ready to start. The chance of accident is thus reduced to a minimum.

Credit for this installation must be awarded to President Clark for the courageous advance he has made in the application of electricity to travel on the steam line; to Col. N. H. Heft, the practical chief of the electrical department, who laid out and supervised the installations at Nantasket, East Weymouth and Berlin, and to the General Electric Company, whose long experience and perfected apparatus rendered the installation possible.

PRICES FOR SAN FRANCISCO MOTORMEN.

The officials of the San Francisco and San Mateo Electric Railway have awarded six prizes that were offered as an incentive to their employés to take an interest in the property of the corporation. The motorman with the best record receives $40 and a silver badge with No. 1 engraved thereon. The motorman with the next best record receives $25 and badge No. 2. The third highest motorman receives $15 and badge No. 3. To the conductor with the best record $25 and a badge similar in design to that presented to the first prize motorman has been given. The conductor who stands next receives $12.50 and badge No. 2. The conductor third on the list receives $7.50 and badge No. 3.

ELECTRIC LIGHTING

ARTIFICIAL LIGHT; MODERN METHODS COMPARED—ELECTRIC-INCANDESCENT, WELSBACH, ACETYLENE.[1]—I.

BY PROF. D. S. JACOBUS.

Stevens Institute of Technology, Hoboken, N. J.

THE lecture was introduced by experiments to show the appearance of various colors when viewed by the different lights. Two surfaces of the same color were held up at an angle between two sets of lights, each set containing eight lamps or burners. The two sets of lights to be compared were placed at a distance of about 6 feet from each other on the lecture table. Screens were placed in front of the burners, to shield the eyes of the audience from the direct glare of the lamps. In the space between the lamps colors were shown on large pieces of cardboard, doubled over at the middle so that the two sides could be held at an angle to each other. This allowed one surface to be illuminated by one set of lamps and one by the other. The audience could observe each surface at the same time, and thus compare the colors as they appeared to the eye.

A second series of experiments consisted in viewing colors of a slightly different hue, which appeared of nearly the same hue when held in one position between two sets of lamps, and a widely different hue when the colors were reversed so as to be lighted by the opposite set of lamps.

Many colors appeared of a different shade when viewed by the acetylene and by the Welsbach lights. Some of the colors appeared brighter under the acetylene light than under the Welsbach, and this is especially so in the case of the lighter shades of pink(whereas the reverse holds true of some other colors. On holding the hand between the Welsbach and acetylene burners, the side of the hand illuminated by the Welsbach light appeared to be of a yellowish hue, and that illuminated by the acetylene exhibited the natural pink tint. The acetylene, therefore, made the hand appear more life-like than the Welsbach light.

TABLE I.

Kind of Light.		Candle-Power of Gas on the 5 Cubic Feet per Hour Basis.	Gas required per Hour for 16 Candle-Power in Cubic Feet.	Heat of Combustion of Gas in B. T. U. per Cubic Foot at 60° F.	Total Heat in B. T. U. for 16 Candle-Power per Hour.	Percentage of Total Heat Converted into Light.	Cubic Feet of CO_2 Produced by a 16 Candle-Power Light per Hour
1		2	3	4	5	6	7
Illuminative Water Gas	Flat flame burner..	20	4.00	700	2,800	0.6	3.4
	Welsbach	70	1.14	700	798	1.9	1.0
Acetylene		200	0.40	1,420	568	2.7	0.8
Incandescent electric ...		...	....	....	250	6.2	0.0

Ordinary gas, and the incandescent electric light also produced more lifelike tints when the experiment was made of holding the hand between them and a Welsbach lamp.

Experiments were described, which had been made before the lecture, in which the apparent tints, when viewed by the different lights, were compared with the tints when the colors were viewed by daylight. The acetylene flame was found to show the light pinks or flesh colors much more nearly in their natural tints, or their colors when viewed by daylight, then the Welsbach. The same results followed for incandescent electric light and ordinary gas, when burned in a flat flame, both of which brought out the lighter shades of pink more truly than the Welsbach. The experiments demonstrated that there is a very slight difference in favor of the acetylene over the incandescent light in bringing out delicate shades of pink, and that ordinary gas burned in a flat flame burner comes next in this respect.

Some colors other than pink were found to appear more nearly of their true tints under the Welsbach than under the other lights, in the experiments where the lights were compared directly to daylight.

CANDLE-POWER DEVELOPED PER CUBIC FOOT OF GAS. ELECTRICAL ENERGY TO PRODUCE THE ELECTRIC LIGHT AND PROPORTION OF TOTAL ENERGY TRANSFORMED INTO LIGHT. ALSO, RELATIVE HEATING AND CONTAMINATION OF THE ATMOSPHERE BY CARBONIC ACID FOR EQUAL CANDLE-POWERS.

The figures for the various methods of illumination are given in Table I, in order that they may readily be compared.

It will be seen, from the figures given in Table I., that acetylene gives ten times as much light as ordinary illuminating water gas when the latter is burned in a flat flame burner, and about three times as much when the latter is burned in a Welsbach burner.

The percentage of the total heat of combustion of the gas transformed into light is also greater for the acetylene than for the ordinary illuminating gas. For a given illumination the atmosphere is vitiated by the carbonic acid formed in burning the acetylene to a slightly less extent than when burning the ordinary illuminating gas in a Welsbach burner.

The figure for the candle-power of the gas on the basis of 5 cubic feet burned per hour, given in Table I., is from my own experiments. The figure for the Welsbach is derived from the results obtained in tests of both old and new mantles on the latest form of lamp, and is safe for ordinary practice, as it is nearer to that obtained with old mantles than to the results obtained with the new.

The candle-power given in the table is an average of the candle-power in a horizontal plane passing through the lamp center. The spherical candle-power is less than candle-power so measured, but the proportion between the spherical candle-powers would be about the same as the proportion between the candle-powers measured in a horizontal plane, or within the range of variation of the experimental results; so that comparative figures may be obtained by using the latter.

SAFETY-EXPLOSIVE PROPERTIES OF ACETYLENE.

If 3 per cent. of acetylene be mixed with air, an explosive mixture is produced. In the case of hydrogen 5 per cent. is required, and for coal gas 8 per cent. The maximum amount of acetylene that can be mixed with air to form an explosive mixture is 82 per cent., and the corresponding figure for hydrogen is 72 per cent.

It, therefore, appears that acetylene is more explosive than either hydrogen or coal gas. As the burners used for acetylene would discharge a less amount of gas—say one-fifth that of an ordinary gas burner—the accidental opening of a burner would cause the atmosphere of the room, as a whole, to be much less contaminated in a given time than with coal gas. On the other hand, acetylene gas is so much more nearly of the density of air than ordinary illuminating gas, that it will not be diffused as rapidly through the air in case of leakage, and will have a greater tendency to collect in a partly enclosed space, and thus cause an explosion in case the gas were ignited.

(Experiments were made in which acetylene and ordinary illuminating gas were exploded when mingled with air. The gas was allowed to escape from a burner into a tube placed at an angle. The explosion produced by the acetylene was much more severe than that produced by the illuminating gas.)

In regard to the explosive properties of acetylene itself, much may be said. When carbon and hydrogen unite to form the compound called acetylene, heat is absorbed. According to Berthelot, if gaseous acetylene, under a pressure of about 15 pounds above the atmosphere, or over, be ignited by a spark, or by a heated platinum wire; it will decompose explosively without the presence of air. The explosion becomes more violent as the initial pressure is increased. In exploding, the carbon and hydrogen are dissociated, and the heat absorbed in the original formation is set free. This heat, according to Berthelot, is sufficient to increase the temperature (provided the pressure be kept constant), about 5,000 degrees Fahrenheit, or to increase the pressure to eleven times the initial (if the volume be maintained constant). At atmosphere pressure, however, Berthelot found that acetylene gas containing no air could not be exploded; for if a spark were generated in it, or even if fulminate were exploded in it, there would be no decomposition into the elements of carbon and hydrogen, except near the point where the spark, or fulminate, acted on the gas.

Berthelot also found that liquid acetylene, as transported in tanks under pressure, would explode as readily as the gas. In one case, he exploded liquid acetylene in an iron tank by means of fulminate of mercury, and shattered the tank to pieces. He also made experiments to determine if blows or shocks would start explosions in cylinders of the liquid. He found that a shock would not of itself start an explosion, but that when steel cylinders of the liquid acetylene were smashed the blow was usually followed by an explosion, probably produced by the sparks generated by the friction of the pieces of broken steel. He states that local elevation of temperature may produce compounds evolving heat, and finally cause an explosion; and also that the sudden opening of a stop-cock may produce local heating and an explosion.

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[1] A lecture delivered before the Franklin Institute, March 12, 1897.

The investigations of Berthelot on the explosive properties of acetylene show how dangerous the gas is when stored under pressures higher than that of the atmosphere. That such is the case is borne out by the fact that a number of accidents have occurred where it has been used under such conditions.

THE NOWOTNY ENCLOSED ARC LAMP.

THE accompanying engravings represent the Nowotny long-burning arc lamp, the latest to claim attention in this recent development of arc lighting.

In the design of this lamp special pains have been taken to avoid all rods, chimneys, clockwork, gearwheels, springs, and side rods and the outer globe-stand which cast shadows. As will be seen, the arc is entirely inclosed by the inner globe, which is in turn surrounded by the outer globe, preventing the access of fresh air, thus prolonging the life of the carbons 125 to 150 hours. The carbon is gripped directly without the intervention of any carbon rod; the clutch is composed of four porcelain balls, maintained in position by a retaining receptacle and performing all the functions of a ball-bearing, arc-maintaining device. It is impossible for the carbon to slip except at the proper time when feeding takes place.

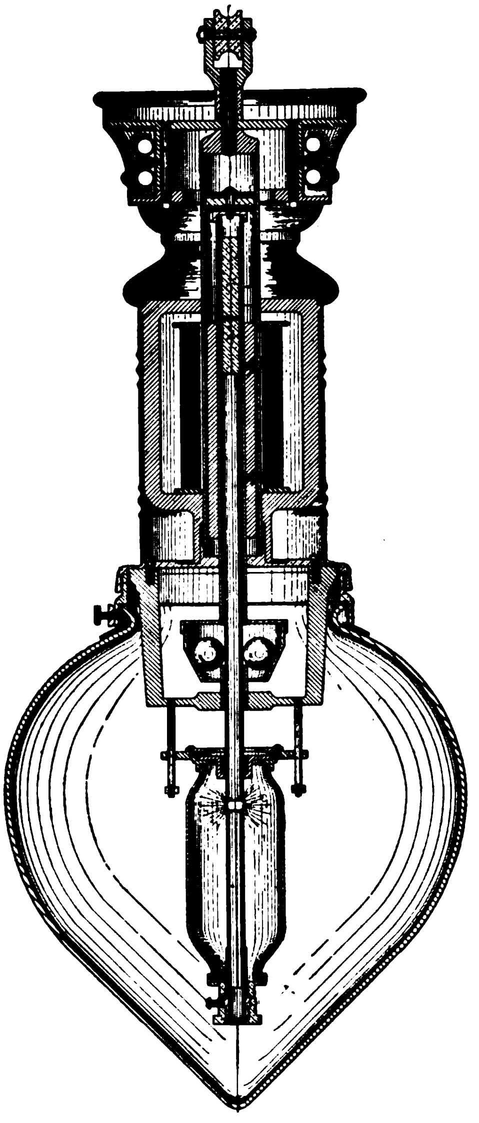


Fig. 1.—The Nowotny Long-Burning Enclosed Arc Lamp.

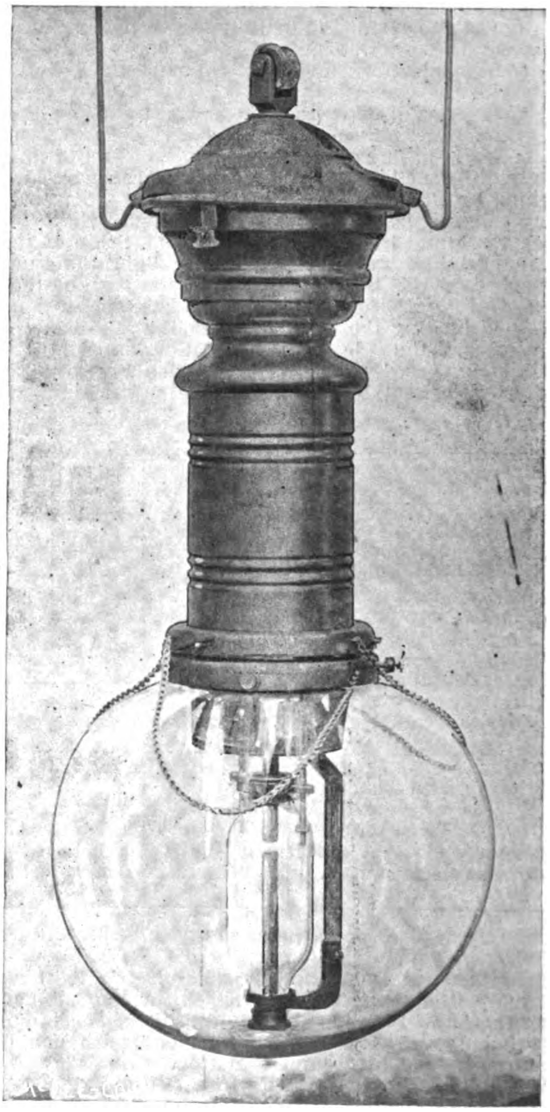


Fig. 2.—The Nowotny Long-Burning Enclosed Arc Lamp.

The general arrangement of this lamp is such that it is extremely easy for even an inexperienced person to re-carbon and take care of it, and there are no adjustments to get out of order. Owing to the unique manner in which the inner globe is held in position there is ample room for the glass to expand and contract without danger of its breaking, and the breakage of inner globes is rare. The outer globe is supported by a ring at its top, which when lowered is held by three chains in such a manner that the globe can be raised or lowered without detaching it. The lamp is ornamental in appearance for both interior and exterior service. The outdoor lamp shown in Fig. 2 is fully weatherproof, preventing any moisture from getting into the mechanism. It is furnished to consume 4 amperes, 4½ amperes and 5 amperes at 80 volts across the arc, with 110 volts on the line.

This lamp is manufactured by the Nowotny Electric Company, 208-212 Lawrence street, Cincinnati, O.

ELECTRIC LIGHTS AT THE NASHVILLE EXPOSITION.

MR. HERMAN JUSTI, of the Nashville Exposition staff, sends us the following data as to the lighting from the plant illustrated and described in The Electrical Engineer May 12:

There are burning on the roofs 12,000 8-candle-power lamps. These lamps require a very small amount of current and the effect is equally as good as 16 candle power would make. The Commercial Building has 1,600 lights on the roof. The lines of the cornice have been followed; all arches have a row of lights above them and the dome alone has 680 lights. The building being of pure white, the effect is enchanting.

The Transportation Building has 620 lights on the roof; the Agricultural Building has 1,600 lights on the roof, and is considered the best effect on the grounds. The Machinery Hall has 580 lights on the roof; the Negro Building has 479 lights on roof; the Rialto has 540 lights in colors. They are exhibited in curved lines, following the line of the ridge and produce a most strikingly attractive effect. The Mineral and Forestry Building has 702 lights on roof; the Auditorium has 840, the Woman's Building has 280, the History Building has 294, the Parthenon has 280 on roof; the Educational Building has 610.

There are a great number of private lights on the grounds and streets, and the number is being constantly augmented.

All wires within the park proper are under ground. The wire consists of 37,000 feet of New York Safety Insulated Wire Co.'s lead-covered cable, and on the entire underground system there has been no trouble whatever, as new lines have been followed here in the installation of the underground.

There are two power circuits 500 volts and 110 volts constant potential. The buildings are thoroughly wired for power circuits. They have in operation at present about 20 small motors from ¼ to 1 horse power; two 5-horse-power motors. There will be added two 30-horse-power motors and a great many smaller ones.

The superintendent, J. W. Pentecost, has been extremely efficient, and has had immediate charge of the work from its inception.

ONONDAGA DIRECT CONNECTED GENERATOR.

PERHAPS the best lighted establishment at Syracuse, N. Y., is the immense shoe store of S. Rosenbloom & Sons. This enterprising concern have installed their own electric lighting plant, consisting of a 75-kilowatt Onondaga direct connected dynamo, built by the Onondaga Dynamo Company, of Syracuse, N. Y. The unit, shown in the accompanying engraving, Fig. 1, consists of a six-pole machine mounted on one base with the engine and thus affording a rigid connection, conducing largely to the noiseless operation of the machine.

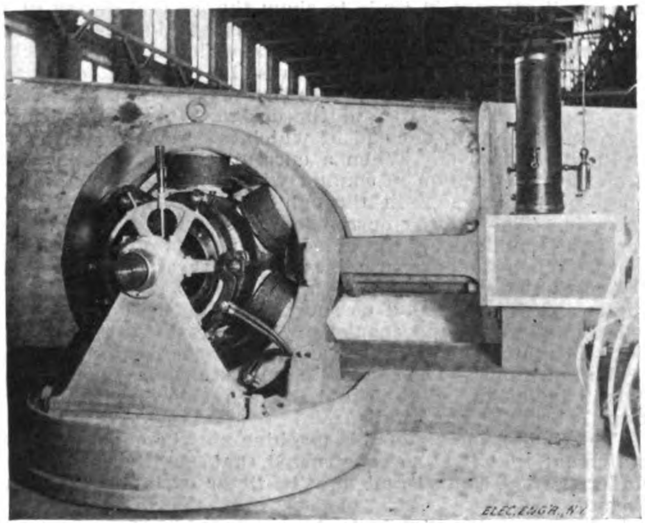
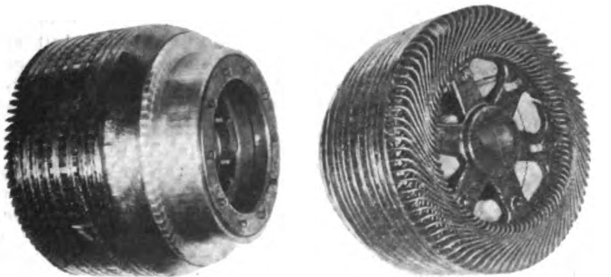


FIG. 1.—ONONDAGA DIRECT CONNECTED GENERATOR.



FIGS. 2 AND 3.—ARMATURE OF ONONDAGA DYNAMO.

The armature and engine are both so well balanced that scarcely a tremor is perceptible when the unit is in operation, the speed being 265 r. p. m.

In this machine, as in all of those built by the Onondaga Dynamo Company, the magnet yoke is made of a special mixture of gray cast iron, while the magnet cores are of soft charcoal forged iron. These cores are cast solid in the magnet yoke, thus avoiding the necessity for bolted joints.

Special attention has been given to the construction of the armature to secure ventilation. The engravings, Figs. 2 and 3, show two views of the armature, indicating how this is secured. The armature coils are formed to standard shape on a "former"; no end connectors are required except the connection with the commutator. The armature when complete allows of a free circulation of air between the coils at both ends. As a result of this construction the machine can run at a temporary overload of 25 per cent.

The Onondaga Dynamo Company build dynamos and motors from ¾ horse power up to 75 kilowatts and over for voltages of 125, 250 and 500 volts direct current. Their "Clover Leaf" type of belt driven machines have already won an enviable reputation.

NEWS AND NOTES.

THE HOLLAND SUBMARINE TORPEDO BOATS.

BY ROBERT McA. LLOYD.

THERE has been so much said in the newspapers during the last year about the two Holland submarine torpedo boats being built at the Columbian Iron Works, Baltimore, Md., and the Crescent Ship Yard, Elizabethport, N. J., and so little actually done with the boats, that the public have very little faith in the promises of the apostles of this kind of navigation. The boat at Baltimore has been two years in process of construction, under government supervision, and may be finished during the coming summer; the one at Elizabethport was contracted for in November of last year (1896) and has been rapidly completed, so that within a few weeks it will be ready for trial, having been launched on Monday.

The Baltimore boat is much the larger, and more powerful, but since it will not be finished for some time, I shall refer to it very briefly. It is 85 feet long and 168 tons displacement. On the surface it will be propelled with 1,500 horse power of steam engines, and under water by an electric motor of 70 horse power, getting its current from a storage battery which has a six-hour capacity at that rate. This boat has a heavy armor turret and a great quantity of machinery and is armed with two torpedo tubes in the bow.

The Elizabethport boat has the advantage of greater simplicity both as to construction of the hull, and equipment of machinery, and will have some features of importance in the way of armament not included in the other. It is 53 feet long with a displacement of 74 tons and a diameter of 10¼ feet. It is propelled by a single screw, and has for power a large gas engine, and an electric motor with a storage battery that will deliver 150 horse power for one hour, driving the boat at 14 knots submerged or 50 horse power for 6 hours, giving a speed of 8 knots submerged. The speed in surface running will not be so great for the same power. The boat has a small telescopic turret for observation and effective devices for handling under water. She has a single 18-inch torpedo expulsion tube in her bow, an aerial dynamite gun forward and a submarine dynamite gun aft. She will be able to dive and run at any any depth below the surface down to 100 feet and can be instantly adjusted to maintain any fixed depth while running. If running under a fleet in deep water, she would of course, need at least 30 feet of clear depth over her, but when attacking a ship might take a higher level so as to be able to come quickly to the surface now and then for an observation. She has a powerful hull and could stand the pressure at 150 feet if necessary, but for fighting purposes would never be required to go to a great depth.

The many details for ventilating, trimming, diving, steering and propelling cannot be described here, but inasmuch as electricity plays such an important part in these operations, electrical engineers may well consider the launching of this boat an event in the history of electrical development. Submarine boats have been built and tried many times in the past two centuries, and of late years have received considerable scientific treatment, but nothing of practical value has been accomplished until recently, when the electric motor and storage battery have made the problem easier to solve. The history of Mr. John P. Holland's tireless efforts with the government, and with capitalists, to put the submarine boat business and submarine warfare on a practical basis would make interesting reading, but a point has now been reached when it is not too much to predict that naval warfare is about to be revolutionized, and electricity is to find a new and large field. If the boat to be tested next month is a success at all, our government will order a large number of them this year and may possibly use hundreds of them, which, of course, means a large quantity of electrical apparatus.

Then there is a large field for their use in wrecking operations and in harbor surveying; in submarine exploration, mining, building, etc., and in all these boats the propulsion, lighting, pumping and other mechanical offices will be performed by electricity. There may be also large submarine battleships but it seems probable that nothing could be accomplished by them that would not be within the capabilities of a 100-foot boat.

In the serious business of war the submarine torpedo boat has such a manifest advantage that the only question ever raised is, can you build one? A few more weeks will apparently settle this question in the affirmative, and the indications are that with every government in the world armed with submarine ships within the next ten years, naval warfare will become very unpopular.

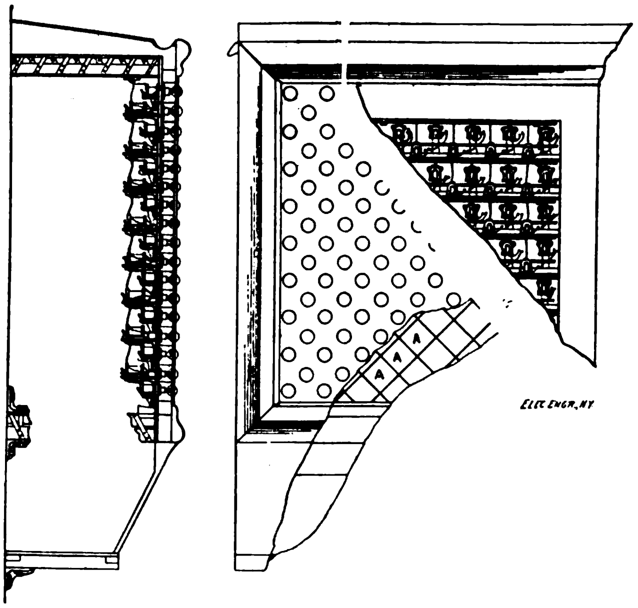
In the fascinating pursuit of lost treasure, and the exploration of submarine property, the submarine boat will doubtless become a great aid to the wrecker and diver, and make possible the lifting of ships that otherwise could not be reached and add much to our knowledge of the sea. Most of the wrecks that are going down every day, lie less than 250 feet from the surface—not too great a depth for submarine boats—and with their aid in sweeping chains and fastening them to pontoons, a much larger proportion will be recovered than in the past.

To enumerate further the possibilities now awaiting fulfillment seems to be taking up space which should be devoted to the technical details of this subject, but the machinery is so simple that it does not compare in interest with the boat as a whole, or its mission. Dynamos, motors, storage batteries, air compressors, gas engine, ventilating pump, bilge pump, steering engines, gauges, valve controllers; nothing worth writing about half so much as a single dive will be in the waters of New York Bay a few weeks hence.

AN AUTOMATIC ELECTRIC ADVERTISING SIGN.

BY FARLEY G. CLARK.

IN the design of the apparatus shown in the accompanying drawings, the inventors, Chas. H. and F. G. Clark, drew up a set of specifications representing what was necessary in an ideal sign, fulfilling all the commercial requirements. The first specification calls for a sign capable of showing perfectly formed and spaced letters of different sizes and styles. The second, for a controlling apparatus which will allow the circuit through the lamp to be made or broken at any instant, independently of any other lamp. The third, for a perfectly automatic arrangement in which a number of designs may be shown on the sign mat according to a prearranged plan which may differ from night to night. The fourth and last calls for an apparatus which will be accepted as safe by the Board of Fire Underwriters. Without showing the different steps taken in perfecting a machine to meet these specifications, we will proceed at once to its description.



FIGS. 1, 2 AND 3.

The Automatic Sign.—Figs. 1, 2 and 3 are views of the sign mat, being respectively the front, side and rear elevations. It will be seen that this follows the Schneider plan of showing the design upon a mat of lamps. Referring to Fig. 1 we note that the lamps are equally spaced, and arranged in rows at an angle of 45 degs. to the ground line. By using the lamps nine deep, as shown in the drawing, perfectly formed letters may be shown. Each lamp is separated from the others by a partition, as shown by A A, so that the reflection of a lighted lamp, upon its neighbors, will not produce the hazy effect noted in signs of this description.

Figs. 2 and 3 show the positions of the relays, and in Fig. 2 a small attempt is made to show the general design of the sign. A generous amount of space is left between the sign mat and building to facilitate repairs, which, although not considered as probably necessary, must be provided for.

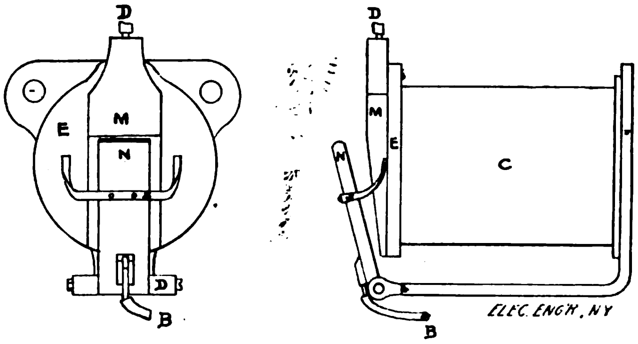


FIG. 4.

The Relay.—In Fig. 4 we have two views of the relay which is a fundamental feature of the design. In the side view C represents the coil, one end of which is connected to the controlling mechanism. When a current is sent through C the armature N is drawn in contact with M, thus completing the main or lighting circuit through the lamp which the relay controls. The lighting current comes from the positive main through D, and passes through B and the lamp to the negative main. When the current ceases to flow through C, the spring S causes the armature N to break contact, thus putting out the lamp. In order that no short circuiting may occur, an insulating piece E and insulating bearings D are used. The parts M and N are made of tempered copper or a brass alloy.

The Controller.—The controlling mechanism is shown in Figs. 5 to 9 inclusive. Figs. 5 and 6 are a side and front elevation; 7, 8 and 9 are details.

The whole principle of this machine may be embodied in the statement that it is so constructed that each lamp is always under perfect control and may be lit or extinguished at any instant.

Referring to Fig. 6, which shows a machine for operating a 3.200-lamp sign, we see nine drums which are kept in synchronous motion by the motor working a worm and train of gears.

Each lamp, or rather relay, has its contact point on one of these nine tiers, as shown by the heavy black and the fine lines, though Fig. 9 shows them full size. Each tier, beginning at the top, carries the contact points for a line of lamps on the sign, and as the mechanism of the nine parts are duplicates of each other, a description of one will suffice for all.

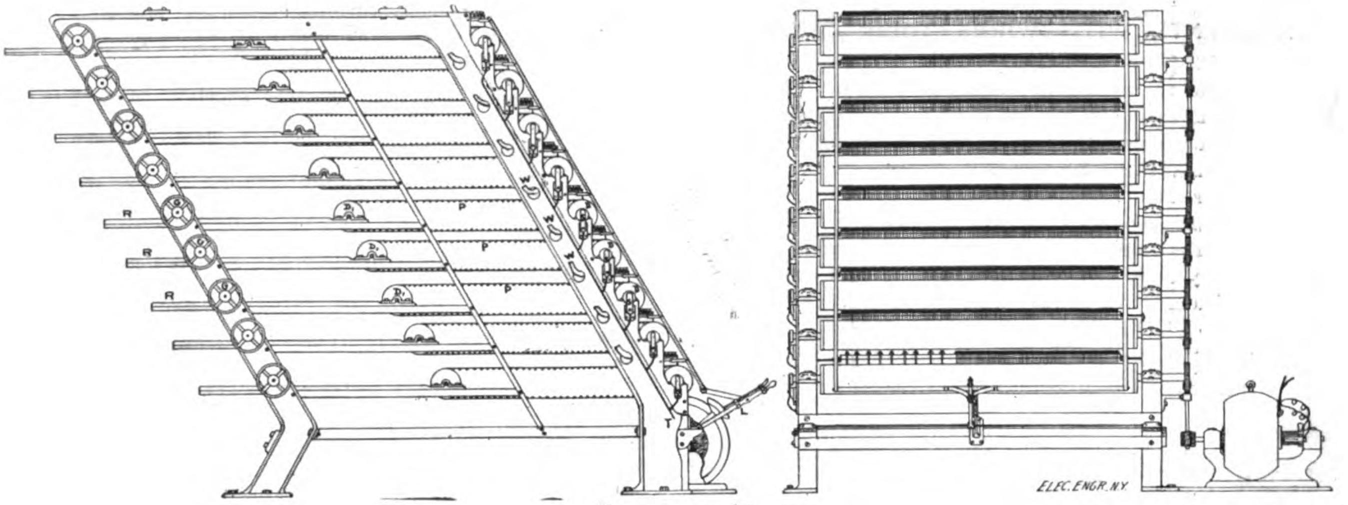
In Fig. 5 D and D are drums carrying the design, and P is the design itself. The design is divided into nine parts and each part consists of a strip of thin and pliable but strong insulating material. Upon each of these strips or sheets a part of the design is represented by slots cut in the material. These sheets are carried over D and D_1 and are between D and the contact points.

The drum D is connected, through S and T, to one pole of a dynamo running at a potential of about ten volts. The other pole is connected with each of the relays. It will now be readily seen that when a slot in the design sheet comes under one of the contact points, that point is thrown in contact with the drum and consequently a current sent through the relay, which in turn closes the circuit through its lamp.

In Fig. 5 D is the driving drum D_1 the drag or follower, and rests on a rack R which can be moved by the gear S. With the drag moved nearer to the left upright of the frame, more designs could be put on the carrier and a longer time would elapse before the designs would begin to repeat.

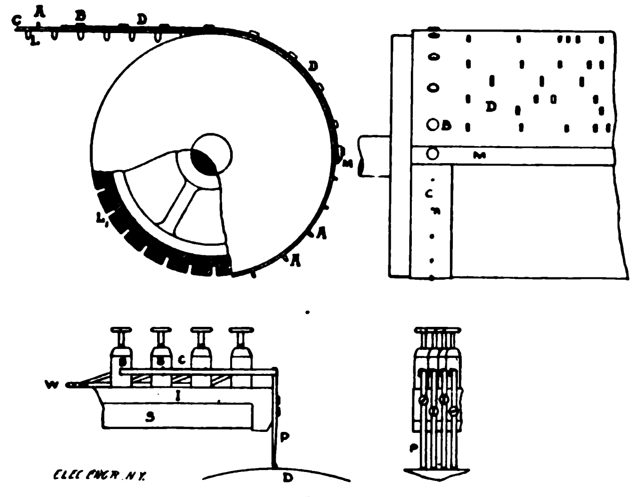
The rod marked I is used in conjunction with L to raise the shelves carrying the contact points. This mechanism is added to keep the points away from the drum when the machine is not running. The wires connecting the contact points with the relays are brought out on the side of the frame and are represented by the cables W, W, etc.

The Drum and Carrier.—Figs. 7 and 8 show the driving drum, design sheet, and carrier in detail. The carrier is a thin ribbon of soft steel, having teeth L on its under surface, which fit into the gear L_1 on the drum. This arrangement is similar at the other end of the drum and insures an even motion to the carrier. On the upper surface are little points A which are made to project through the design sheet, and carry a thread so that a cap B may be screwed on. With the design sheet held thus firmly there is little danger of its becoming warped.. Another detail is what, for want of a better name, will be called a guide. It is represented by M and is a delicate but very rigid strip of steel which is attached to the edge of the design sheet and to the carrier. Its duty is to prevent any sag in the center of the sheet. The slots in D, Fig. 8, give an idea of the appearance of the design sheet.



Figs. 5 and 6.

The Contact Mechanism.—In Fig. 9 I is the insulation between the steel shelf S and the contact mechanism. The tempered steel points P are connected through C and B to the wires W, which run to the relays. These points are so designed that they will give a quick action and make and break contact without perceptible sparking. While insuring good electrical contact they are not so stiff as to distort the design by an undue drag upon the design sheet.



Figs. 7, 8 and 9.

The large contact points on the lower tier of the controller, as seen in Fig. 6, are used to operate auxiliary controlling devices, as, for instance, to increase or diminish the speed of the motor, and to compensate for a decrease in the call for current by the relays. This latter is necessary to prevent sparking at the contact points when a large number of lamps are suddenly switched off.

Wiring Diagram.—In Fig. 10 we have a diagrammatic representation of the wiring plan. The auxiliary dynamo, generating the currents for the relays is represented by A. R is the compensating resistance, D the drum, C C the contact points and R R, the relays. M is the main or lighting dynamo and L L the lamps. The simplicity of a single part of this apparatus is apparent at the first glance.

In preparing the design sheets a very simple machine, somewhat similar to that used in preparing the cards for a Jacquard loom, has been designed. With it, the designs needed for a five-hour run can be made in a few moments.

For showing bulletins or election returns, the controlling machine described could be used, or a machine of the typewriter pattern somewhat similar to that designed by Norden would answer. The possibilities in the effects which may be produced upon the sign by the automatic controlling device are innumerable. As examples it will be sufficient to mention the possibilities in outline sketches, and geometrical figures in motion, such as are produced in firework displays.

The question to be answered by the reader is, Does the apparatus described fulfill the requirements of the specifications? If it does, and it has been the aim of the writer to show it, it is unnecessary to speak of the place it will occupy in the advertising field of the future.

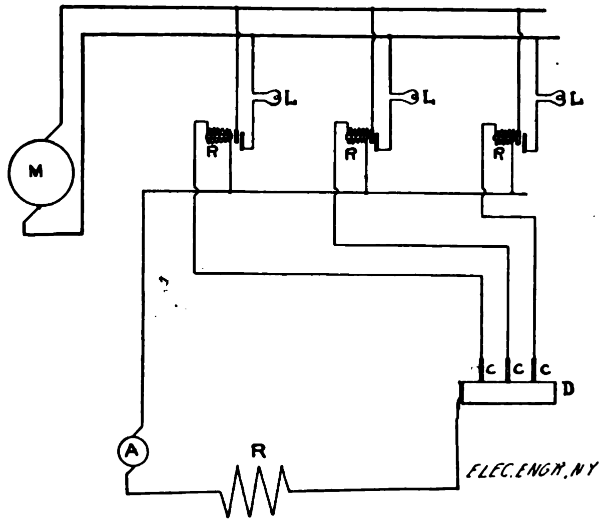


Fig. 10.

TOOK AN ELECTRIC LIGHT TO BED.

A dispatch from Lexington, Va., of April 22 says: A Lynchburg drummer nearly caused a serious conflagration at one of the leading hotels here the other night. The weather was cold, and he took an incandescent light, which had a long connection to it, in his room, wrapped a bed sheet around it, and placed it in the foot of the bed to keep his feet warm. He was awakened some hours afterward by smoke and roasted feet. The light had set fire to his bed, which was in a full blaze, and was extinguished after much difficulty. The globe to the light had become soft and plastic from the intense heat and assumed an almost flat shape.

BOSTON WIRES.

According to the report of the Boston Superintendent of Wires the total number of fires last year due to electrical causes was 85, of which 12 were on the outside and 22 inside of buildings; miscellaneous number 21, and 13 injuries were recorded and 3 deaths. No fire was caused by wires or appliances that had been approved by the wire department. The total amount of street conduit now laid is nearly 92 miles. There are about 566 miles of single duct, 65 miles of Edison tube and about 244 miles of single conductors in them; besides there are about 36,277 miles of single conductors in cables.

ACCIDENTS WITH WIRES—THEIR CAUSE.

BY W. S. ECKERT.

APROPOS of the article appearing in the May 12 issue of the Engineer on "Accidents With Wires," it seems to the writer that there ought to be some way of reducing the number of accidents there recorded.

It has been shown that hard drawn copper wire, having 98 per cent. of the conductivity of pure copper, lacks tensile strength and absolute reliability from a mechanical point of view. Not only does such wire stretch under its own weight, the diameter decreasing always and with it, also, its mechanical resistance, but the slightest abrasion, caused in transportation or when putting the wire in place, will bring about complete rupture when the wire is subjected to strain. The one important mechanical advantage of copper is that it does not corrode.

Galvanized iron wire and steel wire rust, and, as the points of oxidation increase the mechanical resistance decreases. These wires, when first put into service, are, as compared with copper, but poor conductors, but, when oxidized, they lose a large part of their initial properties. It has been found by experience that neither iron nor steel wires can be relied upon, either electrically or mechanically, for any considerable time; they are, therefore, really more costly than a high-grade conductor in the end.

Bi-metallic wire, composed of copper and steel—steel center with solid copper surrounding it—seems to meet the mechanical deficiencies in copper wire, though, for the transmission of direct currents, at the expense of conductivity. In view of the many accidents caused by the breaking of wires, and the liability of damages therefor by the operating companies, it is a question whether it is not best to sacrifice a certain portion of the conducting qualities of the wire rather than the strength. Bi-metallic wire, like copper, does not corrode, neither does it stretch. It retains its electrical and mechanical qualities always, as shown by the experience of the Postal Telegraph Cable Company with wire of that description, put up in 1883, and which, according to reports of the officers of that company, tests as well to-day as it did fourteen years ago.

The conductivity of bi-metallic for the transmission of direct current is, substantially, 65 per cent. of that of solid copper of equal diameter; its strength, practically four times its weight per mile; but, as mentioned before, this strength is retained, while wires of copper, iron or steel commence to deteriorate when first put into service. The conductivity of bi-metallic wire is sufficient to meet all ordinary uses; its strength will more than counteract the deficiency in electrical transmission. Railway companies, using high voltage and bare wires, require a strong and rigid trolley wire, and, if feeders are employed, bi-metallic, which has both strength and rigidity, also has sufficient conductivity to operate the cars. Where guard wires are specified, bi-metallic will be found suitable for that purpose; it neither corrodes nor stretches, remaining strong always.

Telegraph, telephone and other wires must, necessarily, be carried over railway wires at many points, and such wires are always liable to be broken in storms or by other wires or objects falling upon them. To minimize the danger of falling wires it seems best to strengthen the wire—apparently bi-metallic meets the requirements. Telephonically considered, bi-metallic wire is superior to copper wire, and the users of that wire have secured very good service which, at the same time, is reliable. Bimetallic wire, possessing about 50 per cent. of copper, is cheaper than copper wire.

X-RAY PHOTOGRAPHY.

IT may be interesting to note, says William Webster, in "Nature," that it is possible to take shadowgraphs (so-called) instantaneously without any special arrangement of induction coil or deviation in the form of Jackson tube. The apparatus used consists of 10-inch Apps' induction, coil, a Jackson focus tube supplied by Messrs. Newton (one of a set of twenty-five I have in my possession), and a set of small secondary batteries, about 30 ampere hour capacity, six cells in the set. The induction coil is of the ordinary type with ordinary commutator. For the purpose of obtaining these results in such short exposures, a special choice of tube is necessary, working the tube for a considerable period before desired condition is arrived at, and that condition judged by experience, for no ampere measurement will give the information. The tube must be strongly heated by a spirit lamp, and when the desired condition (tube being of course connected with coil) is arrived at, the exposure must take place.

(1) By instantaneously turning current on and off.

(2) By interposing a ½-inch iron plate between tube and object to be shadowed, removing plate for the exposure.

Having carefully timed the exposures, I have been able to repeat the experiment with assured success. For some time past I knew that hands and arms of children could be taken in from twenty to thirty seconds, but have now succeeded in taking children's hands in half a second (showing all bones and cell tissue of bones), and adults' hands, bones of wrist, and even arms, with exposure of only one second, again showing cell tissue of bones.

ELECTRICAL VIBRATIONS OF MERCURY.

The following observations, recorded by E. Braun, in "Nature," were made with a globule of mercury, about 1½ cms. in diameter, placed in a photographic developing dish containing some ordinary tap water, the mercury being well covered with water. A 4-volt accumulator of 6 ampere-hours' capacity supplied the current. Two wires from the terminals served as anode and cathode; the cathode had a short piece of fine wire attached, and this was so adjusted that it only just touched the mercury.

(1) When the circuit was completed by dipping the anode into the water, the mercury, after a few seconds, became visibly flattened.

(2) If the circuit was broken, or the mercury became detached from the cathode, it at once regained its original shape.

(3) When the circuit was completed, and the mercury becoming flattened broke away, it was thrown into a regular and continuous vibration.

(4) The frequency and amplitude of the vibrations depended on the distance of the anode from the cathode, the frequency and amplitude increasing as the anode was brought nearer.

(5) If the current was reversed, thus making the cathode an anode, the vibrations were not produced.

(6) The vibrating mercury generally retained its circular shape, but sometimes it became almost square, or took the shape of a cross, which seemed to be produced by a rapid motion alternating at right angles.

(7) The water was thrown into circular waves, which corresponded to the vibrations of the mercury.

(8) If the circuit was broken, and an interval of time was allowed to elapse, and then again completed, a decided lag was observed between the "making" of the circuit and the flattening of the mercury. If no appreciable lapse of time took place between "make" and "break," the response was instantaneous.

LES APPLICATIONS DE L'ELECTROLYSE A LA METALLURGIE (The applications of electrolysis to electrometallurgy).—By M. U. Le Verrier, Paris, Gauthier-Villars & Fils. 57 pp. 9 x 5½ in. Illus. Price, $1.00.

A concise treatsie on the practical application of electrolysis to metallurgical operations, comprising galvanaplastics, refining metals, treatment of minerals and electrolysis of molten salts.

ELECTRICITAET UND LICHT (Electricity and Light).—By Dr. O. Lehmann, Braunschweig, Vieweg & Sohn. 390 pp. Illus. 9 x 6 inches. Price, $2.80.

This work gives an introduction into the quantitative determination of electric power and light. All measurements required by the electrician are exhaustively treated and clear deductions show the origin of all formulas used in calculating force and effect.

This work constitutes one of the best treatises on the subject which we have yet seen. Its illustrations are particularly well done and very helpful to the understanding of the text.

SOCIETY & CLUB NOTES

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Secretary Porter writes us: The Trunk Line Association, the New England Passenger Association, the Central Passenger Association and the Southern Passenger Association have made a rate of a fare and one-third, on the certificate plan, from all points in their territory to Niagara Falls and return for delegates to our twentieth convention, to be held at Niagara Falls June 8, 9, 10. In purchasing tickets delegates should ask for a certificate which will entitle the purchaser to be returned at one-third the regular fare.

The arrangement for a special train has been a somewhat perplexing question, owing to the desire that our members should enjoy the best possible service at the lowest possible rate. After long and continuous negotiations, a most satisfactory arrangement has been made with the West Shore Railroad to run a special train of vestibuled parlor, library and dining cars, leaving New York (foot Forty-second street, North River, at 10:16 a. m., and foot Franklin street 10 a. m.), Monday, June 7. Tickets to return will be via West Shore Railroad or New York Central and Hudson River Railroad, thus enabling the delegates who take this train to enjoy the view of both sides of the river if they so desire.

The daylight run was decided upon owing to an almost unanimous request on the part of our members, on account of the large number of ladies who propose honoring us with their presence. The special train has always been one of the features of our conventions, and this one promises to excel any of its predecessors, even to providing a souvenir for the ladies.

Price of tickets to Niagara Falls, including parlor car seat, $10. For ticket and parlor car accommodation, apply to C. O. Baker, Jr., 136 Liberty street, New York, master of transportation.

NEW YORK ELECTRICAL SOCIETY.

The annual meeting of the society and election of officers will take place at Columbia University, Madison avenue and Forty-ninth street, on Thursday, May 20. Mr. H. Barringer Cox will lecture on "The Direct Conversion of Heat Into Electricity." A brief review will be given of the history of thermo-electric generators; the reason of previous failure in this direction; the real problem of thermo-electricity; the practical mission of a successful device. Thermo-electric generators will be shown in actual operation, furnishing current to fan motors, X-ray outfits, medical apparatus, telegraph sets, annunciator systems, and other devices in ordinary use and every-day demand. The regular business of the meeting will be taken up at 7:45 p. m., and the lecture will commence at 8.

MARRIED

STACEY-PARKER.

On May 5, at Evanston, Ill., Mr. T. I. Stacey, the estimable secretary and treasurer of the Electric Appliance Company, of Chicago, was married to Miss Lillie Parker, of Evanston, at the St. Mark's Episcopal Church in that city, where they will take up their residence on returning from their honeymoon.

PERSONAL

MR. C. H. WILMERDING announces that he is about to sever his connection with the Chicago Edison Company, and to open an office in Chicago, at 139 Adams street, as designing, constructing, supervising and consulting engineer, more particularly with reference to the planning, remodeling and complete installation of central station and isolated electric lighting, railway and transmission plants, and the underground distribution of electric currents, embracing also the supervision, in an advisory capacity, of the operating of existing plants with a view to improved economy and greater efficiency. His experience in these branches as general manager for five years of the Chicago Arc Light and Power Company, general superintendent for the past four years of the Chicago Edison Company, and president for the past eight or nine years of the Chicago Sectional Electric Underground Company, and in various civil, mechanical and electrical engineering undertakings prior to his association with these companies, warrant him in giving the assurance that work entrusted to him will be executed in a proper and satisfactory manner, with a full knowledge of the latest and most approved methods and appliances, and the advantages of a daily intimacy with their good points and their faults.

MR. J. J. FOWLER, long time general manager of the Southern Bell Telephone and Telegraph Company at New Orleans, La., has resigned and has been succeeded by Mr. J. Sitzenstatter, of New York, well known in the Bell telephone service.

MR. FRANK C. MASON, superintendent of the police telegraphs in Brooklyn, N. Y., and a leading Mason in this part of the country, has been elected president of the Aurora Grata Club, the central and powerful Masonic organization of that city. Mr. C. E. Stump and Mr. E. A. Leslie figure prominently in his cabinet.

MR. H. C. WYBRO, of Wybro & Lawrence Company, Los Angeles, Cal., is a visitor East, and has been spending a week in New York. The concern do a large business in electrical and steam apparatus, and the brisk condition of trade in Los Angeles keeps them very busy. They are just now extending the Anaheim municipal plant, putting in a 60 kilowatt Warren alternator, a 100 horse-power Fisher engine, and a 125 horse-power Stirling boiler, with oil burning furnace.

EDUCATIONAL

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Entrance examinations for the Massachusetts Institute of Technology will be held on July 1 and 2 at Boston; New York, Fifth Avenue Hotel; Philadelphia, Lafayette Hotel; Chicago, Medill High School, and elsewhere. To be admitted as a regular student in the first-year class the applicant must have attained the age of 17 years, and must pass satisfactory examinations in algebra, plane geometry, advanced algebra, or solid geometry, French or German, English and history. Detailed information can be had by applying to H. W. Tyler, Ph. D., secretary Massachusetts Institute Technology, Boston, Mass.

THE STOCK MARKET

VACILLATION.

The general conditions of finance and trade remain vacillating and oscillatory, some things being good, others bad. The financial markets have been affected by the gold exports, and pig iron has been lower, but the crop reports from the West are very encouraging, and the railroads and particularly the express companies report a brisker distribution of all classes of goods.

In electrical securities, the main feature of the past week was the Berliner decision which sent American Bell telephone stock up 10 points, from 222 to 232, a gain that it bids fair to hold; while other "old line" telephone stocks have also gained in strength and are in demand. On sales of 44,312 shares Western Union gained somewhat from its recent decline, and closed at 76¾. General Electric is extremely quiet around 31. It is thought that the management is repressing any tendency to buoyancy in the stock, preferring to see a slow advance on established gains in output and profit. Local lighting and railway securities throughout the country are dull, many quotations being lower than they should be.

COPPER.

The Boston "Globe" says, regarding the copper market: The recent large sales of copper are said by pretty confident authorities to aggregate between 15,000,000 and 20,000,000 pounds at 11 cents. These sales were not only by the Calumet and Hecla, but by other companies, although the Calumet and Hecla was the largest seller.

The Franklin Mining Company sold 200,000 pounds of copper at 11 cents, and has refused to accept same price for more.

The treasurer of several copper mines says: "We are bid from New York, by telephone, 11 cents cash for round lots, and there is a bid for a big lot for each month of July, August and September. It seems to me that copper has started and will go higher."

ANNUAL REPORT OF THE CHICAGO EDISON CO.

THE report of the Chicago Edison Company for the fiscal year ending March 31 shows a gain in both gross and net as compared with the preceding year. For both years the earnings applicable to dividends amounted to a fraction more than 8 per cent on the outstanding capital stock. The figures for the two years are as follows:

	1896-97.	1895-96.	Increase.
Gross	$1,548,608	$1,461,084	$87,524
Operating expenses	948,934	898,517	50,417
Net earnings	$599,674	$562,567	$37,107
Interest	180,334	158,135	22,199
Earned on stock	419,340	404,432	14,908
Per cent on stock	8.43	8.17	....
Dividends	397,518	390,382	7,136
Surplus for year	21,822	14,050	7,772

It is noteworthy that the company has in the last two years made a marked reduction in operating expenses as compared with the two preceding years. The percentage of operating expenses to gross receipts in the last four years has been:

1896-97.	1895-96.	1894-95.	1893-94.
61.3%.	61.5%.	66.3%.	68.2%.

The growth in the company's business during the year was:

BUSINESS CONNECTED.

Incandescent lamps	208,954
Arc lamps	5,180
Motors (horse power)	6,824.7
Total equivalent in 16 c. p. lamps, March 31, 1897	355,140
Total equivalent in 16 c. p. lamps, March 31, 1896	315,732
Increase for fiscal year	39,408

Important changes in the company's funded debt were made during the year as follows:

New 5 per cent. bonds issued		$2,267,000
Retired—		
6 per cent. debentures	$712,000	
6 per cent. first mortgage bonds	130,300	
6 per cent. bonds of Chicago Warehouse and Manufacturing Company	125,000	
6 per cent. purchase notes	53,000	
		$1,020,300
Leaving balance of proceeds of bonds		$1,246,700

This balance has been applied to improvement of plant, extensions, etc. The company's unfunded debt shows a decrease of $175,229 as compared with the previous balance sheet. These changes leave the company with only the balance of the debentures, $1,483,000, and the $2,267,000 of new bonds outstanding. The bonds are part of the $6,000,000 authorized last summer, of which $3,733,000 more may be issued at any time for extensions and improvements or to retire the outstanding debentures. The remaining $1,024,100 is issuable only after an equal amount of capital stock has been issued and fully paid.

In the year just closed the company got comparatively no benefit on account of the reduction in interest on its funded debt. The offer under which the debentures were exchangeable for bonds terminated only on December 15. The Warehouse and Manufacturing Company bonds and the company's first mortgage bonds were called, payable March 1 last. The purchase money notes were called payable May 1 and were paid only a short time before that date.

Whatever extensions and improvements the company has made of recent years have been of the best possible character, and its expenditures on plant have been undertaken not merely to meet immediate needs but with regard both to future growth and to producing and transmitting current at the lowest possible cost. The pursuit of this policy has resulted in a remarkable record during the last four and a quarter years. On December 31, 1892, the company had outstanding $1,500,000 of capital stock and $130,300 of first mortgage bonds, a total of $1,630,300. The last balance sheet shows capital stock $4,975,900 and funded debt $3,750,000, a total of $8,725,900. Thus the company has increased its capitalization by $7,095,600 during four years of almost continuous depression in general business. Of this increase $2,195,000 was paid for the Chicago Arc Light and Power Company's property and business in 1893 and $4,500,000 in round numbers represents new money taken into the concern. The general depression has naturally had a very marked effect on the company's business, and while it has maintained, and earned, its 8 per cent. dividends, it has not reaped the advantage which it would have obtained under normal conditions from its large outlays.

The company has divided its surplus fund, transferring $200,000 to depreciation account and $20,000 to insurance fund. The company will ultimately carry its own insurance, increasing the insurance fund from time to time with that end in view. The charge to depreciation account is in accordance with the terms of the mortgage. It does not represent depreciation in the ordinary sense of the term, but is a fund against which extensions and improvements may be charged. The mortgage provides that certain sums must be set aside yearly, and the company may either charge them off or use the amount for actual extensions and betterments. It is the equivalent of a sinking fund, only the money, instead of lying in the hands of a trustee, goes into the company's property.

The balance sheet for the last two years, with comparisons, shows:

ASSETS.

	March 31, 1897.	March 31, 1896.	Increase.
Plants, real estate, etc	$8,630,330	$7,705,517	$924,813
Work in progress, etc.	136,405	109,915	26,490
Accounts receivable	197,799	190,329	7,470
Cash	206,541	48,920	157,621
Total	$9,171,075	$8,054,681	$1,116,394

LIABILITIES.

	March 31, 1897.	March 31, 1896.	Increase.
Capital stock	$4,975,900	$4,948,437	27,463
Bonds and debentures	3,750,000	2,503,300	1,246,700
Accounts, notes payable	131,066	304,426	*173,360
Open accounts	17,842	19,711	*1,869
Surplus fund	76,267	278,807	*202,540
Depreciation account	200,000	....	200,000
Insurance fund	20,000	....	20,000
Total	$9,171,075	$8,054,681	$1,116,394

*Decrease.

GENERAL ELECTRIC ANNUAL MEETING.

The annual meeting of the General Electric Company was held May 11, when the old board of directors was unanimously re-elected. At the meeting 210,000 shares were represented. The directors are Gordon Abbott, Boston; Oliver Ames, Boston; C. A. Coffin, Schenectady; T. J. Coolidge, Boston; C. H. Coster, New York; T. A. Edison, Orange, N. J.; G. P. Gardiner, Boston; Eugene Griffin, Schenectady; J. P. Morgan, New York; R. T. Paine, 2nd, Boston; G. F. Peabody, New York.

The board will hold their next meeting the second Monday in June.

LEGAL NOTES

DECISION AS TO DUTIES ON CARBONS.

The point having been raised that carbons, as preparations from coal tar should come in free, of if not exempt should come in under the coal duties of 40 or 15 cents a ton, or not more than 20 per cent. ad valorem as non-enumerated manufactured articles, the Board of General Appraisers has overruled the protest and affirmed the collection of a duty of 30 per cent., as on articles composed of earthen or mineral substances. Another protest, on carbon electrodes for mineral reduction, claiming duty at 20 per cent. ad valorem, has also been overruled, and the 30 per cent affirmed.

NIAGARA POWER.

IN Ottawa the standing committee on miscellaneous private bills has reported adversely a bill which would give the Canadian Power Company the right to cut a canal through Queen Victoria Park at Niagara, on the Canadian side, for the purpose of generating 15,000 horse power. The bill asked that the work be declared one for the general advantage of Canada, but Mr. Irving of Toronto, who appeared to represent the Attorney General of the province of Ontario, stated that he considered the work a purely provincial matter. It will be recalled that questions relating to the respective rights of the Canadian Power Company and the Canadian Niagara Power Company have been submitted to the Court of Appeals by the council of the province of Ontario. The Canadian Niagara Power Company is controlled by the Niagara Falls Power Company, and it is paying an annual rental of $25,000 for the exclusive right to develop power in Victoria Park, work on which development was commenced on April 30. The fact that the Attorney General of the province of Ontario was represented at the hearing referred to in opposition to the Canadian Power Company would make it look as though the Ontario government was disposed to maintain the supremacy of franchises granted or approved by it so far as Victoria Park is concerned.

THE EFFECT OF THE BERLINER DECISION.

MR. T. A. ROSS, general manager of the Stromberg-Carlson Telephone Manufacturing Company, Chicago, writes us as follows in regard to the effect of the Berliner decision, on their business and the public generally:

For our part, we are jubilant over the decision and we consider it a signal victory for the opposition companies for the following reasons, which certainly appeal to common sense, viz.: The Supreme Court refused to consider the question of validity of the patent in view of the 1880 Berliner patent and other defences, thus compelling the Bell Company to settle the vital questions relating to anticipation by a protracted infringement suit, which cannot be settled for many years. The only court, Judge Carpenter of Boston, who passed upon the questions which will arise in the infringement suit, decided against the Bell Company, and it is reasonable to suppose that any other court considering the same questions will do the same thing.

The Appeal and Supreme Courts hold that these questions which will arise in an infringement suit could not properly be considered in a suit founded on fraud.

The Chicago "Record," in an editorial of May 11 sums up the situation better than we can do it, as follows: "The policy of the Bell Company in evading a decision upon all the grounds of invalidity that had been raised, and thus throwing away an opportunity to gain a clear title to the invention if it had a right to it, seems to lend color to the claim of the independent telephone companies that the Bell Company has really little faith in this patent, and that, instead of securing a judicial decision upon the merits of the case, it proposes to use the Berliner patent and the decision of the United States Supreme Court as a club over weaker corporations. In spite of all the claims that may be made by the American Bell Telephone Company and its agents and advocates, the decision of the Supreme Court of the United States is apparently of no practical value in continuing and sustaining the monopoly of the telephone industry."

As to the moral effect of the decision on public business, there is no question but what it will be more or less great until the public comes to learn that this is but another cloud the Bell Company has shrewdly thrown over the industry. Nerveless and weak-kneed investors will undoubtedly take alarm for the time being, but this decision gives to those best posted wonderful opportunities to make telephones while the clouds hang low.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 11, 1897.

Alarms and Signals:—

ELECTRICAL STRIKING AND ALARM ATTACHMENT FOR CLOCKS. B. De Witt, Terra Alta, W. Va., 582,273. Filed April 20, 1896.

Adapted for use in connection with ordinary striking clocks to provide means for striking the hours and half hours on electrical bells at places remote from the clock.

ELECTRICAL INDICATING DEVICE, W. W. Dean, St. Louis, Mo., 582,461. Filed Sept. 19, 1896.

An electrically operated visible signal of the self-restoring type.

Connectors, Conduits and Insulators:—

INSULATOR. W. G. Schnee, Pueblo, Col., 582,396. Filed Feb. 26, 1897.

An insulator having the top grooved to receive the conductor and provided with a cap adapted to hold the wire in place.

ELECTRIC CIRCUIT TERMINAL. E. N. Dickerson, New York, 582,462. Filed April 5, 1897.

Consists of a substantially U-shaped, flat portion, one of the arms of the U being provided with a rounded projection.

ELECTRIC CONTACT. C. C. Dusenbury, Lake Mahopac, N. Y., 582,464. Filed Feb. 8, 1897.

Designed to be substituted for a switch.

OUTLET INSULATOR. J. M. Anderson, Boston, Mass., 582,514. Filed March 16, 1897.

Consists of a sleeve of insulating material provided on its interior with screw threads.

Dynamos and Motors:—

ELECTRIC MOTOR. J. A. Mosher, Chicago, Ill., 582,218. Filed Feb. 9, 1893.

An armature of electro-magnets, consisting of a number of plates arranged in succession upon a shaft obliquely to its axis.

ARMATURE FOR DYNAMO ELECTRIC MACHINES. E. P. Clark, New York, 582,269. Filed July 16, 1896.

Consists of segments composed of H-shaped punchings from sheet iron.

FASTENING MEANS FOR CORE PLATES OF ELECTRICAL MACHINES. E. E. Nolan, Wilkinsburg, Pa., 582,481. Filed Jan. 20, 1897.

CORE FOR ELECTRICAL MACHINES. G. Westinghouse, Pittsburg, Pa., 582,494. Filed Jan. 20, 1897.

Comprises a casting having a cylindrical surface supporting laminæ, an annular clamping plate and a fastening ring interposed between the clamping plate and a shoulder on the casting.

Lamps and Appurtenances:—

CARBON FOR ARC LAMPS. J. D. Smith, Washington, D. C., 582,378. Filed March 1, 1897.

Comprises a carbon and a piece of insulating material attached to the carbon and interposed in the path of the arc to extinguish it.

Measurement: -

ELECTRIC METER. G. A. J. Telge, Oldenburg, Germany, 582,493. Filed Nov. 16, 1896.

The measurement of the current is effected by causing the current to influence the oscillations of the pendulum of a clock and from the difference in time effected is deduced the amount of current.

Miscellaneous:—

GOVERNING DEVICE FOR FLUID PRESSURE MOTORS. F. M. Rites, Ithaca, N. Y., 582,233. Filed Jan. 13, 1897.

A device for modifying the effects of inertia and other disturbing forces which is adjustable by electricity.

ELECTRICALLY PROPELLED AGRICULTURAL IMPLEMENT. H. Schimpff, Halle-on-the-Saale, Germany, 582,237. Filed Sept. 25, 1896.

An electric plow adapted to be moved along an anchored chain.

METHOD OF TREATING ARTIFICIAL DENTURES. E. L. Chaffin, Helena, Ark., 582,342. Filed Aug. 31, 1896.

Consists in plating plastic dentures with non-corrodible metal by means of electrolysis.

INCANDESCENT GAS BURNER AND MANTLE. W. H. Cottingham, Milwaukee, Wis., 582,459. Filed April 3, 1896.

Consists of layers of copper, platinum, and ruthenium, which have been electrically deposited upon a suitable base, and the base subsequently destroyed by heat.

Railways and Appliances:—

ELECTRIC TROLLEY DEVICE. W. M. Brown, Johnstown, Pa., 582,259. Filed Dec. 16, 1896.

Comprises a carriage carrying a contact maker, the carriage being adapted to slide transversely within a tube.

TROLLEY WIRE HANGER. J. E. Atwood, Stonington, Conn., 582,337. Filed Oct. 12, 1895.

Obviates the use of solder in fastening the conductor to the hanger.

SUPPORT FOR TROLLEY WIRES. E. J. Cook, Cleveland, Ohio, 582,344. Filed March 6, 1897.

A trolley car having a chambered groove adapted to receive a flattened wire when turned to an unusual position, and to retain it when in the normal position.

Switches, Cut-Outs, Etc.:—

ELECTRICALLY ACTUATED SWITCH. J. Bryan, Pittsburg, Pa., 582,262. Filed Aug. 1, 1896.

Electrically operated switch controlled by motorman on the car.

ELECTRIC SWITCH. W. J. Newton, New York, 582,303. Filed Jan. 28, 1897.

Flush switch.

Telephones:—

TELEPHONE TRANSMITTER. R. P. Green, Columbus, Ohio, 582,200. Filed Jan. 11, 1897.

Comprises an electrode consisting of oxygenated sulfid of copper in an envelope composed of zinc.

TELEPHONE TRANSMITTER. H. C. Alexander, Bonham, Tex., 582,513. Filed Dec. 4, 1896.

Of the granulated electrode type.

TELEPHONE. C. F. Dunderdale, Chicago, Ill., 582,522. Filed June 17, 1895.

Temperature compensating device for telephone receivers.

SYSTEM OF ELECTRICAL INTERCOMMUNICATION. E. A. Clark, Sioux City, Iowa; J. P. Ellacott & W. J. O. Johnson, Chicago, Ill., 582,578. Filed Sept. 28, 1893.

Means whereby the several subscribers of a system may place themselves in communication without the aid of a central operator.

TELEPHONE CONTROLLING DEVICE. T. A. Dull, Chicago. Ill. Filed Oct. 14, 1895.

Coin actuated telephone controlling device.

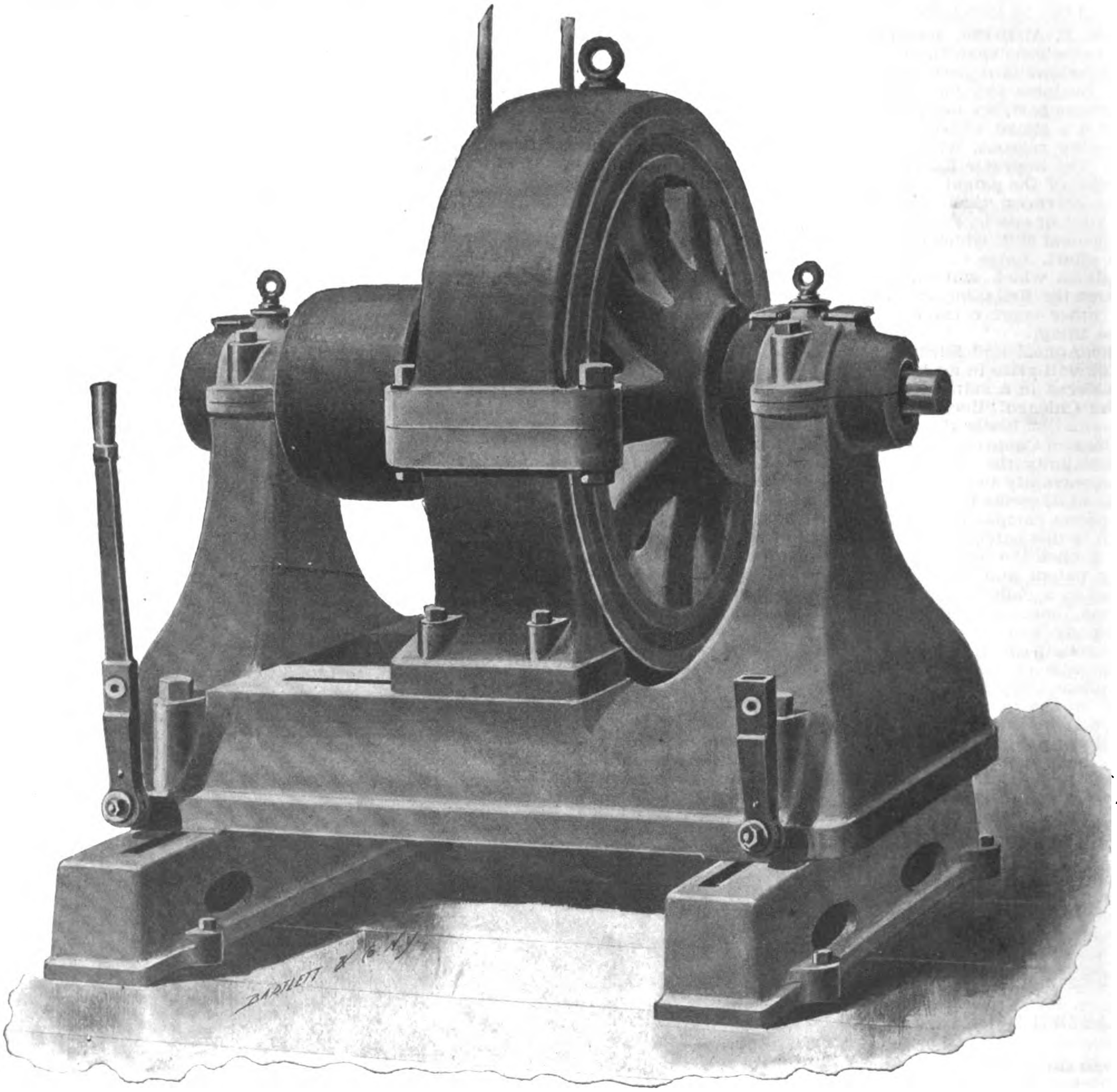
STOWE, VT.—Mr. H. M. Burgett and associates are building what is to be an electric road between Stowe and Waterbury, Vt. They expect to handle a large amount of freight. The organization is to be known as the Mount Mansfield Railroad Company, and P. D. Pike, of Stowe, is president. The road will give a beautiful ride of ten miles through the scenery of the finest mountain region in New England.

BALTIMORE, MD.—In view of the projected consolidation of the street railways, people have been buying up for future use large quantities of the tickets issued at the rate of 6 for 25 cents, thus making 20 cents on the dollar so long as their supply holds out.

TRADE NOTES & NOVELTIES

THE WALKER ALTERNATOR.

Up to recent date the Walker Co. had confined its activity to the manufacture of direct current apparatus, such as dynamos for railway and isolated plant work and to stationary and railway motors. The demands made upon it for arc and alternating apparatus have, however, been such that they could not be ignored, and the result has been the designing of complete systems of both types of the latter apparatus. The Walker arc lamp was illustrated in our last issue, and this week we are able to present an illustration and description of the new Walker alternator.



The New Walker Inductor Alternator.

This machine is of the "inductor" type, the inductor consisting of a solid iron casting keyed to the rotating shaft. The hub, together with the outwardly projecting arms or spokes with laminated iron tips, forms part of the magnet circuit. There are no windings upon this rotor, the function of which is (1) to provide a path for the magnetic field, and (2) as part of the magnetic circuit, to vary the position of the magnetic flux, relative to the armature coils.

To the interior of the fixed ring shown are secured annular laminations. These armature laminations are furnished with inwardly projecting teeth and support the armature coils. There are twice as many armature coils as there are inductor projections, and at any instant half the coils lie opposite these, and half opposite the spaces between the inductors. The armature lying external as it does to the inductor, gives room for ample cross section of conducting wire, without infringing on the space necessary for insulation. The coils, themselves, are thoroughly insulated in the process of construction; and again, the sides and bottom of the slots are lined with composite insulation of the best materials before receiving the coils. Thus the insulation between armature windings and frame is of the highest quality, and being upon the stationary portion of the machine, is not exposed to the slow disintegration which deteriorates some varieties of insulation upon revolving armatures.

The inductor and armature together form a discoidal box, the stationary armature ring being the periphery. One side is closed by the projecting arms of the inductor; the other by a casting continuous with the armature ring, and extending radially inwards, leaving only the necessary clearance between it and the inductor hub. Within this annular box, concentric with the shaft and securely bolted to the armature casting, is the coil supplying the excitation necessary for the machine. The magnetic lines generated by this coil, starting from the armature ring, flow inwards along the side of the armature casting, across the air-gap into the inductor hub, out along the inductor arms and through the laminated tips, across the air-gap into the armature teeth; the changing position of the inductor arms supply the variation of magnetic flux through the armature coils necessary to produce the required voltage.

The machine is so designed that any repairs, when necessary, can be readily and quickly effected.

KEYSTONE PORTABLE VOLTMETERS.

THE Keystone Electrical Instrument Company, of Philadelphia, announce that they are now prepared to offer a complete line of portable voltmeters for combined use on the direct and alternating current.

In the construction of these voltmeters nothing is incorporated which is subject to change or deterioration, and, having been calibrated from absolute standards of voltage, they may be relied upon to maintain their accuracy. The system is such that there is no magnetic lag nor any error due to self-induction, therefore they are independent of frequency variations on the alternating current.

They are mounted in highly polished mahogany cases with key lock and leather carrying handle. With each instrument is included a pair of flexible leads for which a special compartment is provided.

This line of voltmeters is the result of a large number of experiments covering several years followed by time tests in actual practice.

Two features are incorporated which busy users will appreciate; one is that the instruments are dead-beat without the use of a mechanical brake, and the second is that each instrument is provided with a switch for reversing the direction of the current flow through the voltmeter when used on direct current circuits. This latter enables the user to obtain mean readings easily and promptly, and, further, by turning the switch to the dead-point to throw the instrument out of circuit without disconnecting the leads.

These voltmeters are listed in ranges from 12 to 700 volts, single and double scales, so that all classes of testing work are provided for.

INFRINGEMENT OF MAGNOLIA METAL.

WE are in receipt of the following communication from Mr. E. C. Miller, vice-president of the Magnolia Metal Company, of New York City, under date of May 11:

We beg to inform you that the firm of Sugden, Pound & Wagner of London (former selling agents for Magnolia Metal in Europe, and who traded under the name of the Magnolia Anti-Friction Metal Company, of Great Britain, by special permission of our company) have been dispossessed of their agency by the English courts and that our London office and our foreign business are now under the management of Mr. Chas. B. Miller, the president of this company.

We beg also to inform you that Messrs. Sugden, Pound & Wagner were recently perpetually enjoined, together with the Atlas Metal Company, Limited, of London, John Sugden, Max Wagner, Arthur George Brown, the Globe Engineering Company, Limited, of Manchester; the Atlas Bronze Company, Limited, and the Atlas Bronze Company from continuing the fraudulent business of making an anti-friction metal and branding it with the trade mark of the Magnolia Metal Company, of New York, imitating their ingots, marking the boxes in which the metal is packed, "Made in the United States," and otherwise deceiving and imposing upon purchasers of anti-friction metal in Great Britain and Europe.

Justice Collins heard this case and gave judgment against Sugden, Wagner, Brown, the Globe Engineering Company, Limited, and others, for selling counterfeit goods and deceiving the public by representing that the goods they sold were made in the United States by the Magnolia Metal Company.

An appeal was taken from the injunction above referred to. This appeal was tried before the Court of Appeals, Lord Esher presiding, and the perpetual injunction granted by Justice Collins was confirmed. It was in this trial that Lord Esher denounced the action of the parties above named and characterized their performance as "A Disgusting Fraud."

It has come to our notice that parties in this country have attempted to perpetrate a similar fraud, and we now have one Western firm in the courts over this matter, and we desire through your columns to warn the engineers and the general public, users of anti-friction metal, against these fraudulent attempts to pirate and appropriate the use of our trade marks and name of our metal.

Every bar of Magnolia metal bears the steel stamp of the Magnolia flower, and the impression of the steel die "Patented June 3, 1890," and "Manufactured in the United States," with the exception of the metal manufactured by this company in Russia, which bears the stamp of the Magnolia flower and the words "Manufactured in Russia."

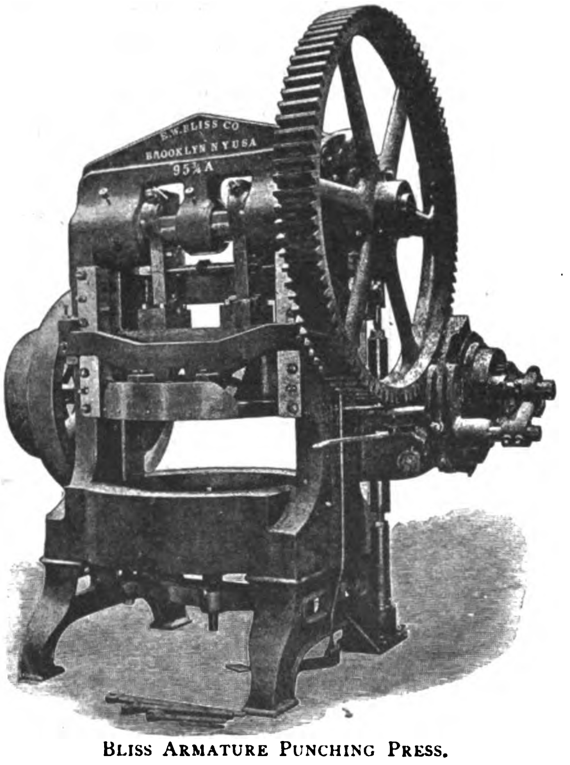
Will you kindly publish this letter and help in that way to give publicity to the facts set forth and thereby protect, in some measure, American manufacturers who are being wronged by foreign as well as domestic competitors.

BLISS ARMATURE DISC CUTTING PRESSES.

THE requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet metal work.

The usual form of armature is made up of annular discs with notches on the outside or inside circumference. As it is essential to have the outside and inside exactly concentric, it has been found best to adopt dies which, by cutting them simultaneously, eliminate the inaccuracies which are almost unavoidable when the cutting is done in two or more operations. In many cases the notches and key-slots are also punched at the same time, all of which calls for tools having "throw-out pads" in addition to the cutting parts, so as to automatically push the disc and scrap out of the dies and punches.

These "throw-out pads" are now usually operated by means of heavy springs, which are not always reliable, and consume a great deal of the power of the press. The press shown herewith is designed to operate these "throw-outs" in a positive manner, and consume but little of the power of the press. The bottom plate which operates the "die-pads" through radial slots or pin-holes in the bolster, is actuated by an outside crank connection, or by means of two rods connecting it directly with the slide, as shown. Two cross-pieces, adjustably attached to the frame of the press, actuate the "throw-out pads" of the punches by striking against them on the return motion of the main slide.



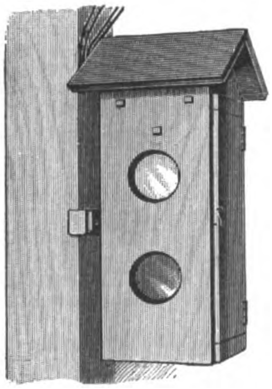
BLISS ARMATURE PUNCHING PRESS.

This press is designed for the class of work mentioned by the E. W. Bliss Company, 43 Adams street, Brooklyn, N. Y. It will cut the outside and inside simultaneously on plain discs up to 31½ inches diameter, and up to 14 or 15 inches diameter, when all the outside notches are also to be cut at the same stroke. It may also be used for cutting segments or sections complete at one stroke with all their teeth or holes up to 31½ inches long.

ELECTRIC BLOCK SIGNAL FOR TROLLEY ROADS.

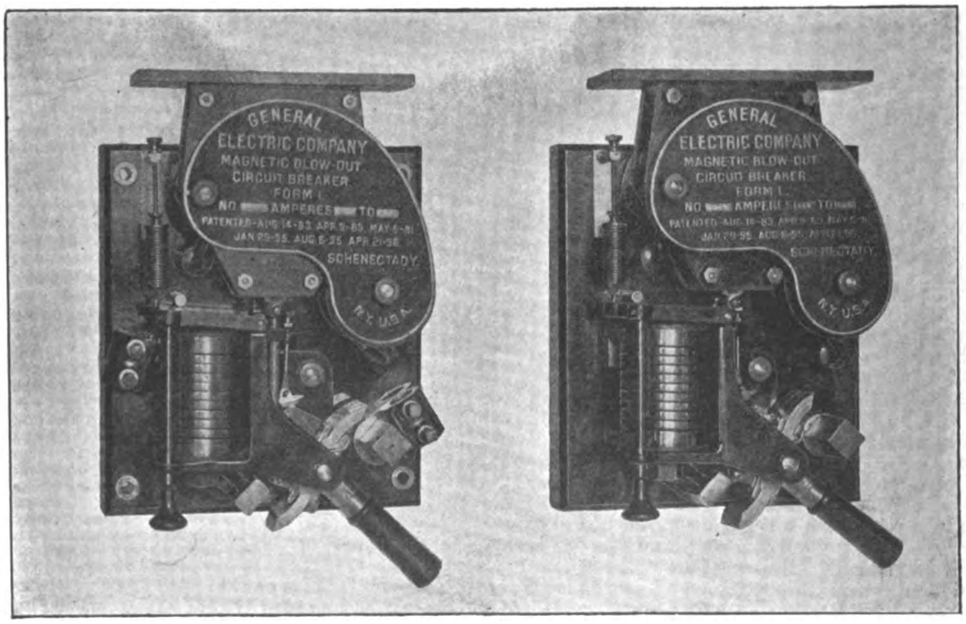
THE Automatic Block Signal Company, of 136 Liberty street, is introducing a novel and ingenious automatic electric block signal that should be hailed with delight by both managers and patrons of single track trolley lines, as it does away with the annoyances incident to cars going in opposite directions meeting between turnouts.

The accompanying engraving shows the appearance of the box containing the signal. One of these boxes is placed on a pole near the turnout at each end of the "block" or section of single track. The box has two lenses on each side, the two upper lenses having green glass and the two lower ones red glass, with a group of lamps between each pair of lenses. Each box has wires running to automatic contacts on the in and out trolley wires of the switch. Two wires also connect the two signal boxes with each other.



AUTOMATIC ELECTRIC BLOCK SIGNAL FOR TROLLEY ROADS.

The operation is as follows: The trolley wheel of a car on passing over the turn-out to enter the block strikes the corresponding automatic contact which lights the lamps that show the green signal in the signal box at entering end and the red signal at the other end of the section. On passing out of the block or section the trolley wheels strike the automatic contact on the "out" side of the turn-out trolley wire and this shuts off the current from the lamps at both ends of the section. It will thus be seen that this block signal not only indicates at each end when a car is on the "block," but also the direction in which it is moving.



THE GENERAL ELECTRIC CIRCUIT BREAKER.

These signals have been in use by the Paterson (N. J.) Railway Company and by the New Jersey Electric Railway Company, in Hoboken, since October, 1896, and have given perfect satisfaction.

NEW G. E. FORM L CIRCUIT BREAKER.

THE well-known automatic circuit breaker of the General Electric Company, known as form K, for heavy currents, is now followed by one for use with smaller currents, that is, for 100 to 500 amperes. It is known as the form L and as with the K, may be used on any potential up to 750 volts.

The deleterious effect of arcs on unprotected contact parts, destroys in a short time their usefulness, introducing a serious problem on all circuit breaking apparatus, and the greater the voltage and current the greater the difficulty presented in handling arcs. To eliminate the destructive effect of arcs on contacts the magnetic blow-out principle was applied, and by this a means is provided for destroying the arc at the moment of its formation. The addition to a switch thus equipped of a tripping device to open the circuit as soon as a predetermined current flows, gives an automatic circuit breaker unsurpassed for reliability and convenience.

The form L circuit breaker is substantial in construction and compact in form. It is mounted on a slate base 11 by 12½ inches, and the maximum overall measurement from the back of the base is 6 inches. It can be provided with either front or back connections. Its action is similar to that of the form K circuit breaker, adopted so widely in power stations for use with heavy currents. The current passes through built-up leaf contacts to the tripping coil, the armature of which actuates the tripping device. An adjustable tension spring holds the armature away until sufficient current flows to overcome its pull, drawing the armature to the magnet coil.

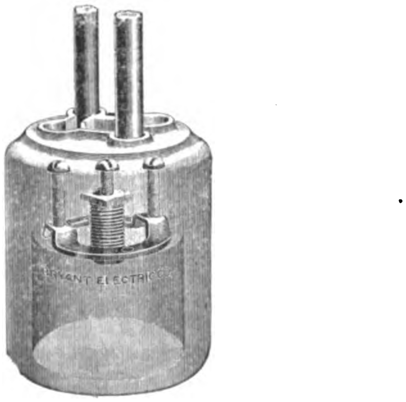
The leaf contacts are held normally against the main contact blocks. When the tripping armature is drawn to its magnet, the main contact is released and the circuit instantly opened by the action of the main spring. To prevent arcing at the main contact, the current is shunted through a secondary contact plug protected by the blow-out magnet. This plug is not withdrawn until after the leaf contacts have left the contact blocks and all tendency to arc, therefore, is confined to this point, where the magnetic action prevents it from doing damage. The blow-out magnet and secondary contact are in series contact. Owing to their high resistance, practically no current flows through them until the circuit through the main contact is opened, when they take the whole current, creating the magnetic field and extinguishing the arc indepenently and apart from the main contact.

The marked rating of a circuit breaker, as 100-500, indicates the lowest current that will automatically open the circuit and the maximum normal current carrying capacity. The circuit breaker is set to open at any desired current from its lowest rating to 50 per cent. in excess of its highest rating, by adjusting the calibrating spring of the tripping armature. An indicator on the adjusting stud registers with well-spaced marks on a brass scale, showing the current at which the circuit will be opened.

The handle of the form L circuit breaker is removable, but is automatically locked in place so long as the circuit remains closed. It can be removed only when the circuit breaker is open. Moreover, when the handle is removed the circuit breaker cannot be closed. This interlocking device allows feeder circuits to be kept open at the will of a single operator, avoiding to a large extent any accidental closing.

THE BRYANT WEATHER-PROOF SOCKET.

THE accompanying engraving represents a new weather-proof socket just brought out by the Bryant Electric Company, of Bridgeport, Conn. The special features of this new socket are the method of sealing in the wires, which makes it absolutely weatherproof, and the length of the porcelain skirt, which is unusually long and which fully covers the lamp base. This style of socket is made with T-H and Westinghouse bases.



BRYANT WEATHERPROOF SOCKET.

SALES OF BALL ENGINES.

The Ball Engine Company, Erie, Pa., report the following recent shipments of engines for electric purposes: Vulcan Coal Co., Treveskyn, Pa., one 225-h.-p. direct connected to generator; Queen City Electric Light and Power Company, Clarksville, Tenn., one 125-h.-p. engine; Langhorne Electric Light and Power Company, Langhorne, Pa., 3d order, one 200-h.-p. engine; Maxwell House, Nashville, Tenn., 3d order, 125-h.-p. engine, direct connected to dynamo; Rockville (Md.) Water Works, one 80-h.-p. engine; Wilmington Gas Light Company, Wilmington, N. C., 3d order, one 300-h.-p. cross-compound engine; Pennsylvania Tube Works, Pittsburg, Pa., one 60-h.-p. engine; Seaboard Air Line, Portsmouth, Va., one 70-h.-p. engine, direct connected to dynamo; Apollo Iron and Steel Works, Apollo, Pa., 4th order, one 150-h.-p. vertical cross-compound, direct connected alternating machine; Kirk's Soap Factory, Chicago, Ill., one 50-h.-p. engine, direct connected to dynamo; Lexington Hotel, Richmond, Va., one 40-h.-p. engine; (Congo O.) Mining Co., Congo, O., one 175-h.-p. engine, Wainwright Brewing Company, Pittsburg, Pa., one 80-h.-p. engine, direct connected to dynamo; Fox Pressed Steel Company, Pittsburg, Pa., one 100-h.-p. engine, direct connected to dynamo; F. O. Norton Cement Co., Binnewater, N. Y., one 60-h.-p. engine; Lakewood Hotel and Land Company, Lakewood, N. Y., one 165-h.-p. tandem compound engine.

BRISK TRADE OF THE BERLIN, IRON BRIDGE CO.

The Berlin Iron Bridge Company, of East Berlin, Conn., are working full time, and report that Spring business is opening up in quite a brisk manner. They have a large number of contracts on hand, including a water tower at North Berwick, Me.; large school building at East Albany, N. Y.; steel frame work for the Providence Institution for Savings, at Providence, R. I.; steel frame work for the new Waterbury, Conn., Savings Bank; large addition to the Waterbury, Conn., Farrel Foundry and Machine Company; an addition to the boiler plant of the Bay State Brewery, in South Boston, Mass.; steel trusses for the Opera House at Corinth, N. Y.; steel work for the new Public Library Building, at Providence, R. I.; an addition to the boiler plant of the Connecticut Hospital for the Insane, at Middletown, Conn.; new pumping station for the York, Pa., Water Company; addition to the boiler plant of the Dunnell Manufacturing Company, at Pawtucket, R. I.; fire proof building for the Guggenheim Smelting Company, at Perth Amboy, N. J.; steel frame work for a church, at Bartlett, N. H.; bridge at Charlemont, Mass.; large steel bridge for Somerset County, N. J.; a steel bridge for the town of Coventry, Conn.; steel highway bridge for the town of Hermon, N. Y.; large city bridge at Vergennes, Vt.; large bridge for the S. D. Warren Company, at Cumberland Mills, Me.; also highway bridge at Wilmington, N. Y.

THE STANDARD AIR BRAKE CO.'S NEW CATALOGUE.

A CATALOGUE that entirely satisfies the eye and mind and gives the feeling of a piece of work thoroughly well done, is that just issued by the Standard Air Brake Company, of 100 Broadway, E. J. Wessels, general manager. It is 9 by 12, in stiff paper cover, and contains about 40 pages of text, put together in a very illuminative and instructive manner. The uses of the Standard brake are dealt with, in relation to street cars, freight cars and locomotives, cable cars, rack-rail cars, lift bridges, etc. These various applications are dealt with in detail, and are shown in many handsome illustrations. A large part of the text, and that which for most people will be of chief interest, is devoted to a discussion of air brake problems, and to a very complete illustrated description of the mechanism and the method of employing it. The introduction of air brakes on street cars has been uphill work, but the day seems fast approaching when no car that ought to have such brakes will be without them. To that end such admirable trade literature as this must contribute powerfully. The company will be glad to send copies on application to any one who is genuinely interested. They want every shot to tell.

THE BELTLESS AGE.

Mr. A. M. Lozier, M. E., of the Bullock Electric Manufacturing Company, says in the "American Machinist": "When electrical transmission stepped to the fore, even the best equipped factories presented a most inconsistent appearance. Their condition might be compared to two strong iron links of a chain held together by a piece of string, for on the one hand their boilers and engines were of the best and most economical types, and on the other hand, their tools or printing presses were compact, automatic and highly efficient. But the connecting link, the means of transmitting the power from the engine to the tool, was a weak one, a great source of waste in power and a relic of conservatism. It is astounding that for years, thousands (indeed, one may say millions) of horse-power hours have been wasted in the mere friction load of shafting and belting, without any serious consideration of the matter by mill owners and printers. Records of tests made in over two hundred representative factories and printing establishments of this country alone show, as an average, that about 50 per cent. of all the power generated by the engines has been wasted in belt or rope transmission of power."

ADVERTISERS' HINTS

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY have removed to 152-154 Lake street, occupying larger quarters in their new location.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., will send a free sample of "Highland" soldering paste on application. One pound of the paste is equal to three gallons of soldering solution.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY have secured offices in the Bowling Green Building, 11 Broadway, New York.

THE ELECTRIC ENGINEERING AND SUPPLY CO., Syracuse, N. Y., illustrate their "ad" in this issue with a cut of their style "K" "Baby" switch in 35 and 50 amperes capacity.

THE ELECTRO-CHEMICAL STORAGE BATTERY COMPANY, 36 Broad street, New York, have moved their factory to 35 Gold street, which will greatly facilitite the prompt delivery of goods.

THE MITCHELL TEMPERED COPPER COMPANY, Corry, Pa., advertise pure hardened copper electrical appliances.

WM. S. TURNER, M. S., is now located at 1 Nassau street, New York.

THE INGERSOLL-SERGEANT DRILL COMPANY draw attention to the Pohlé system of raising water by means of compressed air. This system is designed specially for pumping water from artesian wells. Besides the economy claimed for the system, sand or grit does not affect it, the water is purified and one air compressor will pump from any number of wells regardless of distance. The company's interesting catalogue contains descriptions of a number of successful installations of this kind.

WESTERN NOTES

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., report that business has been very good with them for some time past and that they have found it necessary to run their factory at night in order to enable them to make prompt shipments. Amongst the most important orders which they have lately supplied were all the printing press controllers, field rheostats, and starting boxes for the new Germania Building, Milwaukee; a 200-horse-power rheostat for the Chicago Edison Company, Washington street station, and several others to different parts of the country.

KEELYN & SMITH, electrical engineers and contractors, Milwaukee, Wis., have removed from their old quarters at 148 Second street to much more commodious premises at 169 W. Water street.

D. L. BATES & BRO., Dayton, Ohio, are running night and day to fill the unprecedented demand for their ceiling fans.

NEW YORK NOTES

L. E. FRORUP continues as general sales agent of Schiff, Jordan & Co., with offices at 232 and 234 Greenwich street, New York. The sales of the well-known carbon handled by this company during the past three or four weeks have been enormous.

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REPORTS OF COMPANIES

ERIE TELEGRAPH AND TELEPHONE CO.

FOURTEENTH ANNUAL REPORT.—FOR THE YEAR ENDING DECEMBER 31, 1896.

The principal assets of the Erie Telegraph & Telephone Company consist of an ownership of stock in the following telephone companies:

Sixty-five per cent. of the capital stock of the Cleveland Telephone Company. Capital issued, $1,700,000. Territory, Cuyahoga County in Ohio, which includes Cleveland.

Seventy per cent. of the capital stock of the Northwestern Telephone Exchange Company. Capital issued, $2,000,000. Territory, the States of North Dakota, South Dakota, excepting the Black Hills District, and Minnesota, excepting the City of Duluth. (For list of cities see below.)

Seventy per cent. of the capital stock of the Southwestern Telegraph and Telephone Company. Capital issued, $3,000,000. Territory, the States of Arkansas and Texas. (For list of cities see below.)

To the Stockholders:

Your Directors respectfully submit the Fourteenth Annual Report of the Corporation, showing the operations of this company and of the three telephone companies (in which this company owns a controlling interest), for the year ending December 31, 1896, together with a statement of assets and liabilities.

THE CLEVELAND TELEPHONE COMPANY.
THE NORTHWESTERN TELEPHONE EXCHANGE CO.
THE SOUTHWESTERN TELEGRAPH & TELEPHONE CO.

Income.	1894.	1895.	1896.
Exchange Service	$896,525.07	$924,455.65	$988,249.52
Toll Service	96,769.99	125,397.23	172,560.47
Private Line	20,076.16	15,003.74	14,449.15
Messenger	1,287.13	1,867.70	2,782.56
Interest	2,756.11	8,235.67	11,834.11
Real Estate	1,793.00	504.00	4,987.00
Miscellaneous	14,411.76	10,431.71	11,284.59
Total	$1,033,619.22	$1,085,895.70	$1,206,147.40
Expenses.			
General, including taxes	$96,288.31	$112,786.95	$101,233.80
Executive	23,295.74	29,662.27	34,942.34
Operating	154,155.72	178,163.23	218,266.44
Maintenance	162,924.56	184,965.51	199,823.78
Rebate	12,823.16	14,666.37	26,122.42
Rental and Royalty	162,659.08	97,155.12	103,818.93
Interest (Miscellaneous)	21,986.07	15,748.66	19,944.10
Private Line	3,775.03	1,816.53	338.50
Real Estate	575.08	293.53	1,644.42
Total	$638,482.75	$635,258.17	$706,134.73
Net Earnings	395,136.47	450,637.53	500,012.67
Surplus Account Dec. 31, 1895		$165,455.54	
Net Earnings, 1896		500,012.67	
			$665,468.21
Regular Dividends, 1896			461,662.50
Surplus Account December 31, 1896			$203,805.71

THE ERIE TELEGRAPH AND TELEPHONE COMPANY.

Income.		1896.
Dividends		$314,913.75
Expenses.		
Interest and Executive		106,273.68
Net income		$208,640.07
Surplus Account, Dec. 31, 1895	$182,005.57	

Net Income, 1896	208,640.07	
		$390,645.64
Dividends, 1896 (4 quarterly 1 per cent.)		192,000.00
Surplus Account, Dec. 31, 1896		$198,645.64
Undivided Surplus of the Sub-Companies; due the Erie Telegraph and Telephone Co., Dec. 31, 1896		140,163.79
Total Surplus		$338,809.43

THE CLEVELAND TELEPHONE COMPANY, THE NORTHWESTERN TELEPHONE EXCHANGE COMPANY, THE SOUTHWESTERN TELEGRAPH AND TELEPHONE CO.

Statement of Assets and Liabilities Dec. 31, 1896.

Assets.		
Property and Franchise	$6,345,020.25	
Real Estate	390,000.00	
Supplies (unused)	225,135.53	
Accounts Receivable	214,809.59	
Cash	35,039.35	
Liabilities.		
Capital Stock (issued)		$6,700,000.00
Reserve		306,199.01
Surplus		203,805.71
	$7,210,004.72	$7,210,004.72

THE ERIE TELEGRAPH AND TELEPHONE COMPANY.

Statement of Assets and Liabilities Dec. 31, 1896.

Assets.		
Stocks and Bonds	$7,165,722.27	
Accounts Receivable	86,221.34	
Cash	81,721.08	
Liabilities.		
Capital Stock (issued)		$4,800,000.00
Bonds and Notes		2,243,000.00
Reserve		92,019.05
Surplus		198,645.64
	$7,333,664.69	$7,210,004.72

SUBSCRIBERS.

The Cleveland Telephone Company.

Exchange.	1883.	1894.	1895.	1896.
Cleveland Ohio—				
Exchange	....	3,549	3,984	4,270
Private Line	....	387	406	411
Total	1,500	3,936	4,390	4,681

Total number of metallic circuit subscribers included in above, 1,204.

THE NORTHWESTERN TELEPHONE EXCHANGE COMPANY.

Exchange.		1883.	1894.	1895.	1896.
Anoka,	Minn	0	0	0	30
Brainerd,	“	69	0	0	0
Faribault,	“	49	45	46	116
Fergus Falls	“	60	0	0	0
Fort Snelling	“	0	6	6	0
Little Falls,	“	0	27	26	38
Mankato,	“	30	98	111	140
Minneapolis	“	800	2,137	2,347	2,424
Northfield	“	0	14	20	48
Red Wing,	“	26	40	59	62
St. Cloud,	“	0	78	90	101
St. Paul,	“	482	1,506	1,602	1,671
Stillwater,	“	96	157	176	182
Wabasha	“	9	0	0	0
Winona,	“	54	191	117	137
Fargo,	N. D.	179	247	348	452
Grafton,	“	0	0	0	57
Grand Forks,	“	79	239	301	370
Sioux Falls,	S. D.	0	131	174	197
Yankton	“	0	45	42	47
Private Line		0	518	503	466
Total		1,933	5,479	5,968	6,538

Total number of metallic circuit subscribers included in the above, 381.

THE SOUTHWESTERN TELEGRAPH AND TELEPHONE COMPANY.

Exchange.		1883.	1894.	1895.	1896.
Conway,	Ark	0	0	33	27
Fort Smith,	“	0	247	322	418
Helena,	“	62	90	111	144
Hot Springs,	“	88	171	151	169
Little Rock,	“	286	523	506	765
Morrillton,	“	0	0	18	0
Newport,	“	0	0	0	43
Pine Bluff,	“	0	178	197	308
Texarkana,	“	54	34	73	105
Van Buren,	“	0	30	50	107
Alvarado,	Texas	0	10	9	8
Austin,	“	127	336	377	446
Belton,	“	0	43	94	170
Brenham,	“	91	50	66	117
Cleburne,	“	41	0	0	0
Corpus Christi,	“	0	55	65	69
Corsicana,	“	68	54	39	69
Dallas,	“	270	597	678	766
Denison,	“	75	22	20	103
El Paso,	“	0	164	185	220
Eagle Pass,	“	0	35	46	57
Ennis,	“	0	0	90	108
Fort Worth,	“	157	429	439	455
Gainesville,	“	68	27	29	124
Galveston,	“	323	723	752	862
Hillsboro,	“	0	0	98	130
Houston,	“	150	652	724	855
Jefferson,	“	0	12	36	28
Lampasas,	“	0	12	12	10
Laredo,	“	0	108	113	111
McKinney,	“	0	9	13	17
Marlin,	“	0	0	0	102
Marshall,	“	53	73	86	101
Orange,	“	0	12	13	59
Palestine,	“	38	0	0	0
Paris,	“	85	172	226	295
San Antonio,	“	316	617	667	733
Sherman,	“	118	134	197	228
Taylor,	“	0	0	80	118
Temple,	“	0	94	180	240
Terrell,	“	0	51	65	87
Tyler,	“	0	92	160	125
Victoria,	“	0	50	52	52
Waco,	“	88	328	405	455
Waxahachie,	“	0	11	117	177
Weatherford,	“	0	42	60	83
Wichita Falls,	“	0	39	26	30
Yoakum,	“	0	0	47	56
Private Line,	“	....	433	506	418
Total		2,558	6,759	8,233	10,170

Total number of metallic circuit subscribers included in the above, 476.

SUMMARY.

	1883.	1894.	1895.	1896.
The Cleveland Telephone Co.	1,500	3,936	4,390	4,681
The Northwest. Telep. Ex. Co.	1,933	5,479	5,968	6,538
The Southwest. Tel. & Tel. Co.	2,558	6,759	8,233	10,170
Total	5,991	16,174	18,591	21,389

Net increase for 1896, 2,798.

Total number of metallic circuit subscribers included in the above, 2,061.

Total Number of Exchanges.	1883.	1894.	1895.	1896.
The Cleveland Telephone Co.	3	3	4	4
The Northwest. Telep. Ex. Co.	13	15	15	16
The Southwest. Tel. & Tel. Co.	38	38	44	45
Total	54	56	63	65

The Erie Telegraph and Telephone Company was organized in June, 1883, and originally owned the telephone properties now operated by the Cleveland Telephone Company, the Northwestern Telephone Exchange Company, and the Southwestern Telegraph and Telephone Company. In 1887 an arrangement was entered into with the American Bell Telephone Company whereby perpetual contracts were issued covering the three sections mentioned, and the properties were conveyed by bills of sale to the corporations now owning them, this company retaining a controlling interest, heretofore mentioned, in each company. The growth of the business since 1883 has been marvelous, and the year 1896, notwithstanding the general unsatisfactory condition of the business of the country, shows a greater increase, comparatively, than any previous year.

The expenditure upon the plant and equipment during the year has been—

For new construction	$828,317.65
For maintenance	199,823.78
For real estate	206,273.07
Total	$1,234,414.50

The number of subscribers has increased from 5,991 in 1883 to 21,389 in 1896, a net gain of 15,398.

Income and expenditures since 1883 have been as follows:

Gross income	$10,745,911.59
Gross expenses	6,927,918.04
Net earnings	$3,817,993.55
Included in the item "Gross Expenses" is the sum of	$1,832,989.71
Expended in improving the plant, to which must be added the cost of all classes of extensions, and the cost of real estate	3,006,470.25
Grand total cash disbursement upon the plant since 1883 (exclusive of the cost of the original properties and rights)	$4,839,459.96

The Erie Telegraph and Telephone Company has paid 53 dividends since the organization of the company, including the dividend declared by the directors January 29, 1897, from the earnings for the quarter ending December 31, 1896.

Real Estate.—For an exchange of about 700 subscribers, where an underground system is necessary, it is advisable that a permanent location be secured for the "Central Office." The company now owns land and buildings in the following cities:

	Value.
Austin, Texas	$3,500.00
Galveston, Texas	55,000.00
Houston, Texas	37,000.00
Little Rock, Ark.	6,500.00
San Antonio, Texas	18,000.00
Cleveland, Ohio (Main)	250,000.00
Cleveland, Ohio (Branch)	20,000.00
St. Paul, Minn. (purchased Jan. 1, 1897)	50,000.00
Total	$440,000.00

There is now being constructed for our use at Minneapolis a building, which we have the option of purchasing, that will cost, with the land, a sum not exceeding $125,000. We also have under consideration a permanent location at Dallas and Fort Worth, in Texas, although at present we are well situated, under satisfactory leases.

It is the policy of the management to purchase land and erect buildings only of sufficient size and practically for our own use, as far as possible, so as to avoid the trouble of renting offices.

Underground.—The Sub-Companies commenced burying their wires in 1888, and now have 11,808 miles of wire working underground, in the following cities:

Houston, Texas. (Conduit laid ready for wires.)	
San Antonio, Texas	550 miles
St. Paul, Minn.	1,690 miles
Minneapolis, Minn.	2,173 miles
Cleveland, Ohio	7,395 miles
Total	11,808 miles

Toll Lines.—A decidedly valuable auxiliary to the exchange telephone service is the toll line department, and we have spared no effort to extend this branch of the business to every city and town in our vast territory, wherever the lines can be operated profitably. With the exception of about seventeen hundred miles of iron wire to small branch stations, our entire system of eleven thousand five hundred and twelve miles is composed of heavy copper metallic circuits, and we are prepared to give an excellent long distance service throughout our territory. The time is not far distant when we expect that the American Telephone and Telegraph Company (the Long Distance Company) will build to points in our territory, thereby connecting our extensive system with the great long distance service of the United States.

Most of the toll line construction has been done during the years 1895 and 1896, under the direction of our efficient superintendent of construction, Mr. P. G. Reynolds. The lines in most cases have been constructed outside of the railroad right of way and parallel thereto on land purchased by the company, and are built in a most able and thorough manner.

In the Northwest we are operating 5,054 miles of toll wire, as follows:

Circuits.	From	To	Pole Miles.	Copper Wire Miles.	Iron Wire Miles.
1	Grand Forks	Park River	54	108	...
1	Grand Forks	Larimore	28	...	56
2	Grand Forks	Fargo	78	312	...
1	Hillsboro	Portland	23	46	...
1	Fargo	Valley City	57	...	114
1	Fargo	Lisbon	60	120	...
2	Fargo	Fergus Falls	82	328	...
3	Fergus Falls	St. Cloud	112	672	...
1	St. Cloud	Little Falls	32	64	...
3	St. Cloud	Minneapolis	60	360	...
1	Minneapolis	St. Francis	12	66	...
22	Minneapolis	St. Paul	10	120	320
1	Minneapolis	Excelsior	9	38	...
2	Minneapolis	Sioux Falls	264	1,056	...
1	Minneapolis	Albert Lea	76	216	...
1	Shakopee	Carver	6	20	...
1	St. Peter	Cleveland	4	12	...
1	Sioux Falls	Dell Rapids	22	...	44
1	Sioux Falls	Parker	48	40	56
1	Sioux Falls	Salem	38	76	...
1	St. Paul	White Bear	12	24	...
2	St. Paul	Stillwater	20	80	...
1	Stillwater	Osceola	15	...	15
1	St. Paul	Austin	100	200	...
2	St. Paul	Red Wing	41	164	...
1	Red Wing	Winona	62	124	...
1	Waterville	Faribault	23	...	23
1	Winona	La Crosse	26	52	...
1	Winona	Rochester	50	100	...
1	Winona	Tremleau	28	...	28
60			1,452	*4,398	656

*Includes two wires, one circuit, No. 8 copper wire, Minneapolis to Fargo. This wire is of sufficient size to enable Park River, N. D., to talk with Bar Harbor, Maine, when the connection is made between Milwaukee and Minneapolis. The distance from Milwaukee to Minneapolis is 340 miles, and from Park River, North Dakota, to Bar Harbor, Maine, is about 2,148 miles. Longest circuit operated by this company is from Park River in North Dakota to Parker in South Dakota, via Minneapolis, which is 700 miles.

In the Southwest we are operating 6,458 miles of toll wire, as follows:

Circuits.	From	To	Pole Miles.	Copper Wire Miles.	Iron Wire Miles.
1	Little Rock	Dardanelle	81	162	...
1	Dardanelle	Mt. Nebo	5	...	5
1	Russellville	Dover	7	...	7
3	Fort Smith	Van Buren	5	...	30
1	Van Buren	Alma	9	...	9
1	Fort Smith	Waldron	72	...	144
1	Little Rock	Pine Bluff	43	86	...
1	Helena	Clarendon	50	...	100
1	Little Rock	Hot Springs	68	136	...
11		Total in Arkansas...	340	384	295
1	Clarksville	Paris	30	60	...
2	Paris	Sherman	63	252	...
1	Sherman	Denison	11	22	...
1	Sherman	Gainesville	34	...	34
1	Sherman	Greenville	52	104	...
4	Sherman	Dallas	63	504	...
1	Greenville	McKinney	32	...	32
1	Dallas	Terrell	31	62	...
1	Dallas	Denton	37	...	74
1	Carrolton	Grapevine	11	...	22
1	Terrell	Kaufman	11	...	11
3	Dallas	Fort Worth	33	198	...
1	Fort Worth	Decatur	40	...	40
1	Fort Worth	Graham	65	...	65
1	Fort Worth	Weatherford	32	...	64
4	Dallas	Waco	100	800	...
1	Waxahachie	Cleburne	40	...	40
1	Waxahachie	Ennis	12	30	...
1	Hillsboro	Corsicana	30	...	82
1	Hillsboro	Itaska	10	...	11
2	Dallas	Corsicana	53	212	...
1	Corsicana	Bremond	69	138	...
1	Mexia	Groesbeck	0	22	...
1	Jefferson	Waskom	35	...	35
2	Waco	Bremond	43	172	...
4	Waco	Austin	110	880	...
1	Eddy	McGregor	22	22	...
2	Temple	Belton	7	28	...
1	Round Rock	Corn Hill	22	20	12
1	Belton	Salado	10	...	10
2	Bremond	Hempstead	91	364	...
2	Austin	Hempstead	115	460	...
2	Hempstead	Galveston	104	208	...
2	Austin	San Antonio	81	324	...
1	Kyle	Luling	31	...	31
1	Luling	Prairie Lea	5	...	5
1	San Antonio	Castorville	20	...	20
1	Elgin	Bastrop	19	...	19
1	Weimar	La Grange	25	...	25
1	Columbus	Schulenburg	23	...	23
1	Hempstead	Wallis	38	...	38
1	Houston	Eagle Lake	69	138	...
1	Houston	Morgan City	26	...	52
1	Galveston	Texas City	7	14	...
63	Total Texas		1,762	5,034	745
11	Total Arkansas		340	384	295
74	Total Southw'n Tel. & Tel. Co.		2,102	5,418	1,040

The longest circuit operated by this company is from Clarksville, Texas, to Galveston, Tex., 600 miles. The construction of 165 miles of line between Memphis, Tenn., and Pine Bluff, Ark., and 163 miles from Malvern, Ark., to Clarksville, Tex., would connect all of Arkansas and Texas with the general long distance system of the United States. The longest telephone circuit in the world would be Bar Harbor, Me., to Galveston, Tex., 2,738 miles.

TOLL LINE SUMMARY.

Circuits.		Pole Miles.	Copper Wire Miles.	Iron Wire Miles.
60	Northwestern Telephone Exch. Co.	1,452	4,398	656
74	Southwestern Teleg. & Teleph. Co.	2,102	5,418	1,040
134	Total	3,554	9,816	1,696
	Miles iron wire		1,696	
	Total miles wire		11,512	

Grand total number of miles of wire in operation December 31, 1896 42,032

As follows:

	Underground.	Aerial.	Toll.	Total.
The Cleveland Telephone Co.	7,395	6,588	195	14,178
The Northwestern Telephone Ex. Co.	3,863	5,573	5,054	14,490
The Southwestern Teleg. & Telep. Co.	550	6,356	6,458	13,364
Total	11,808	18,517	11,707	42,032

Extensions.—To establish ample facilities in the Northwestern and Southwestern sections for the large and increasing toll business, and to reach important points demanding service, it will be necessary to build within the next eighteen months 842 miles of pole line and 3,982 miles of wire. We estimate of the total expenditure for extensions of the plant and real estate for the year 1897 will be as follows:

For New Construction	$500,000.00
For Real Estate	200,000.00
Total	$700,000.00

Funds.—To provide funds for the future growth of the business, the capital stock of the Cleveland, the Northwestern and the Southwestern companies is increased from time to time as the work progresses, the American Bell Telephone Company taking and paying for their pro rata of the increase, at par, with this company. For this purpose, to December 31, 1896, the number of shares sold in each company has been as follows:

	Shares.	Par Value.
The Cleveland Telephone Company	9,000	$900,000.00
The Northwestern Telephone Exchange Co.	21,429	1,071,450.00
The Southwestern Telegraph & Telephone Co.	10,000	1,000,000.00
Total	40,429	$2,971,450.00

To enable the Erie Telegraph and Telephone Company to take its proportion of new stock issued to date and that that may be issued in the future, you have authorized an issue of four million 5 per cent. bonds, payable in 1926. All of the bonds have been sold, to be delivered as the company may require funds. One million of this issue has already been delivered, making the total outstanding indebtedness $2,243,000.00

THE SUB-COMPANIES HAVE NO OUTSTANDING INDEBTEDNESS.

I can conservatively say that the affairs of the various corporations are in good hands throughout, that we may look forward for continued prosperity in every section of the territory.

For the Directors,
LEVI SPRAGUE, President.
Lowell, Mass., U. S. A., January 29, 1897.

The Electrical Engineer.

Vol. XXIII. MAY 26, 1897. No. 473.

ELECTRIC LIGHTING

THE VILES ELECTRIC LIGHT AND POWER PLANT, MIDDLESEX, VERMONT.

THE stimulus which has been given to the development and utilization of water powers by the introduction of electric transmission methods is becoming more and more pronounced as time passes. Water falls that had been entirely neglected in the past are now being developed on all sides and electric machinery is called in to aid in bringing the energy to the place where it can be utilized profitably.

A little over a year ago, Mr. J. S. Viles, proprietor of the Pavillion Hotel, and one of the most enterprising citizens of Montpelier, Vt., recognizing the fact that the Winooski River afforded a source of power, began the development of a power site at Middlesex, a point on the river about six miles from Montpelier. The Winooski River drains a water shed of 600 square miles and it was estimated that about 2,500 horse power could be counted on for the average throughout the year.

The operators began by the construction of a dam 35 feet high and 148 feet long, built in the shape of a V with the tip of the angle pointing down stream. The overflow or mill pond caused by the erection of the dam is the old river bed and runs back about two miles, the dam itself being at the end of a canal 600 feet long, built to change the course of the river, which was found to be necessary. Besides the main dams there are two side dams by which the water may be emptied out of the canal in case of need.

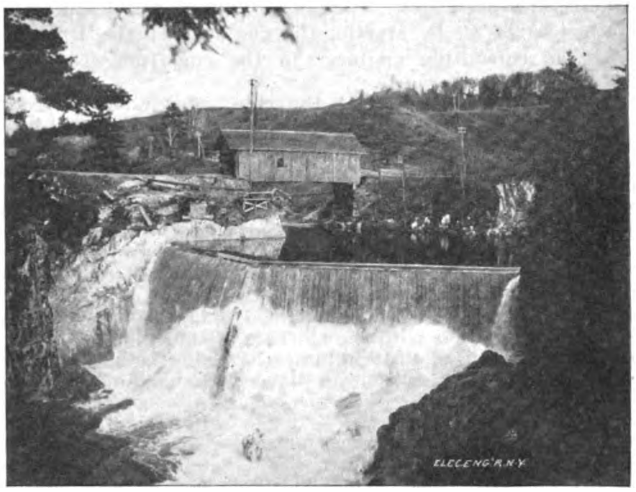
THE VILES WATER POWER TRANSMISSION PLANT, MIDDLESEX, VT.

The main building, illustrated in the accompanying engraving, is 104 feet long by 35 feet wide, with a lean-to wheel house of the same size. The water is led to the wheel house through two penstocks, 8 feet and 13 feet in diameter, respectively, and 175 feet long, with shells of one-quarter-inch boiler iron. These were built up on the site. In the wheel house there are erected three 42-inch Alcott special turbines, built by Messrs. T. C. Alcott & Co., of Mount Holly, N. J., each wheel being capable of delivering 750 horse power under a head of 48 feet. The draft tubes are 60 feet in length and give a vacuum of 21 inches.

The driving pulleys attached to the turbine shafts are 10 feet in diameter with 60-inch face; they run at 198 r. p. m., and belt direct to the line shaft which is driven at 350 feet per minute.

From the latter there are driven at present two 150-kilowatt Westinghouse three-phase alternators at a potential of 2,500 volts, and two exciters of 7½ horse power each running at 125 volts.

The switchboard is of the Westinghouse standard type, of marble, arranged so that either dynamo can be connected to any circuit. The potential is regulated by a Chapman voltage controller arranged with double-pole, double-throw switch, so that it can be connected to either generator. Running in front of all the dynamos and the switchboard is a heavy rubber mat for the attendants to stand on, thus affording immunity from accidental grounds.

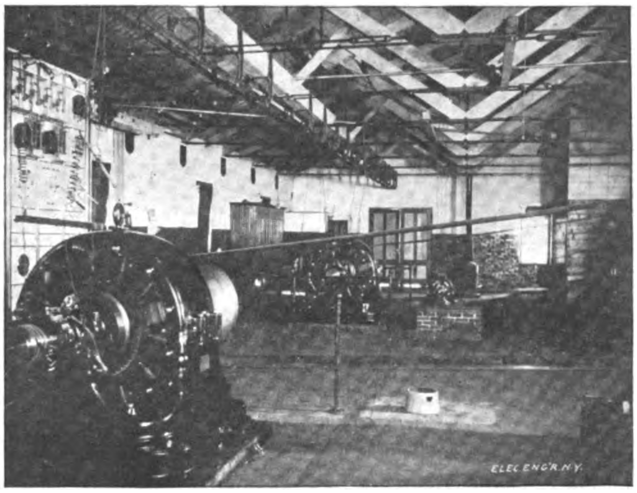


DAM OF MIDDLESEX, VT., WATER POWER TRANSMISSION PLANT.

The transformers are situated in the frame building shown in the engraving, which contains three 50-kilowatt Westinghouse transformers, with room for six more. The circuits are provided with Wurts lightning arresters with choking coils.

At present a circuit of No. 4 wires carries current at 2,500 volts to Montpelier, and another, of No. 6 wire to Barrie, at 5,500 volts, for the time being, which will be raised to 10,000 volts when the load increases. The step-up transformers are oil insulated. Porcelain insulators are employed on the line.

The distance to Barrie is 13 miles and with a motor load of 200 horse power there is a drop of 9 per cent. in the line. The motors are of the Westinghouse three-phase type, without brushes, and range from 1 to 20 horse power capacity. Besides these the station supplies about 3,000 incandescent lamps.



INTERIOR OF MIDDLESEX, VT., WATER POWER TRANSMISSION PLANT.

The plant is in charge of Superintendent E. A. Earle, and has been in continuous operation without interruption since April, 1896. The management has it in contemplation to put in a 150-kilowatt railway generator and storage batteries,

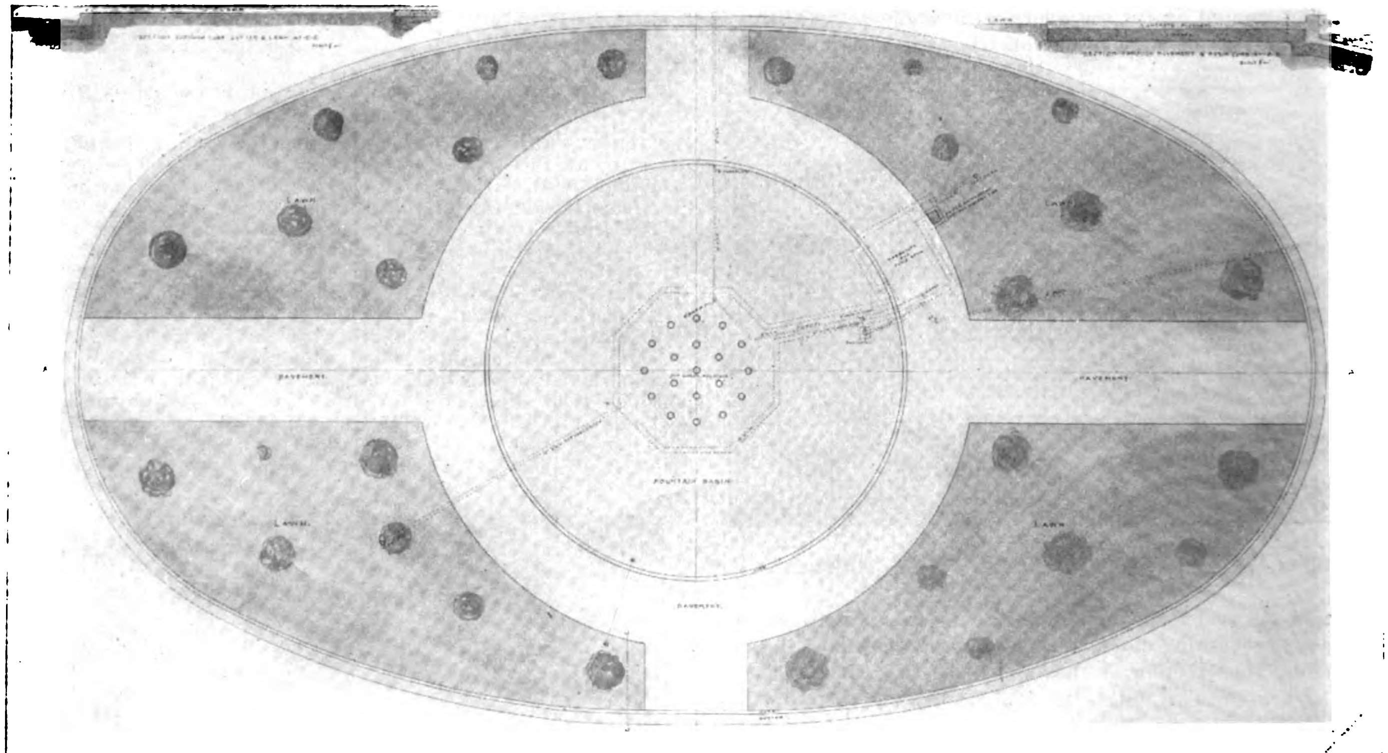
AN ELECTRIC FOUNTAIN FOR BROOKLYN, N. Y.

PARK COMMISSIONER DETTMER of Brooklyn, N. Y., has awarded a contract for the construction of an electric fountain in the park plaza to the Wilson & Baillie Manufacturing Company. The contract price is $24,500, and for this sum the company agrees to provide a fountain in complete working order and to operate it for one month to demonstrate its perfection before the final payment is made. The plans for this fountain were designed by F. W. Darlington of Philadelphia, who has constructed several fountains of a similar character in other cities. The park commissioner has secured the services of C. C. Martin, the engineer of the Brooklyn Bridge, as consulting engineer in the construction of this fountain.

The contract provides that the contractor shall take the plaza as it exists to-day and erect a fountain which will have a capacity of throwing 100,000 gallons of water per hour, and that the current required will approximate less than 100 h. p. This amount of electricity is to be furnished free of cost to the city by the Brooklyn Heights and the Nassau companies, which have entered into an agreement with the park commissioner, each to supply one-half of the current required.

The circumference of the basin will be 370 feet and will be constructed of kosmocrete. Under the center of this basin will be a pit in which will be placed a large portion of the machinery connected with the shifting of the colored plates of glass which are used to illuminate the rising columns of water. Leading from this pit to a place at the edge of the fountain basin will be a tunnel which will connect the pit with the operating room, where the person in charge of the fountain will stand, looking out of a window six inches above the water, thus enabling him to see the various combinations which his manipulation of the machinery will produce.

The electrical apparatus consists of nineteen automatic focusing arc lamps, connected in three series. Each lamp will be of 6,000 candle-power, mounted on an adjustable stand, which permits of its being raised from four to six feet from the floor of the pit, and thus providing different angles at which the light may be thrown upon the ascending water. Three rheostats are to be furnished, one for each series of lamps, and each lamp is to be provided with large silver parabolic reflectors. The colored glass is to be operated by compressed air and controlled by electricity. There will be eighty incandescent lights ranged about the wall of the basin. The combinations possible by this arrangement of pipes and lights are innumerable. They will consist of fancy jets, umbrellas, ball sprays, straight sprays, wheat sheaves, rings, fans, funnels and combination jets. One curious display that can be given at the fountain is the throwing of a wide sheet of spray upon which pictures may be displayed. The first exhibition to be given at the fountain will be on July 4, if the contractor completes his work within the required time.



PLAZA AT PROSPECT PARK, BROOKLYN, N. Y., ARRANGED FOR DARLINGTON'S ELECTRIC FOUNTAIN.

ARTIFICIAL LIGHT; MODERN METHODS COMPARED—ELECTRIC-INCANDESCENT, WELSBACH, ACETYLENE.—II.

(Concluded.)

BY PROF. D. S. JACOBUS.

IN the Pictet works, in Paris, acetylene is compressed in steel cylinders that have previously been tested to 250 atmospheres. A short time ago a cylinder of this description, of large capacity, exploded at the Pictet works, killing two workmen and injuring another. The two men were torn to pieces, and a part of the works was blown down.

There is another case on record where a cylinder of acetylene, fitted up to light a dwelling house, exploded and seriously injured a tinman and his laborer, who were at work upon the premises.

An explosion of liquid acetylene, resulting in the death of four persons, took place in a Berlin suburb some time in last December. This explosion occurred at the time when a chemist named Isaac, who had for some time experimented with acetylene with a view of depriving it of its dangerous qualities, was preparing an exhibition of the results of his experiments, a record of which was to be presented to the German Emperor. The use of acetylene is prohibited in Germany, owing to its explosive character, and it was to deprive it of its dangerous qualities that Mr. Isaac made his experiments, and thereby met his death.

By an explosion of a cylinder of liquid acetylene at New Haven, in January, 1896, three persons were killed and four injured. The explosion occurred while experiments were being made on a regulator to reduce the pressure in the tanks to that required at the burners.

An explosion occurred in Jersey City about one year ago, when it was attempted to generate the gas from the carbide under pressure. This shattered the roof of the building, the apparatus being in the upper story, and demolished the wood work in the neighborhood of the generator; but fortunately no one was near enough to the generator at the time of the explosion to be seriously injured.

All the above explosions are cases in which the acetylene was under pressure, and exploded in the same way as ordinary dynamite or gunpowder; that is, by the decomposition of its own elements without the aid of the oxygen of the air. There have been accidents, however, where it is probable that the explosions were caused by the mixture of air with the acetylene.

For example, an accident took place at Lyons a few months ago, in a café lighted by acetylene generated on the premises. The explosion produced much damage and killed two persons.

Another explosion, or, perhaps, it might be called a case of accidental ignition of the gas, occurred in Jersey City last January. The liquid acetylene was being blown from a tank into a felt bag, in order to obtain solidified acetylene, or snow, in the same way that snow may be obtained from carbonic acid. An explosion of the escaping gas occurred, which set fire to the mass of solidified acetylene. One of the workmen was severely burned about the face and hands.

In view of the above practical demonstration of the danger of acetylene gas under pressure, it would seem unwise to use it in that way; and even when generated on the premises at atmospheric pressure great precautions should be employed to prevent explosion, on account of the admixture of air.

RELATIVE COSTS FOR EQUAL ILLUMINATION.

The costs per hour for a production of 16 candle-power of light, in the city of New York, are shown in Table II:

TABLE II.

		Cents.
Incandescent electric light at 1 per cent per lamp hour		1.0
Illuminating water gas.	Ordinary burner, 4 cubic feet, at $1.25 per 1,000 cubic feet.	0.5
	Welsbach burner, 1.14 cubic feet at $1.25 per 1,000 cubic feet	0.17
Acetylene employed for Municipal distribution.	Calcium carbide, furnished to gas company and converted into gas for $40 per ton*	0.5
	Calcium carbide, furnished to gas company and converted into gas for $19.50 per ton†	0.17

* To replace flat-flame burners.
† To replace Welsbach, cost of replacing mantles of Welsbach lamps included in the estimate.

The price at which calcium carbide would have to be furnished for domestic lighting, to be as economical as kerosene oil at 8 cents per gallon, is $45 per ton. The compressed liquid acetylene would have to be furnished for 6½ cents per pound to be as economical as kerosene.

It will be seen from Table II. that to compete with an ordinary illuminating water gas selling at $1.25 per 1,000 feet in municipal distribution, the carbide would have to be furnished to the gas company and converted into gas for $40 per ton, to net the gas company the same profit, and to be as economical to the consumer as the ordinary illuminating gas burned in the flat-flame burner. To be as economical to the consumers as ordinary gas burned in Welsbach burners, it would have to be furnished to the gas companies and converted into gas for $19.50 per ton.

It is further shown that, to be as cheap as kerosene in domestic lighting the carbide would have to be supplied to the consumer at $45 per ton, and the compressed liquid acetylene would have to be supplied at 6½ cents per pound.

The figure for the Welsbach burner in Table II. is obtained by adding to the cost of the gas 0.03 cent per hour per 16 candle-power to replace mantles, which are assumed to cost 50 cents, and last 500 hours on a lamp furnishing 50 candle-power. The difference in cost in favor of the Welsbach will disappear to a great extent in practice; for if ordinary gas burners are replaced by the Welsbach, the total amount of illumination, as a rule, becomes greater, and if three times as much, the cost of gas to the consumer per month would be the same with the Welsbach as with the ordinary gas burners.

The figures for the acetylene are obtained in the following way:

Assume a plant which is furnishing an illuminating water gas at $1.25 per 1,000 cubic feet. If this plant were converted into a plant to furnish acetylene gas, there are certain expenses, such as the cost for distribution, including the maintenance of the plant, collection of bills, office expenses, etc., that would remain about the same per day for the acetylene as for the water gas. These constant expenses would practically be all other expenses, except those involved in making the gas and storing it in the holder. To simplify matters, let us consider a plant of any given capacity, say 500,000 cubic feet of gas per day. Then we have:

Paid by consumers per day, 500,000 cubic feet, at $1.25 per 1,000 cubic feet	$625.00
Cost of gas in holder, at 40 cents per 1,000 cubic feet*	200.00
Constant expenses per day, together with profit of gas company	$425.00

To furnish the consumers with the same amount of light that they obtained with the flat-flame burners and the ordinary illuminating gas, would require one-tenth the volume of acetylene, hence one-tenth of 500,000, or 50,000 cubic feet of acetylene would have to be stored in the holder for $200, in order that there should be the same profit to the gas company. This 50,000 cubic feet would be produced by 5 tons of calcium carbide; hence, the cost of 1 ton of calcium carbide, together with the cost of converting the carbide into gas, would be $40, to compete with ordinary gas at $1.25 per 1,000 cubic feet, burned in flat-flame burners.

To compete with ordinary gas burned in Welsbach burners, the amount of acetylene stored in the holders would be in the ratio of 70 to 200 to the amount of ordinary gas required for equal illumination; or, we would have to store 175,000 cubic feet in the holder for $200. In addition to this, the cost of the mantles replaced per day in the Welsbach lamps should be included, which would be $140, making a total of $340. To produce the 175,000 cubic feet would require 17.5 tons of calcium carbide, and it would have to be furnished at the gas works and converted into gas at about $19.50 per ton.

It may be claimed that to replace ordinary gas in an existing plant by acetylene would be making use of a plant much too cumbersome for the purpose, and that the interest on capital investment and depreciation would count more heavily against the acetylene than in a plant specially constructed for the purpose. On the other hand, in a plant specially constructed for acetylene, the system of mains for transmission of the gas would have to be laid with much more care than for ordinary illuminating gas, and special piping might have to be used, so that the capital investment of a specially constructed acetylene gas plant might be as much or more than for one furnishing ordinary illuminating gas.

If one-tenth as much acetylene were used for a given illumination as with the ordinary gas, then, if transmitted through the same system of pipes, the percentage of leakage, based on the amount of gas used by the consumers, would be increased about tenfold; or, if the percentage of leakage in a system had been 5 per cent. with ordinary gas, it would be about 50 per cent. with acetylene, of the gas used by the consumers, or 33 per cent. of the gas stored in the holder.

The system of piping now in place for ordinary illuminating gas would not, therefore, be suitable for the transmission of acetylene gas. If special pipes were laid for the acetylene gas they would be required to carry a less volume of gas for a given illumination, and could be made smaller, but it is probable that the care required to produce tight joints would make it just as expensive to lay them as to lay the pipes for ordinary illuminating gas.

Let us next consider the price calcium carbide must be sold at to take the place of kerosene in domestic lighting, where the gas is generated on the premises. Assume that the cost of labor to charge the gas generator, and depreciation of the plant, is equal to the cost of labor to fill and repair the oil lamps; then we have to compare the cost of the carbide with the cost of kerosene oil required to produce an equal illumination. It was found by my own experiments that to produce 16 candle-power in an argand, or in a good flat flame lamp required about 0.002 gallon of oil per hour. At 8 cents per gallon this would cost 0.18 cent. To produce 16 candle-power with acetylene requires 0.4 cubic feet of gas per hour, so that 0.4 cubic feet would have to be produced for 0.18 cent, or 10,000 cubic feet for $45. Hence, the carbide would have to be purchased for $45 per ton to be as cheap for equal illumination as kerosene oil. As one pound of the compressed liquid acetylene produces about 14½ cubic feet of gas, it would have to be sold for 6½ cents per pound to be as cheap for a given candle-power of light as kerosene.

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* The cost of gas stored in the holder is less than 40 cents per 1,000 cubic feet in many large plants, and the price that the gas companies could afford to pay for the carbide would be proportionally reduced. For example, if the gas were stored in the holder for 30 cents per 1,000 cubic feet, the carbide would have to be furnished to the gas company and converted into gas for $30 per ton, to be as cheap as ordinary gas burned in flat-flame burners.

In some of the earlier literature on acetylene it was proposed to convert electric lighting plants into plants for the production of acetylene, and thus obtain economic results. This could not be done economically, for only about one-half as much light could be obtained from the acetylene as by using the electricity direct for incandescent lights. The results obtained at Spray show that 2 cubic feet of acetylene gas could be produced per hour per electrical horse-power. This would furnish $2 \times 40 = 80$ candle-power. If the electricity were used direct with incandescent lamps requiring 4½ watts per candle-power, the light produced would be $746 \div 4.5 = 166$ candle-power per electrical horse-power, or about twice as great a light as would be produced by the acetylene, as has already been stated.

To be as cheap an illuminant as electricity, therefore, the carbide must be made at some point, say, a water-power, where the cost of the power and attendance is much less than at the lighting station.

It has been shown that for an equal illumination the electric incandescent light costs twice as much as gas when the latter is burned in flat-flame burners. The incandescent electric light has, however, held its own against the gas light on account of its superior qualities, which are its brilliancy, cleanliness and adaptability. The electric light is also preferable on account of the fact that it does not vitiate the atmosphere with carbonic acid gas, and that it produces a less heating effect than ordinary illuminating gas. It also eliminates the danger of asphyxiation through an accidental leakage of gas. That the incandescent electric light has held its own at a higher cost to the consumer for a given candle-power, is a proof that other elements enter into the problem of artificial lighting as strongly as the cost of a given amount of light. From this standpoint, it may be argued that acetylene, producing as it does a more brilliant light than any now used for interior lighting, and having the quality of showing the complexion in life-like tints, will have its own field, even should it be the most costly style of illumination.

Again, acetylene is now used in place of the calcium light for lantern projections, etc. Were it not for the explosive character of the compressed acetylene, it would be useful for cases of isolated lighting, such as for beacons and light-buoys.

It has also been shown that the Welsbach lamp produces about three times the illumination for a given cost as ordinary illuminating gas burned in a flat-flame burner, but that it is deficient in showing the complexion in life-like tints. For most classes of work, this defect is not of great enough importance to outweigh the advantage derived from its great economy.

The whole situation may be summed up by saying that each system of lighting has its own field of usefulness, on account of properties peculiar to itself, which make it more desirable than the others for certain classes of work.

CURRENT BOILER PRICES FOR LARGE ELECTRICAL PLANTS.

OUR Washington correspondent sends us the following account of the bids for boilers received by the United States Electric Lighting Co., of Washington, D. C. The bids were opened publicly on May 5.

The specifications called for six boilers of 3,000 square feet of effective heating surface each, erected complete, including all mason work, and ready for all connections. The following are the bids submitted by the different competing companies:

Abendroth & Root Mfg. Co., for six boilers, each having a rating of 288 h. p., equipped for hand firing, $24,448; equipped with American stoker, $29,448; equipped with Hawley down draft furnace, $30,948; equipped with Roney stoker, $30,508; equipped with Acme stoker, $30,948.

The Babcock & Wilcox Co. submitted bids for six boilers, having a total heating surface of 18,126 square feet, equipped for hand firing, $17,452. For the addition of the following named stokers and furnaces, add the following amounts: For Hawley down draft furnace, $1,375 each; Babcock & Wilcox chain grate, add for six boilers, $9,060; for total equipment with Roney stokers, add $6,360; for total equipment with Murphy stokers, add $7,350. These bids include steel heater construction.

Messrs. Thayer & Co. submitted bids and specifications for six boilers of the Babcock & Wilcox type, containing a total of 17,857 square feet. These boilers were to be equipped with their flowed steel headers. For equipment for hand stoking, the bid for six boilers was $20,000. If equipped with Hawley down draft furnace add $1,375 per boiler. If equipped with Acme stoker, add $6,500 for six boilers. If equipped with Roney stoker, add $6,060 for six boilers. This company stated further that a deduction of $500 would be allowed for furnace fronts and grates in case any of the above stokers were used.

Messrs. Thayer & Co. also submitted a bid for six Cahall vertical boilers, erected complete, including a separate stack for each boiler. Their bid for these boilers was $20,000, and in case stokers were to be used in connection with these boilers, $500 was to be deducted from the above price for fronts, etc. This company made a guarantee when using George's Creek coke, containing not less than 13,000 B. T. U. per pound, with boilers operating within 25 per cent. above their rated capacity and efficiency of 70 per cent., and when the boilers were being crowded to 75 per cent. above their rating they would develop 60 per cent. efficiency.

The Heine Boiler Co. submitted a bid for six boilers, each having 3,048 square feet of heating surface when equipped for hand firing, $23,900. These boilers when equipped with Hawley down draft furnace, add $8,190 to the above figure. When equipped with Roney stoker, add $6,000 to the above figure. When equipped with Acme stoker, add $6,440 to the above figure.

The Campbell & Zell Co. submitted a bid on six boilers to conform to the requirements of specifications, equipped for hand firing, $24,102.93; when equipped with Murphy stoker, $31,410.93; when equipped with Acme stoker, $31,089.93; when equipped with Roney stoker, $30,591.93; when equipped with Hawley down draft furnace, $32,891.93.

The Edgemoor Boiler Co. submitted a bid on six boilers, each containing 3,008 square feet of heating surface, when equipped for hand stoking, $25,000; when equipped with Acme stoker, $30,094; when equipped with American stoker, $30,844; when equipped with Hawley down draft furnace with extension front, $32,872; when equipped with Hawley down draft furnace with flush front, $31,554; when equipped with Murphy stoker, $31,120; when equipped with Roney stoker, $30,674; when equipped with Vicar's stoker, $30,204; when equipped with Wilkinson stoker, $29,100.

Gill Boiler Co. submitted a bid on six boilers, each having a rated capacity of 300 h. p., for $19,500, when equipped for hand firing. No mention was made of addition of stokers in this bid.

National Boiler Co. bid on six boilers, having a total rated capacity of 1,800 h. p., when equipped for hand stoking, $18,200. In case steel cast headers were required, add $3,925 to this figure. When equipped with Murphy furnaces, add, for six boilers, $6,750; when equipped with Roney furnace add $6,060; when equipped with Wilkinson stoker add $6,000.

The Phoenix Iron Works submitted a bid for eight boilers, presumably of the shell type, each having a rated capacity of 250 h. p. These boilers, when equipped with Vicar's stokers, $40,000.

The Columbian Steam Boiler Co. submitted a bid for six boilers, each containing 3,000 square feet of heating surface, equipped for hand firing, $27,000. No bids were made for addition of stokers.

The Clonbrock Boiler Co., manufacturing the Climax boiler, submitted a bid for six boilers, each having a rated capacity of 300 h. p., for $21,600. No stokers were mentioned in connection with this bid, the above figure being for hand firing.

The Caldwell Boiler Co. submitted a bid for six boilers, each having a rated capacity of 270 h. p., when equipped for hand firing, $18,820; when equipped with Murphy stoker, $26,170; when equipped with Roney stoker, $25,930; when equipped with Hawley down draft furnace, $27,070.

The Geary Boiler Co. submitted bid on six boilers, having a total of 18,000 square feet of heating surface, when equipped for hand firing, $24,300; when equipped with Hawley down draft furnace, $32,550; when equipped with Acme furnace, $31,000; when equipped with Wilkinson stoker, $30,500.

The Stirling Boiler Co. submitted bids on two different kinds of boilers, one of which they termed a No. 1 boiler, and the other was termed a No. 2 boiler. Each kind of boiler contained a total of 18,000 square feet of heating surface, and when equipped for hand stoking, the No. 1 boiler was submitted for $17,925; No. 2 boiler for $18,000. The Meisner stoker was offered with these boilers at an additional cost of $14,400 for the six boilers.

Robert Wetherill submitted a bid for seven Berry boilers, having a total of 18,000 square feet of heating surface, for $24,500. No mention of stoker was made in connection with this bid.

"We prize your paper very much, and feel that you have a great future. We also consider your articles very authentic. The feature of your Data Sheets alone has been a sufficient argument to place the advantages of your paper over other periodicals printed for people seeking knowledge." Northwest Electric Engineering Company, Portland, Ore.

ELECTRIC TRANSPORTATION

THE K. A. K. ELECTRIC SYSTEMS FOR STREET, ELEVATED AND TRUNK LINE RAILWAYS.

FOR the past year and a half there has been in practical operation at Springfield, O., a section of railroad equipped with the K. A. K. conduit system, which has given very good results.

The engraving, Fig. 1, shows a section of this line with a portion of the top removed with the trolley or contact plow lying at the side. Figs. 2, 3 and 4 show additional details of construction by which such an insulation resistance has been attained, that the leakage current for several hundred feet of conduit did not exceed .004 ampere.

Fig. 2 shows the detail of the conduit with the electrical equipment installed, demonstrating the ease with which the electric system could be introduced into a cable conduit. A is a cast iron yoke, in this case fitted with metal ties which support the track rails. B B are substantial insulators of special construction which support the iron pipes, C C, on the yokes, in which the insulated auxiliary feed wires D D are laid and which act as a support as well as a protection to them. The couplings for the pipe are so constructed as to also form a support for the conductor rails E E by means of the insulators F F. It will be seen that the feeders and conductor rails are both doubly insulated, making four heavy insulations through which the current must pass to form a short circuit; hence the slight leakage shown in the test above alluded to.

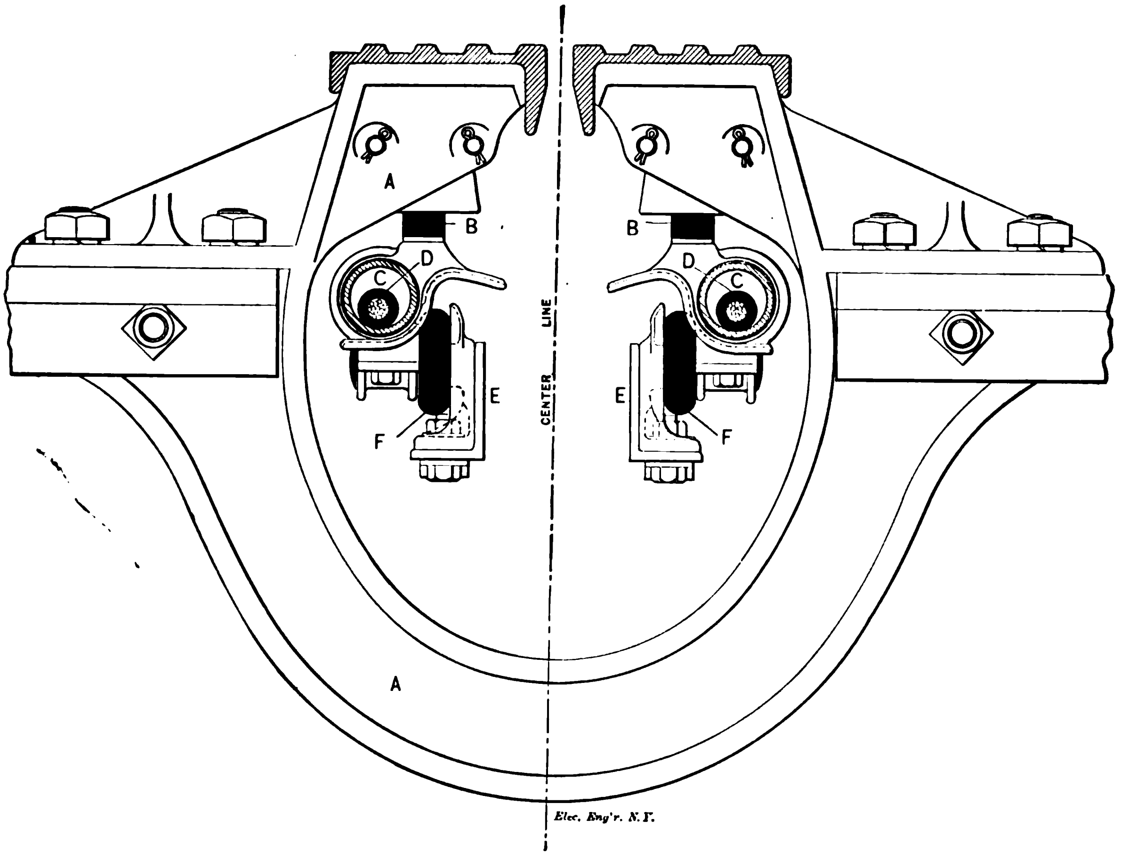


FIG. 2.—SECTION OF K. A. K. RAILWAY CONDUIT SYSTEM.

The conductor rails are of angle steel and are in sections of convenient length, say, 300 feet, and connected to the auxiliary feeders by fuses and plugs, as shown in Fig. 3. In case a short circuit should occur at any point the fuse would be blown on that section only, leaving all the remainder of the line in good working order, so that the ground would be quickly located and trouble easily repaired. At the end of the sections where the fuses are attached, the auxiliary feeders are deflected from the conductor rails, for safety, as shown in Fig. 3, manholes being provided for this purpose. Where there is a heavy traffic to provide for on a long line of road the main feeders can carry a current of 5,000 or 10,000 volts and at suitable distances by means of rotary transformers supply the auxiliary feeders D D at 650 volts.

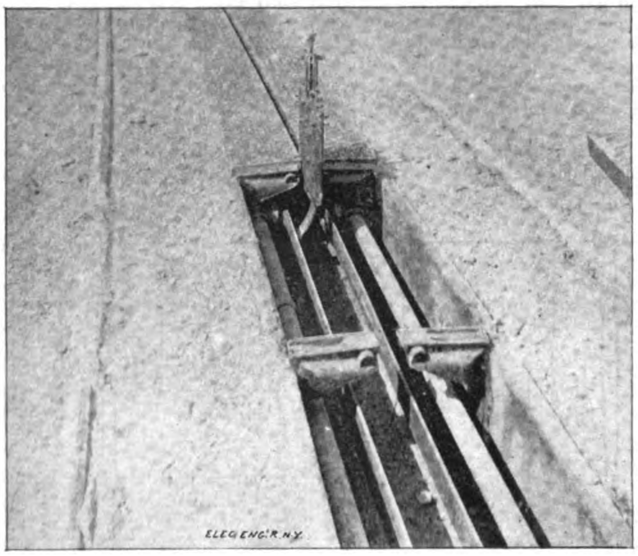


FIG. 1.—SECTION OF K. A. K. RAILWAY CONDUIT.

Fig. 4 shows a side and sectional view of a plow or contact device which can be made single or double, as required. A contact shoe, G, is supported on a spring H, which is so supported in the post I that it can be raised or lowered; and as seen in the sectional view, when raised, the shoe comes within the lines of the post, so that the whole can be lifted from the slot at any point along the line, making it possible to equip suburban cars having overhead trolleys, to be run over the conduit lines also, and where desired provision is made so that this change can be made without stopping the motion of the car. It will be noticed a heavy insulation of fiber or other suitable material is used in the post, and that is protected by hardened steel plates, so that the liability to short circuiting in the contacts is reduced to a minimum. It has already been fully demonstrated that electrical equipment possesses so great an advantage over steam in economy of motive power on elevated and surface railways, that to meet such conditions of traffic the K. A. K. third-rail system has been devised which is claimed to eliminate the two most serious obstacles in the way of equipping all roads now using steam power with electricity. These obstacles are the danger to life from an exposed third-rail conductor and the delays in traffic occasioned by sleet and snow in the use of the unprotected third rail. Our illustration, Fig. 5, shows a model section of the K. A. K. covered third rail, with the cover partly removed, showing an angle rail conductor A supported on posts S which are sustained in place, on the ends of the ties outside the track-rail by the cast iron sockets spiked to the ties the same as the track rails. A flange on the under side of the sockets fits into a groove in the ties; this groove is uniformly cut by gauge with the track rail so that ordinary trackmen can construct the line without mistake and do it accurately. The rail has the same capacity for carrying the current as other forms of third rail in use while the wooden cover C over the top and at the back of the post supports protect the rail in every way, at the same time keeping the posts (which are first treated by boiling in oil) dry and thus making them good insulators.

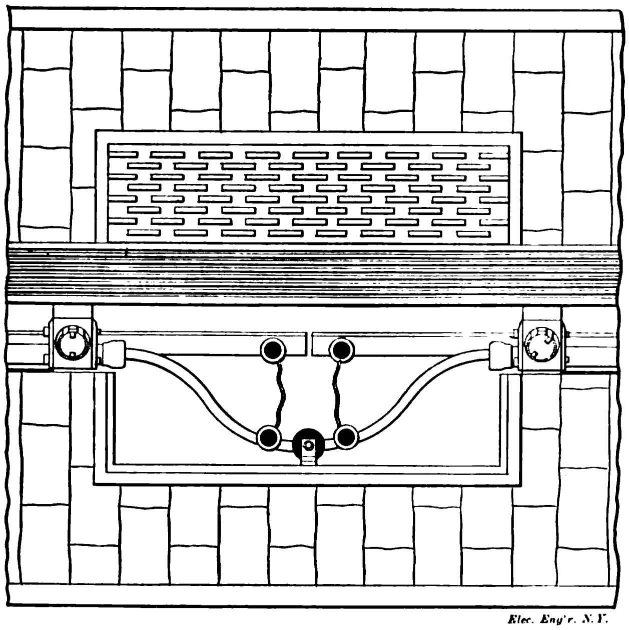


FIG. 3.—CUT-OUT BOX IN K. A. K. RAILWAY CONDUIT SYSTEM.

The contact shoe shown in Fig. 5 is supported from the truck of the car, by means of a spring and comes in sliding contact with the under and inner surfaces of the angle rail conductor, giving a good contact with any pressure desired.

At crossings or switches the covered third rail is cut out and the train passes over by coasting, or all the trucks of all the cars can be provided with contact shoes, so that those in the rear are in contact while those in front are making the crossing or switch.

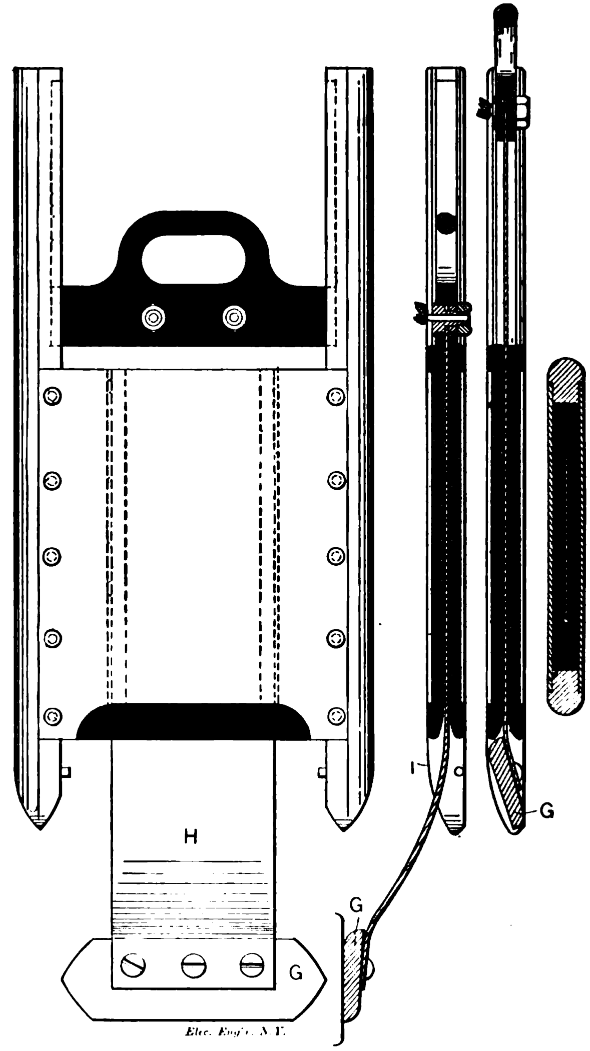


FIG. 4.—CONTACT SHOE OF K. A. K. RAILWAY CONDUIT SYSTEM.

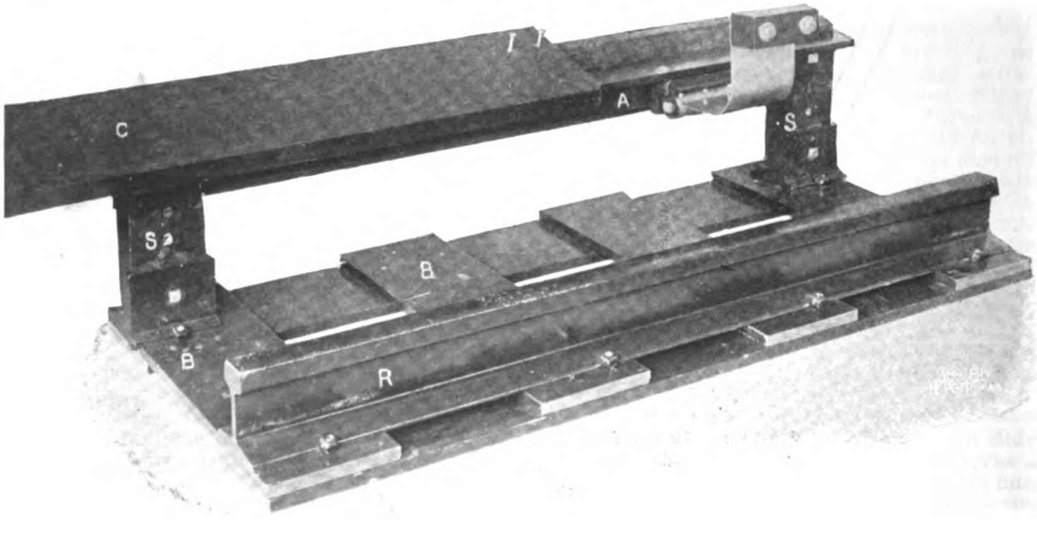


FIG. 5.—THE K. A. K. THIRD RAIL CONDUCTOR SYSTEM.

The K. A. K. systems, on conduit and covered third rail, are owned and controlled by the Hon. O. S. Kelly and A. S. Krotz, of Springfield, O., and W. P. Allen, of Chicago, and negotiations are now pending for their introduction on a number of roads.

HEATING OF ARMATURES.

BY GEORGE MOFFAT.

WHILE an armature has been defined as a bundle of wires cutting magnetic lines, with suitable connections for carrying off the induced current, it is this "bundle of wires" which is the vital part of our electric systems to-day and has given more trouble and study than all the rest of the system combined.

The working capacity of armatures may be said to be limited by two things, sparking at the brushes and heating of the armature itself. Of these the heating of the armature has been found the more troublesome of the two on account of the difficulty in overcoming it. To stop sparking at brushes, unless a structural defect, is much easier accomplished. Besides the element of risk accompanying undue heating we have a large waste of power, and power means money.

Fig. 1 is a diagram showing the waste in watts for different ranges of temperature in an armature carrying 2,000 amperes, tested by the writer. At the higher temperatures the power lost is surprising. The same machine showed a rise of 176 degs. Fahr. above surrounding temperature; it is with this rise that the diagram in Fig. 2 is plotted out to show the waste as the output of the machine is increased. There will also be increased permeability with increased temperature and as the machine tends to lose its load, if working in parallel, the attendant will in the majority of cases cut out resistance, thus making a machine carry the brunt of the load when it is least able to do so.

The cause of undue heating may be traced to any or all of the following: Hysteresis, eddy currents, insufficient ventilation, heating of the conductors themselves and in a few cases the friction of the brushes. That due to hysteresis is of course due to grade of iron and is purely a structural defect for which there is no excuse whatever; the only remedy being to use a good grade of soft iron.

Eddy currents are not so easily disposed of. Their wasteful nature and causes giving rise to the same are well understood by manufacturers of electrical machinery generally, who all claim to have overcome them. The well-known laminated core is adopted by all with laminations in direction of magnetization, so that the magnetic continuity may not be broken, and with varnish, paper, enamel or some other like insulating material used about every 10 or 12 laminations. With all these precautions eddy currents are mainly responsible for heat in the core.

Should metal supports of armature constitute closed circuits there will be wasteful currents contributing towards this injurious heating. Insulated tie-bolts are giving way to the much solider "harveyized" bolt in which there is no insulation to char and loosen.

As is well known it is at the periphery that the insulation is most needed on the discs; it is there also that it is the weakest. After being assembled the core is generally trued up, sometimes with a file and by others in a lathe. In either case the result is the same; the tools burr the edges until it is practically a solid mass.

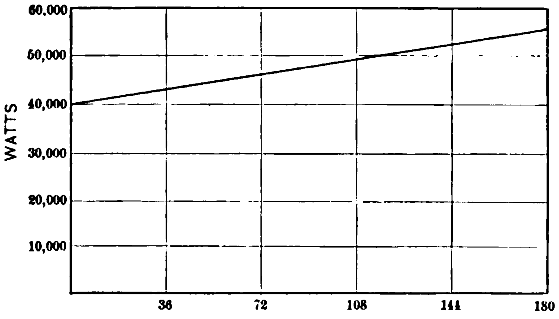


FIG. 1.—LOSS FOR DIFFERENT RANGES OF TEMPERATURE IN AN ARMATURE, LOAD 2,000 AMPERES.

In the machine referred to above, which had a rise in temperature of 176 degs. Fahr., the insulation could not, of course, last. One morning there was a pyrotechnic display and an armature to rewind. Before rewinding the engineer loosened up the bolts and made generous use of varnish on the discs. After the machine was started the improvement was startling; temperature dropped to about one-half for the same load.

Other machines in process of construction were treated likewise and with the same result.

If the ventilation is thorough and there are large radiating surfaces the heating from eddy currents will be greatly alleviated, but still there remains the loss of power. One abominable practice is that of putting canvas heads over winding. There was some excuse a few years ago for doing this—to hide poor workmanship—but now it should be religiously shunned. Immediately after a dynamo has stopped its temperature will rise as the fanning effect due to rotation of armature has ceased. This fact was accepted by one maker as a gentle hint for a remedy for his hot armatures. He at once put on his machine, back of armature and fastened on shaft, a set of sheet iron wind mill blades to blow a current of air through interior of the machine—a warning to all men to have nothing to do with that class of machines. The large, slow-speed spider armatures give the best result when ventilation alone is considered, as there is a greater surface exposed both of the iron and the conductors. But even with this it is simply the "cure" and not the "prevention" we have.

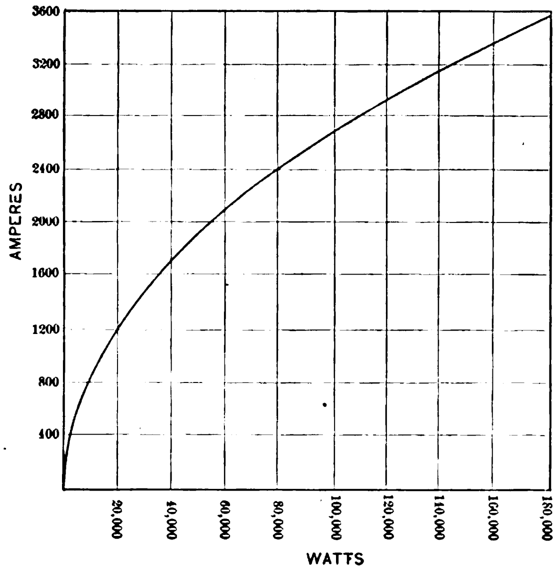


FIG. 2.—CURVE SHOWING LOSS OF POWER, IN AN EXCESSIVELY HEATED ARMATURE, FOR DIFFERENT LOADS.

Another fruitful source of trouble is the heating of the conductors themselves. The chief cause of this is working the machine beyond its true capacity—not its rated capacity—which may be very much higher. For a legitimate increase of temperature above that of the engine room 50 degs. Fahr. may be taken; for the highest permissible limit 90 degs. Fahr. is the maximum. The formula for calculating this, with 90 degs. as the maximum, is as follows:

$$\text{Maximum load-amperes} = 0.95\sqrt{\frac{S}{R}}:$$

In which S = number square inches surface of coils, and R = their resistance in ohms.

Even with this moderate increase of temperature the resistance is increased about 20 per cent. If a machine heats above this when running at its rated load its share of the work should be reduced until it comes within this limit.

In some machines tested it was necessary to reduce the load almost 50 per cent. before the above conditions were met with. The maker's guarantee that the machine's capacity is 100 per cent. above what is found safe will not bring back the power thus wasted.

The heating arising from the friction of brushes, if excessive, may be remedied by better brushes, springs no stronger than necessary to make perfect contact, a true commutator, and, if necessary, a little light bodied oil applied occasionally which will quicken the polish.

The main requisites for cool running would then seem to be, machines run at their true capacity, properly insulated, laminated cores and thorough ventilation.

PRESIDENT H. H. VREELAND, of the Metropolitan Street Railway Company, New York, states that the transfer system has reduced the average fare to 3.71 cents, and that more than 200 men are receiving an extra compensation of 25 cents a day because no complaint had been lodged against them by passengers or officers during the past year. The number is growing.

THE HISTORY OF A SAN FRANCISCO TROLLEY ROAD.

THE San Francisco and San Mateo Electric Railway, the first extensive line operated by electricity constructed in San Francisco, has been formally transferred to the purchasers under the foreclosure sale of a year ago. The time for redemption granted by the law to the original owners of the road expired over a week since. The road has, therefore, been at last rescued from its financial troubles, and it is now said that the new proprietors will expend some money in its improvement and development. Exactly when the work of reconstruction will begin is not stated; but from the fact that the enterprise can be made to pay handsomely upon the money now invested in it, it is reasonable to suppose that no time will be lost in putting it upon a sound mechanical basis.

The history of the San Francisco and San Mateo Electric Railway presents an interesting illustration of the vicissitudes of what the Populists call "corporation monopolies." The road was constructed primarily for the purpose of bringing certain lands in the outskirts of the city into the market. These lands were largely owned by Behrend Joost, who contributed in great part the money to build the road. A practical railway builder was brought out from the East, and the extensive trolley system which now operates the line was constructed. The work cast the corporation organized by Behrend Joost over a million and a half dollars. Joost is said to have contributed about $600,000 of this amount. The road was bonded for nearly or quite its full value and the bonds were sold extensively to local investors.

The boom period during which the railway line was conceived, however, subsided soon after its completion. The result was that sales of land fell off, and people did not appear to populate the real estate owned by Joost and his fellow land boomers. The road defaulted in its interest, a receiver was appointed and the bondholders began proceedings in foreclosure. The result of these proceedings show to what an enormous extent the value of the road shrunk between 1893 and 1895. The property sold by the sheriff brought $330,000, which included the rails, rolling stock and other equipments of the entire line. After deducting the receiver's fees, costs and attorneys' charges, there was left for the bondholders a dividend of just exactly 10 cents on the dollar. Those who invested one thousand dollars in the bonds of the road, had returned to them one hundred dollars.

A more complete financial wreck has rarely been seen, yet the road is a good property, and under first-class management can be made to pay. The trouble with it was that practical railroad men neither planned it at the beginning nor engaged in its management afterwards. There is no property so susceptible to bad management as railroad property. Wrecking a railroad is easier than wrecking a steamship, and it is well known that a captain can run the latter upon the rocks any dark night, and not suffer the loss of his certificate. However,; the San Francisco and San Mateo Electric Railway, now that its capital represents an expenditure of but little more than $300,000, ought to be made to pay a handsome dividend upon the investment. It is operated through a country which some time will support a dozen similar railways.—San Francisco "Post."

"HOG LANE"

At the meeting of the Somerset County (N. J.) Board of Freeholders, to consider the application of the New York and Philadelphia Traction Company, to be permitted to erect a bridge across the Raritan river at Bound Brook, for the purpose of laying a trolley line, the company asked that it be allowed to rest part of the structure on one side of the present bridge, in order to save the expense of an extra truss. Some of the members would not agree to that, but wanted to compel the company to erect an entirely separate bridge. Andrew Lane then arose and said that that would be too much like a story he had heard of two farmers who live near Bound Brook. Their farms join and it was necessary to erect a fence to divide the two properties. Ordinarily one farmer would have had to build half of the fence and the other the remainder. But they could not agree on the style of fence to be built, and the result was that two fences of different pattern were built, leaving a narrow space between. This strip is called "hog lane" in the surrounding neighborhood. "Now," said Mr. Lane, concluding, "we don't want any hog lane across the Raritan river."

The point struck the Freeholders forcibly and they unanimously agreed to give the company the grant they desired.

ELECTRIC ROAD FROM HOUSTON TO GALVESTON, TEX.

Engineer A. B. Blevins and party, now engaged in running the survey for the proposed Houston-Galveston Electric Railway, completed the survey from Seabrook to Dickinson bayou on April 20. The route as surveyed runs through the North Galveston tract lands a distance of about two miles and nearly parallels the Galveston, La Porte and Houston Railroad, being east of that line about half a mile. With the building of this road begins a new era in the matter of transportation in the State of Texas. This will be one of the largest roads of its kind in the United States, and it is the intention to make it one of the best. New York capitalists are said to be at the back of the enterprise, and a million and a half is in readiness awaiting the completion of the preliminary work. The building of this road means a rapid development of the country through which it passes; quick train service and low rates for both passengers and produce will make it a boon to farmers and city people alike. Of the three surveys the bay shore route stands a fair chance of acceptance. It is not difficult to understand why there are advantages to be gained in keeping near the water from Houston on down, as this entire strip is destined to be a great summer and winter resort as well.

MECHANICAL

THE PRINCIPLES AND CONSTRUCTION OF WATER WHEELS.—III.

BY W. E. WINES.

TURBINES are capable of using a large amount of water with great economy and develop their highest efficiency—about 75 to 85 per cent.—under rather low heads. Their excessive speed under high heads produces foaming and eddying of the water which involve large losses; the wear due to the presence of sand and grit in the water is also increased and causes rapid destruction of the wheel. The enormous static pressure due to a high head also necessitates greatly increased cost for flumes and penstocks.

To obviate all these difficulties a wheel known as the Pelton water wheel has been developed on the Pacific coast for use in the mountainous mining districts where high heads are the rule, not the exception, where the water is likely to contain large quantities of sand and other foreign matter, and where simplicity of construction and ease of transportation are necessary features.

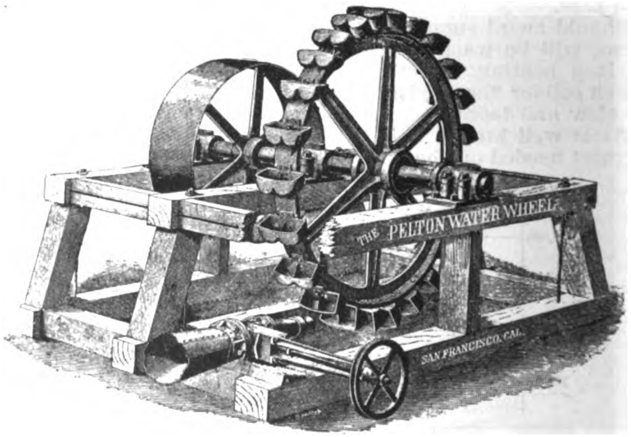


FIG. 7.—PELTON IMPULSE WATER WHEEL.

It may be briefly described as a vertical wheel having cups or buckets attached to its circumference against which a stream of water is directed by means of a nozzle, the whole being supported by a base requiring no expensive foundation and enclosed in a suitable case.

Fig. 7 shows one of these wheels, with cover removed, mounted on a wooden frame bolted together so that it may be readily taken apart for transportation. The flow of water may be regulated by the valve or in times of low or high water the tip of the nozzle may be changed. The bearings are not subjected to the action of the water and are at all times readily accessible. The most remarkable feature of this wheel is its high efficiency, 85 per cent. being in all cases guaranteed by the makers. The cause of this is to be found in the shape of the bucket.

It has been already pointed out that when a jet of water strikes a vane, the axis of the jet being perpendicular to the surface, that the water spreads out into a sheet and flows over the surface; but one fact of this phenomenon was not mentioned, namely, the formation of a cone of what may be termed "dead water" just at the point where the water strikes the vane. This is shown in Fig. 8. As this water does not flow over the surface its reactive effect is entirely lost, and the recurrence of this at every passage of a bucket through the jet entails a serious loss of energy. It is for this reason that the wedge, Fig. 9, has been made a part of the Pelton bucket. The curvature of the inner surface of the bucket is such that the direction of flow of the water is as nearly as possible completely reversed and the makers require that the speed of the periphery of the wheel be one-half that of the entering water thus conforming to the two cardinal principles which theory indicates are necessary for high efficiency. Experiments made at the University of California by Mr. Ross E. Brown, a well-known mining and hydraulic engineer, show conclusively the advantage of the wedge in the bucket. Wheels running under a head of 50 feet with a ⅝-inch nozzle gave the following efficiencies:

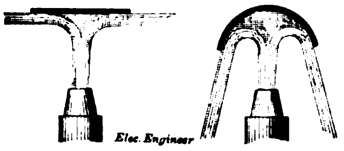


FIG. 8.

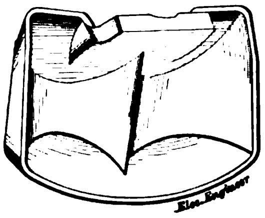


FIG. 9.

Flat vane wheel	40.4	per cent.
Curved bucket without wedge	65.6	" "
Curved bucket with wedge	82.5	" "

By varying the diameter of the nozzle, the size of the buckets, and the diameter of the wheel, the Pelton wheel may be adapted to meet the requirements of any particular case in regard to head and quantity of water available, power required and speed of wheel. Since the velocity of the jet depends upon the head and since the velocity of the circumference must be one-half that of the jet it is necessary in some cases to build wheels of large diameter in order to bring the rotative speed within the required limit. An instance of this is the case of the plant recently installed for the North Star Mining Company, at Grass Valley California, which contains the largest Pelton wheel ever built. It is 18 feet 6 inches in diameter and is constructed somewhat like a bicycle wheel. Water conveyed through a pipe line five miles long is furnished under a head of 775 feet through a 1½-inch nozzle. The speed of the wheel, 110 revolutions per minute, is necessitated by the fact that it is directly connected to air compressors.

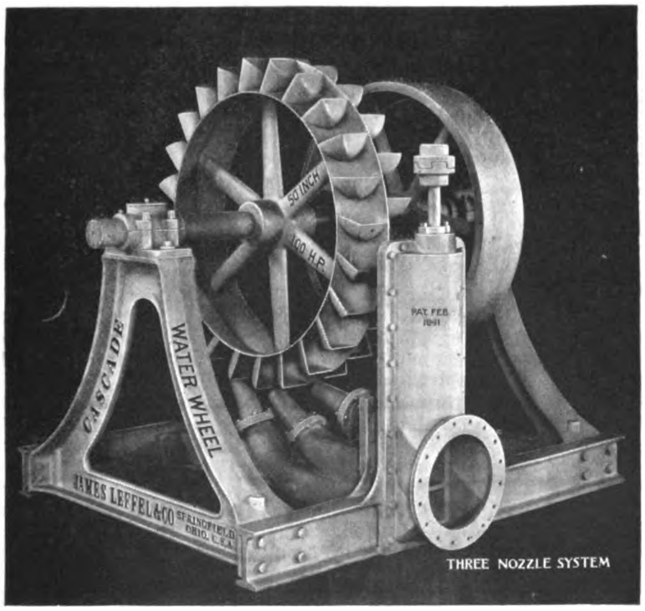


FIG. 10.—THE LEFFEL CASCADE WATER WHEEL.

Another form of tangential water wheel now on the market is known as the Leffel "Cascade" wheel, shown in Fig. 10. It differs from the Pelton principally in the design of the buckets. It will be seen that this wheel has two separate sets of buckets located alternately on opposite sides of a continuous dividing ridge. This dividing ridge has a sharp edge which serves to divide the jet of water before it reaches the buckets and keeps it divided into two equal portions, one portion being received by each set of buckets. It will be seen that the buckets are arranged alternately, or "staggered," with a view to obtaining greater steadiness of motion. The entire runner is cast in one piece making it at once strong and simple in construction, and preventing loosening of the buckets.

One of the greatest drawbacks to the use of water power has been, until rather recently, the difficulty of maintaining a constant speed under varying load. This has been especially the case where water wheels have been used to drive electric generators, an unvarying speed under all changes of load being in such a plant absolutely necessary. A variety of governors are now on the market, three of which may be described.

The Pelton differential governor, a general view of which is shown on the extreme left of Fig. 11, consists of four mitre gears, two of which are attached to pulleys which turn loosely on a shaft, the other two being capable of rotation about studs which project from a crosspiece rigidly attached to the same shaft. One of the pulleys is belted to the wheel shaft; the other is driven by a small motor in the opposite direction and at the speed which it is desired to maintain. As long as the speed of the wheel remains constant the gears on the crosspiece simply revolve on the studs, but as soon as the speed of the wheel changes, these two gears move bodily, rotating the cross piece and shaft to which it is attached. A pinion on the shaft moves a quadrant with which it is in gear and this operates a valve or moves the deflecting nozzle. Safety stops are provided to prevent the governor from acting when the valve is fully open or shut.

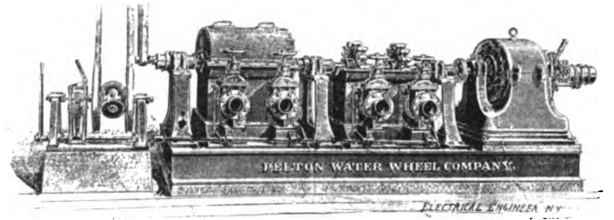


FIG. 11.—PELTON WATER WHEEL GOVERNOR.

The Replogle governor operates on an entirely different principle. Whenever a variation in speed occurs, an electric current is established, the current through this circuit energizing a magnet which attracts its armature, and thus actuates the mechanism for moving the gate. A small belt from the wheel passes over the small pulley seen in the upper part of the machine, Fig. 12. and by this means the governor balls are rotated. Any change in the speed of the wheel produces a change in the angular velocity of the balls thus raising or lowering the end of a horizontal rod, which touches one of two contact points and completes the circuit through one of two magnets. This magnet attracts its armature, thus throwing a piece in contact with a lug or a sliding table. This table is set in motion by means of a rod, actuated by a small crank on the shaft of the large pulley which is also belted to the water wheel. The sliding lug now forces one of two friction wheels into action and the gate is opened or closed as may be required. The speed governor will keep the circuit closed and the gate in motion until its speed is restored to normal, and might overdo the work, but for the action of a most ingenious device. The small pinion on the hand wheel shaft which gears with the quadrant, begins to rotate as soon as the position of the gate is altered. The consequent motion of the quadrant and quadrant shaft is transmitted to the two contact points by means of a cam on the quadrant shaft and the circuit is broken, thus preventing too great a movement of the gate. When the gate is either entirely opened or closed the electrical circuit is broken automatically and the governor prevented from further action. The manufacturers of this machine claim that it will regulate a water wheel to a given speed as closely as a Corliss engine.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - - per year.	$3.00
Four or more Copies in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York Post Office, April* 9, 1888.]

VOL. XXIII. NEW YORK, MAY 26, 1897. No. 473.

THE SCOPE OF MUNICIPAL FUNCTIONS.

FOLLOWING out a practice in which it has indulged for some time past the New York Independent has had another discussion in its interesting pages, this latest being upon the public ownership question, presenting the views of a number of well-known men on the ownership of telegraphs, tramways, gas works, etc., and supplementing the longer articles by several "short testimonies" from various cities where municipal ownership has been tried. The articles are all good and well worth reading. If they do not settle the question, that need cause no great surprise.

The first contribution in the symposium is the excellent one of Dr. Albert Shaw, on the advantages of municipal ownership, but we have read it carefully without discovery of any new facts to justify the title. He appears to approve of the German civic method, of disregarding any underlying political principle and of settling each case on the point as to whether the proposed plant will pay. That seems to us treacherous ground for a teacher of public morality, but conceding its tenability, we must renew the expression of our deep seated doubt as to whether these plants in Germany or any other European country, or even in this country, "pay" in the rightful sense of that term. The assumption by Dr. Shaw that government in Europe has "dignity, character and strength," with the inference that here it has not, so that while they can handle affairs successfully over there we cannot, seems to us a little lacking in confirmation in view of the beautiful work of the Concert of the Powers in Eastern Europe and the awful, needless disaster in the Rue Jean-Gougon in Paris, both of which we take to be examples of absence of any kind of governmental skill, character or strength in dealing with a situation. Most government is bad everywhere, and people are best off when government handles least of their affairs, not alone in bureaucratic Europe but in the far commonwealths of Australia. Mr. William Epps, the secretary of the Australasian National League, in another of these articles, complains bitterly that this tendency to bureaucracy "has a most baneful effect on the national life of the people by making them look for everything to the State." In New South Wales to-day, one man in every ten is in the public service and "politicians approach with trepidation, or avoid, any scheme for retrenchment or greater economy, because their support would mark them out for opposition." We all know that such a statement is true. Some of us feel, therefore, that it should be one great aim to keep down the number of public officials, despite any plausible plea that it "pays." Mr. Epps in speaking of the State Railroads of Australasia mentions that a private road in New Zealand is running with working expenses of 46.13 per cent. of revenue, while the State lines take 63.51. The private line appears also to be the best worked and best equipped in the colony.

Among the other articles in this series is one by Prof. Edwin R. A. Seligman, in favor of the public ownership of telegraph and telephone; one by Prof. E. W. Bemis, in favor of municipal lighting, and one by Mr. Lee Meriwether, Missouri Commissioner of Labor, in favor of municipal street railways. According to Prof. Seligman, the United States and Canada lag behind in a primitive stage with telegraphs and telephones "used for purposes of extortion or profit," the later stages being trusteeship with tolls, government service run for profit, government service run only to make ends meet, and fifth and finally no charge at all. We confess our sheer inability to grasp the conditions of the last stage, where everything is to cost nothing, being defrayed by a general tax on the community. As a man would pay this tax whether he used the services or not, the extortion of the pirate barons of old was a form of benefaction compared with such rank, wholesale, unavoidable robbery of the citizen. A great many of the services in Europe operated by government are run at a loss now, and therefore the deficiency is made up by some such inequitable taxation. Moreover, they are run with terrible badness. In this country the postal service is conducted by the government, and we know of few things that could not be done better. There is not a big dry goods store or express company that in promptness and accuracy of delivery does not beat the postoffice clean out of its boots.

Prof. Bemis, of course, favors in his usual way municipal lighting plants, and offers as usual several propositions that do not hold. Having burnt his fingers over electric light statistics he lets them alone very carefully, but concludes that gas works are a good thing to spend public taxes on. When he explains satisfactorily why gas in Philadelphia, according to the last official report, takes three men to produce the same quantity that is produced by one man in private works, and when he explains also why the city is glad to buy its gas largely from a private company, we may be made ready to indorse his views as to the general desirability of such municipal enterprises. It would be strange, indeed, if there were no municipal enterprises well run; but Dr. Shaw intimates in his article that the municipality generally gets the poorest talent.

Mr. Meriwether's article is mainly a recital of his grievance that standing as a candidate for mayor in St. Louis, chiefly on a platform of confiscation, he got little support from the press, in his campaign against the street railway companies. He also rails at the average citizen for his low sense of duty and morality. The average citizen is all right, and it seems to be a good deal to his credit, anyhow, that there are some candidates for mayor that he turns down. Conceded that public franchises have a value, and should be paid for, it does not follow that the next step, of public ownership, is desirable. Even the value of the franchise depends not on its intrinsic merit as property, but on what the company can get out of it by energy and good service; and a high rate of franchise fee does not always inure to good service, as Mr. Higgins showed recently in his remarkably able paper printed in these pages. Prof. Laughlin, of the University of Chicago, meets the Meriwether arguments by his pithy point that transfer of ownership from private to public is not going to make the city official clean if he was corrupt before, and that "prudent arrangements with private companies may, by frequent renewals of franchises, produce nearly, if not all the gains of competition in low charges and efficient service." For ourselves, we believe rather in long franchises with frequent revision of terms as to rates chargeable, etc., but as to the whole question Prof. Laughlin seems absolutely correct when he says that the causes of municipal morality lie deeper than municipal ownership.

THE GAS ENGINE IN CENTRAL STATIONS.

THERE was a time when a bold writer might have undertaken to lay down the lines on which the central electric distributing station of the future would be laid out; but recent developments, it seems, have brought to light certain facts that may well cause the most sanguine speculator on the future of electrical generation to pause before venturing to express a positive opinion on that subject. For some time past not a few able engineers have expressed the belief that the steam engine would in time give way to the internal combustion or gas engine, and we are bound to confess that that opinion was shared by us, and for that matter is still unshaken, but one's faith gets a rude shock from some recent experiences recorded in England with stations in which gas engines have been used exclusively. To be specific, it seems that at Coatbridge, England, a station has after fifteen months' operation with gas engines, abandoned the latter in favor of steam. As this is a matter touching directly all stations now employing gas engines, and those contemplating their employment, it seems worth while to enter a little more deeply into the causes which have led to this radical step. The machinery of the Coatbridge station comprised three generating sets, each consisting of a 120-horse-power engine rope-geared to a 50-kilowatt Mordey alternator. The gas engines were double acting, two cylinder, side-by-side type, working on the Otto cycle at 185 revolutions per minute. The governing of the engines was by graded charge down to one-third of full power, below which explosions were missed. Each engine shaft carried three fly-wheels, and the system was arranged for the alternators to be run in parallel. Fuel gas was generated from anthracite coal, in generators resembling the Dowson type. We give these details in order that our readers may be familiar with the conditions existing in this particular installation. This plant was run from March, 1894, until the end of June, 1895, the load on the station being so small as to obviate the engines being run very often with the alternators in parallel. When the alternators were run in parallel, however, it is said that the result was not altogether satisfactory.

At the beginning of July, 1895, the gas plant was abandoned, and three vertical steam engines were installed in their stead. The results of the cost of operating the station during these two periods is illustrated in the accompanying table.

A COMPARISON OF COSTS OF WORKING OF COATBRIDGE ELECTRIC SUPPLY STATION RUNNING BY GAS POWER AND BY STEAM POWER.

——	1894	1895	1896
Period of steam-engine running	......	July to Dec.	Jan. to Dec.
Period of gas engine running....	April to Dec.	Jan. to June	......
Units generated.................	25,800	51,000	59,600
Cost of fuel.....................	£205	£305	£212 8s. 4d.
Cost of fuel per ton, for gas.....	18s.	18s.	......
Cost of fuel, per ton, for steam..	......	4s. 6d.	4s. 6d.
Cost of oil, waste, stores, etc.....	£130	£160	£84
Salaries and wages at station....	£375*	£482	£500
Salaries and wages at mains.....	£182	£142	£106
Net loss on year's working.......	£1,000 (9 months)	£,451	£663
Cost of fuel per unit generated.	2.545d.	1.435d.	0.855d.
Cost of oil, waste and stores per unit generated..............	1.25d.	0.753d.	0.338d.
Salaries end wages at station per unit generated...............	3.50d.*	2.27d.	2.03d.
Net loss per unit generated......	1.6d.	6.83d.	2.67d.

It will be noted that only nine months of gas engine work is given, but this is probably sufficient to enable a fair comparison to be made. It will be apparent also that the year of 1895 is a composite period, the first half representing gas practice and the latter half steam practice. Inasmuch, however, as it represents results of lighting intermediate between the other two sets of results, it tends to confirm the conclusion that the introduction of steam has effected an improvement in the financial results. In making comparisons between these figures it must not be overlooked that the output of the station was much lower in 1894 than in subsequent years, thus rendering the comparison unfair to gas. The managers believe on the other hand that not a little of the improvement in output of the station is due to the greater confidence consumers have acquired since it has been run by steam. Taking the figures as they stand, however, perhaps the most striking fact brought out in the table is that the gas engines cost much more for fuel than a steam plant. This apparently inexplicable condition is well accounted for by the fact that the anthracite coal required for the gas generators cost 18s. per ton, whereas the boilers are at present fed with local slack, costing 4s. 6d. per ton; and as a matter of fact in 1894 with gas, only 26.4 pound of coal was used per unit generated, whereas in 1896 with steam 35.3 pounds were required. It will thus be seen that the present steam plant which is working non-condensing, consumes nearly 33 per cent. more fuel than the abandoned gas engine. We may remark here, that if by the unit is meants as usual the Board of Trade unit, the kilowatt hour, the consumption of fuel in either case appears to us to be out of all proportion, indeed almost inexplicable considering the high class machinery employed.

The item next in importance to that of fuel, perhaps, is lubrication, which, it will be noted, amounted to 2½ cents per kilowatt hour, an apparently heavy indictment against the gas engine. This amount, it will be noted, includes, besides lubricating oil, the cost of ignition tubes and material for gas scrubbers. In 1895 no less than $5.10 per week was being paid for ignition tubes alone, four new tubes being used in each engine every day. The lubricating oil was not filtered nor used again, so that the expense on this score might have been reduced. Indeed, it is estimated that the best present gas engine practice would enable the cost of lubrication to be reduced to nearly one-third of that given in the above table. There are, however, other reasons which may have led to the resumption of steam in the Coatbridge station, which are not apparent from an inspection of the accompanying table. Among these may be irregularity of speed, imperfection of working at reduced loads, difficulty in starting, and noisiness. Our contemporary, the London "Electrician," to whose columns we are indebted for the facts above enumerated, remarks that the Coatbridge station is now a much less noisy station than it was during the gas engine days. Perhaps the most serious objection, however, to the gas engine arises from its behavior at light loads, for the fact remains, as proved by experience, that even governing by a graduated charge of fuel and air and working on the Otto cycle the consumption of fuel rises at an extremely rapid rate as the load falls off. On the other hand if miss-fire governing is employed, no regularity of speed can be maintained, at least for the requirements of electric lighting, and especially when alternators are run in parallel.

Besides the abandonment of gas engines at Coatbridge similar plants at Morecambe and at Belfast are shortly to be changed over to steam also. In Belfast, we may add as an extenuating circumstance, that the gas employed, although made from cheap bituminous coal, was obtained from the local gas company, who, of course, made a profit out of it before delivering it to the electric light company. We have thought it worth while to go into these details, as it bears directly upon a question of vital importance to central station managers. We must confess that, apparently damaging to the gas engine as the showing is, we are not prepared to consider the evidence presented as at all final or conclusive. The relative efficiencies of a gas and a steam engine are well known, and while we are aware that the mere item of fuel is not the only one to be considered in estimating the working efficiency of a plant, still the experience at Coatbridge is not one which we deem to be that of a truly typical case. But even admitting the defects as well established, are engineers to assume that the gas engine is incapable of improvements to meet the conditions imposed in electric central station work? We have full faith in the ability of gas engine manufacturers to overcome whatever difficulties may have been the cause of the dismal experience above noted. Of course, we may be confronted by the argument that gas engine building is by no means a new industry, and that it is to be fairly assumed that the gas engines installed at Coatbridge represented the best current practice; but even if such were the case, that would not alter the argument, since improvements are constantly being made even on the best standard apparatus of the day, and the gas engine has been the particular study of some of the best engineers of the day. It would be a matter of general interest to analyze the results of experiments in the United States with the operation of electric generators by gas engines, and we hope those who have had experience with them will come forward with the results they have obtained.

THE INSTITUTE.

THE election of Prof. Crocker to the presidency of the Institute is not only a well deserved recognition of long and disinterested service in its behalf, but an earnest of much good work to be done. Prof. Crocker has had the Institute handed over to him in excellent condition by Dr. Duncan, and has many excellent ideas for increasing its usefulness and enlarging its scope of effective action.

The "Wheeler" badge adopted at this annual meeting is an improvement on the old one in many respects, but in making the change the credit due to Mr. W. J. Hammer for his intelligent and enthusiastic work in this direction must not be forgotten or overlooked. The old badge embodying his ideas had many merits, and the fact that 400 were sold testifies to its popularity; but we think it will be generally agreed that the new badge is an improvement, perhaps chiefly because it is in line with those of the sister engineering societies. We understand that its beautiful and dignified design is due to a lady. If so, the Institute might recognize her work gracefully by presenting her with the first one jewelled, or in some such way testify its appreciation.

CHURCH SERVICE BY MACHINERY.

QUITE a dispute has arisen out in New Jersey over the use of the phonograph in church. One parson with a poor opinion of choirs has patronized the inoffensive machine and its little wax tubes, while another parson nearby thinks that if the phonograph is to sing the hymns, intone parts of the service and pronounce the benediction, it might as well preach his brother's sermon, too. So it might, provided the machine is all right. But there's the rub, as Hamlet said. A damage suit has just been decided against an electrical concern in this city because its organ motor installation gave out just at the thrilling moment when the choir was on its high C in the Easter Sunday musical performance, and left the melody of the soprano's "Ave Maria" swinging around helplessly in the church without a rudder. The choir came to a dead, sickening halt, the service was spoiled, the pastor lost his temper, the congregation felt gloomily for its hat and fan, and all the blithe and jocund sentiment of the glad Easter morn was sacrificed to the inefficiency of a poor machine. Such things ought not to be, and least of all in a church. Hence, if the whole service is to be run by a machine, the responsibility thrown upon the electrical contractor and the consulting engineer should be realized at its full weight in advance.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—XI.

APPLICATION OF STORAGE BATTERIES TO ISOLATED PLANTS.—Continued.

BY JOSEPH APPLETON. (Copyright, 1897.)

THE direct current system of electric lighting has been developed and brought to its present state of perfection in America by the Edison Illumnating Co., and the storage batteries are now playing an important part in the recent developments of this system.

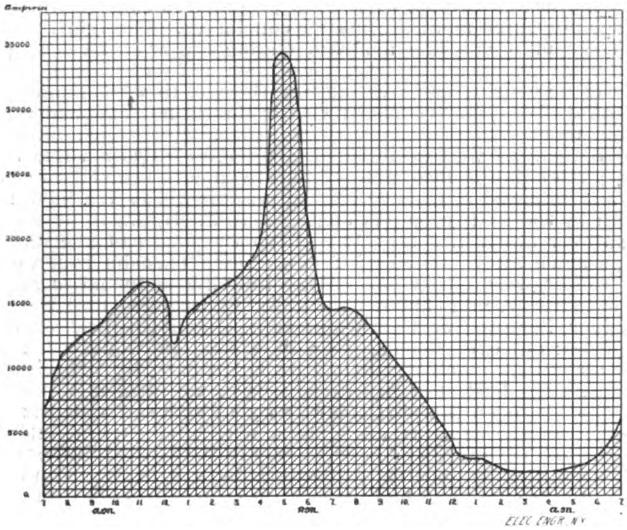


FIG. 37.—CENTRAL STATION LOAD DIAGRAM.

The method of distribution adopted by these companies is known as the three-wire system, which makes it possible to utilize direct currents over extended areas where the ordinary two-wire system would require such an investment in copper as to render it commercially impracticable.

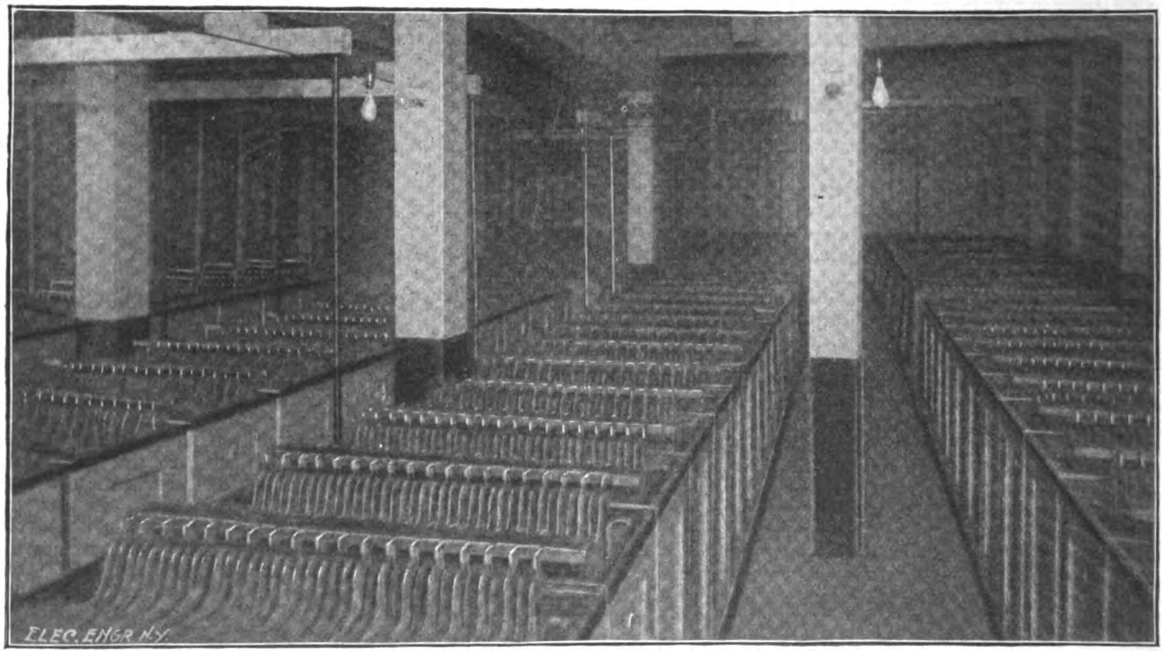


FIG. 38.—STORAGE BATTERY ROOM AT THIRD STATION OF THE BOSTON ELECTRIC ILLUMINATING CO.

The principle of this system is too well known to require explanation other than the diagrams given later. This same system is in general use in Europe, and it was there that the value of storage batteries in connection with it was first demonstrated, the Tudor Company of Germany being the pioneers in this field. There are now, however, to be found in America, storage battery equipments in connection with Edison stations which surpass European practice in both size and detail.

The various ways in which storage batteries can be used to advantage in central stations of this description may be divided into the following heads:

1. To carry a portion of the peak or maximum load which occurs for very short periods only, during each twenty-four hours.
2. To carry the minimum load, thus enabling the generating plant to be shut down during this period.
3. To equalize the pressure and maintain a constant load on the generating plant.
4. To act as a reserve in case of emergency.
5. For the equipment of sub-stations.

The local conditions in every case will determine which of the above will prove most profitable; examples of each application in actual practice will be described and illustrated later, but the following general explanation of the various methods will show the field which exists for storage batteries in central station work.

1. To Carry a Portion of the Peak or Maximum Load.—In central stations supplying current for lighting purposes, the load curve, especially during the winter months, takes the form of a peak for two or three hours during each day, see Fig. 37, at which time the load is generally double that at any other in the twenty-four hours. This means that sufficient generating plant has to be installed to carry the maximum load, while only about 50 per cent. of it is used for more than two or three hours per day; the remainder of the time it lies idle and unprofitable.

Various attempts have been made to straighten out the load curve, making the maximum load less of a peak and more of a gradual rise, but the very nature of the demand for light makes this impossible. The practice of supplying current for motors will increase the average load during the twenty-four hours, but does not get rid of the peak. One of the largest Edison Illuminating companies has found that dividing their maximum load during the year into two parts, the upper half consists entirely of peaks, containing only 10 per cent. of the total output, the lower half being 90 per cent. The value of a storage battery under these conditions is obvious.

2. To Carry the Minimum Load.—It will be seen from Fig. 37 that there are several hours during the twenty-four when the demand for current is very light, and the cost of production per kilowatt hour is much greater than at any other time. In many cases a great saving in fuel and operating expenses can be effected by shutting down the generating machinery during this period and carrying the entire load on the storage battery, which has been charged at a time when the generating machinery was operated under more economical conditions and therefore producing current at a cheaper rate.

3. To Equalize the Pressure and Maintain a Constant Load

on the Generating Machinery.—The use of a storage battery for this purpose appeals at once to those connected with the operation of central stations. As the use of electric light becomes more general, it is all the more necessary that the supply be steady and regular. Again the demand for current for motor and elevator service is rapidly increasing and this being an extremely fluctuating load causes unsteadiness in the lighting service, so much so, in fact, that central station managers are often compelled to refuse this class of work on account of its disturbing influence unless a storage battery is used to equalize the pressure.

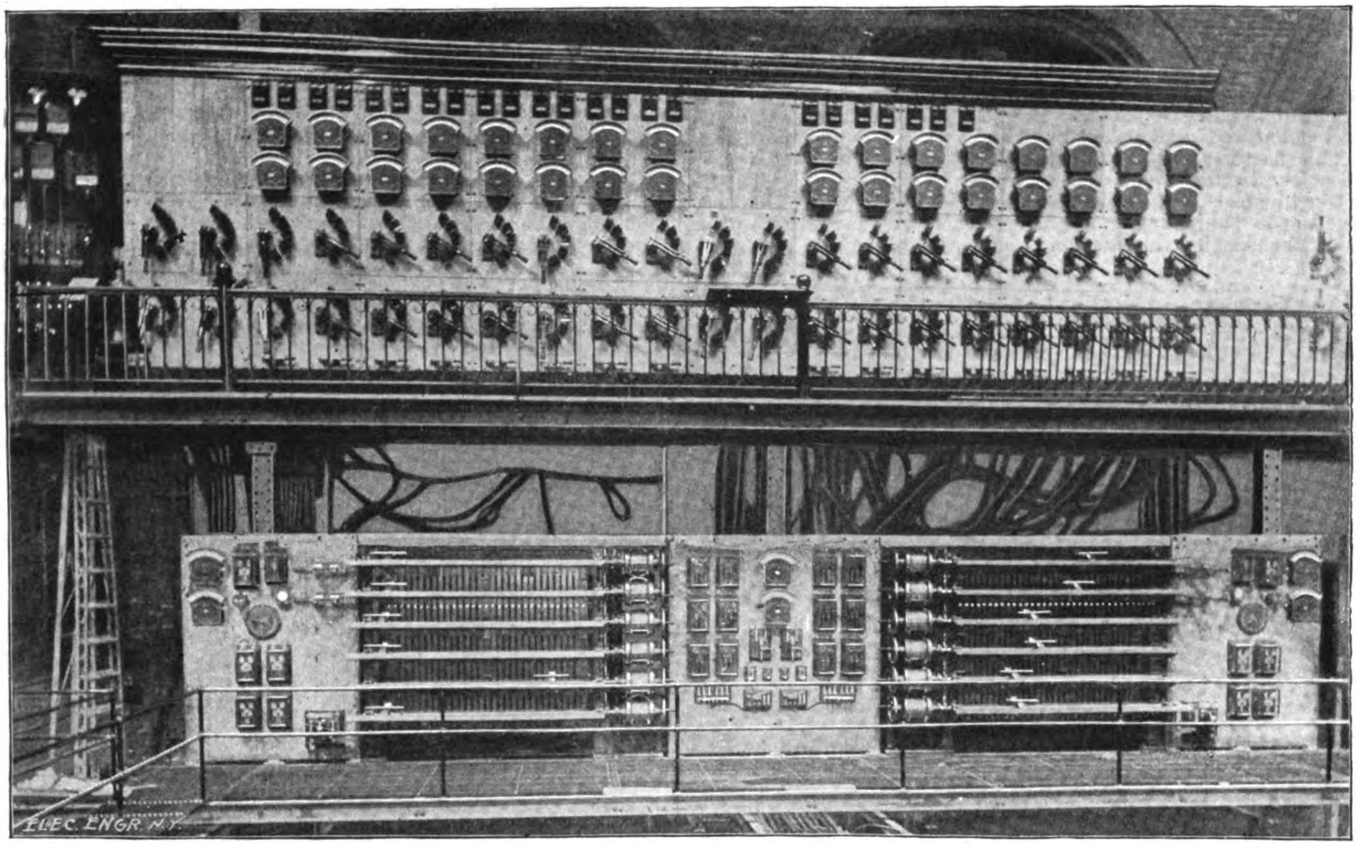


FIG. 39.—STORAGE BATTERY SWITCHBOARD, THIRD STATION, BOSTON EDISON ELECTRIC ILLUMINATING CO.

The advantage of maintaining a constant load on the generating machinery is evident, as it is the ideal condition for economical operation.

A storage battery enables this to be done to a much greater extent than by any other method; it allows of larger units being used, and keeps those units fully loaded, the surplus current being stored up in the battery and any demand in excess of the capacity of the generating plant being taken care of by the battery.

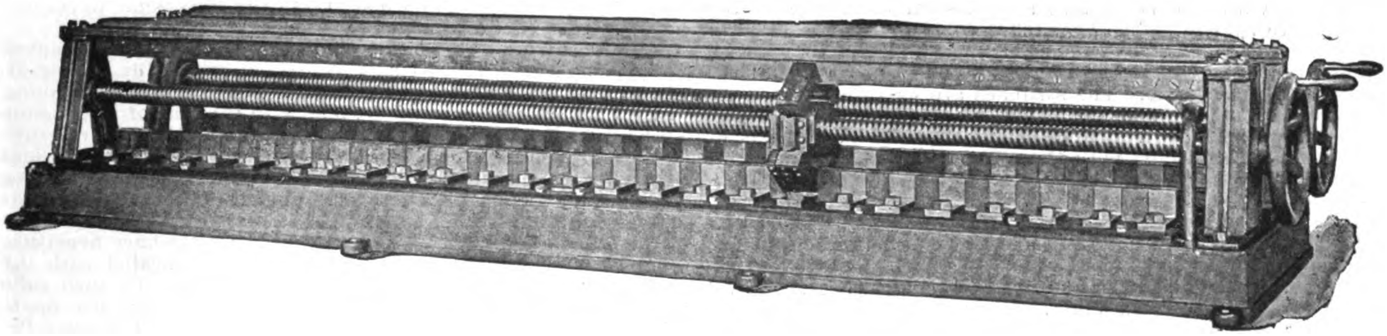


FIG. 40.—END CELL REGULATING SWITCHES FOR CENTRAL STATIONS.

It is impossible to overestimate the value of a storage battery for these purposes, as the advantages derived are so numerous that they cannot be reckoned in dollars and cents.

4. To Act as a Reservoir in Case of Emergency.—The question of reliability of service is of the utmost importance, and any method whereby this is increased cannot be too highly valued. Only those actually connected with the operation of central stations know the anxiety and worry attached to this work, and therefore, they alone can fully appreciate the security and value of a storage battery having sufficient capacity to tide over any short periods of mishap which are liable to occur in any plant, or any sudden increase of load due to weather changes, etc.

5. For the Equipment of Sub-stations.—This application of the storage battery is one of recent developments of the direct current system of distribution, and is most useful in the case of large cities where the suburbs and residential districts are too far from the main generating stations to be supplied economically during the hours of maximum load. By means of suitable battery sub-stations the center of distribution for these outlying districts can be located where it would be impossible to erect a generating station, and moreover, can be operated with much less expense.

The battery is charged from the main generating station when the load is light and the loss over the feeders or lines is small, thus securing the advantages of loading the generating machinery when it would otherwise be idle and relieving the distributing system of conductors of a portion of the current which it would otherwise have to transmit at times of maximum load. This system also enables a motor or elevator load to be carried in the outlying districts which would be extremely difficult, or perhaps impossible with the ordinary three wire system. We will now consider some of the instances where the above mentioned applications have been put into practical operation.

The Boston Edison Illuminating Company was the first electric light company in America to adopt storage batteries to any extent. They have three equipments in actual operation, and are now installing a fourth. Their first storage battery consists of 140 cells of the Tudor type, installed on the three-wire system, giving them a capacity of 3,300 amperes for one and one-quarter hours 1,716 amperes for three hours, 694 amperes for ten hours.

This battery is installed at their Third Station, which is the main generating station, being equipped entirely with modern apparatus, triple expansion engines, all condensing, and direct connected multipolar dynamos.

This battery plant is illustrated in Figs. 38 and 39, which show the battery room and switchboard, respectively. In the latter illustration the lower portion is the battery switchboard, the upper board being a part of their regular distributing switchboard. In this station there are five sets of busses to give different pressures as required; therefore, the battery is provided with five regulating switches on each side of the three-wire system. These switches consist of 31 contacts to which are connected 30 of the cells on each side of the system, thus allowing any number of cells, from 40 to 70, to be connected to the system. The switches are operated by motors controlled from the distributing switchboard.

Fig. 40 illustrates a switch of this type, which consists of the contacts connected with the respective cells, a continuous copper bar, connected with the buss, and a sliding brush traveling on a quick thread screw which makes connections between the contacts and bus bar. The traveling brush has divided contacts, with a resistance inserted between them as previously illustrated and described (Fig. 27), to prevent opening the circuit or short circuiting the cells during its travel from one contact to the other.

"THE BEST PUBLISHED."

Mr. H. F. Cottle, chief of the Electrical Construction Division of the city of Boston Public Buildings Department, writes us: "Please find enclosed subscription for the coming year from May 19. Regarding your paper, I wish to say that I believe it is the best electrical journal published, and one that I always advise my friends to get, for the reason that everything in it is easily understood and in such language that the practical man can grasp the sense of the subject."

GENERAL ELECTRIC REVOLVING FIELD ALTERNATING GENERATORS.

Among the latest additions to the apparatus manufactured by the General Electric Co., is a new alternating dynamo of the so-called "inductor" type, in which the field revolves and the armature is stationary.

This machine, which is illustrated in the accompanying engraving, Fig. 1, has been designed especially for very high and very low voltages, and possesses a number of interesting and valuable features. The chief among these are the following: The wire on the armature, being stationary, can be effectively insulated for high pressures, and the machine can thus feed directly into the line without the use of step-up transformers.

The only collector rings on the machine are the two used for conveying the exciting current to the revolving field coils. They are therefore small affairs, subjected to a low potential, and their brushes can be handled while the machine is running without danger. All the high potential terminals are thoroughly insulated, and it is practically impossible to receive a dangerous shock from the machine.

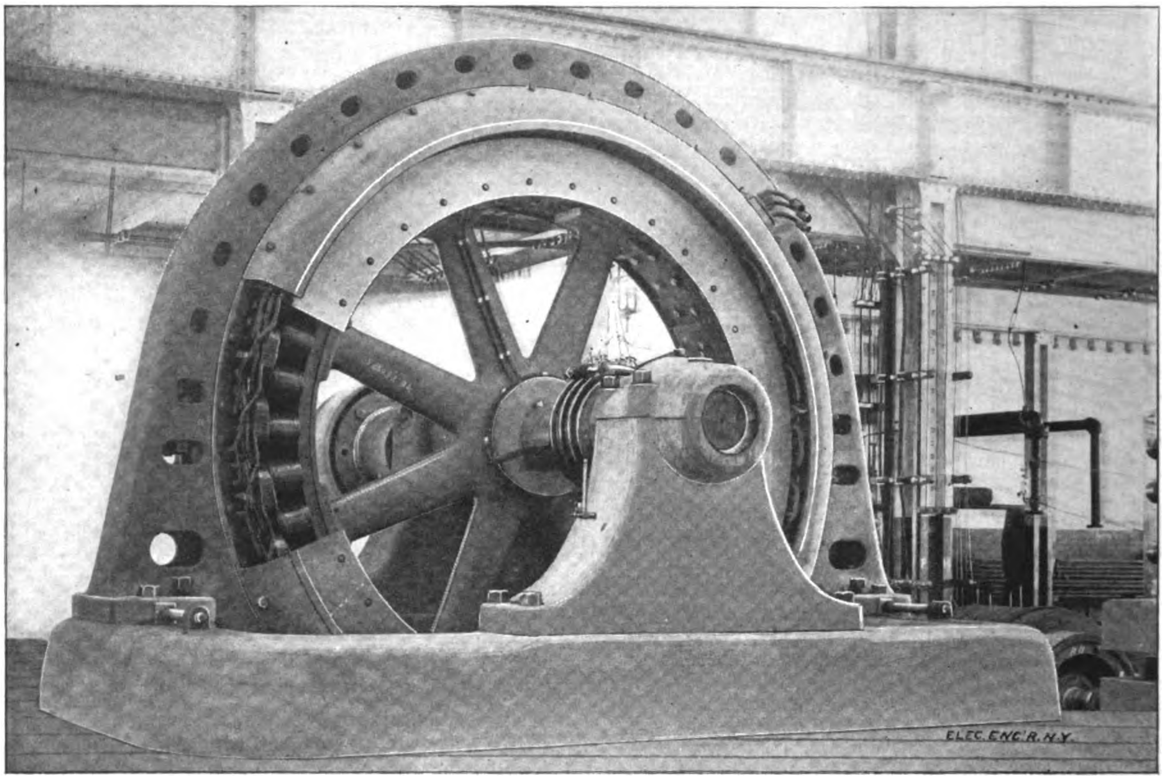


Fig. 1.—New General Electric Revolving Field Alternator.

The revolving field is very substantial, and has laminated pole-pieces, which are easily detachable. The engraving illustrates a 40-pole, 750 kilowatt, three-phase generator running at 175 revolutions per minute, and with sections of the shields removed, shows the arrangement of the field and armature coils very plainly. On the large sizes of this type the field coils are wound with copper strip placed on edge, thus forming single helices and giving a maximum radiation for the heat developed in the coil.

The machine is so constructed that the stationary armature can be moved along the base in a direction parallel with the axis of the revolving field shaft, thus exposing its own coils and those of the field for repair. These machines are made for various voltages, speeds and periodicities, and monocyclic, two-phase or three-phase, as conditions may require.

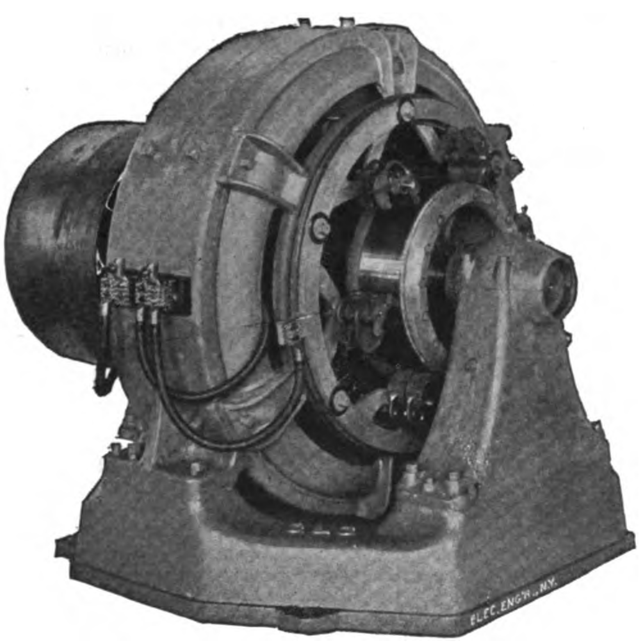
LIGHT WITHOUT LAMPS.

The best proof of the intelligence, the good taste of a theatrical audience is its conduct during an accident on the stage. In a German theatre in this city the other night a real mishap did not cause any unseemly demonstration. The heroine told a servant to bring in a lamp. Without waiting a moment the electrician in the wings turned on the light full power. About five seconds later the maid appeared at the door bearing the lamp, a palpable and ludicrous case of effect preceding cause, of putting the cart before the horse, in fact, what Dr. Trench would have called a preposterous business. Of course, it is possible that this German audience did not have a keen sense of the ridiculous.—N. Y. Sun.

THE DESIGN OF THE NEW C & C DIRECT CONNECTED DYNAMO.

BY D. W. BARNES.

PLACING a new direct connected or slow speed dynamo on the market in 1897 is a different matter from what it was a few years ago. At that time almost any dynamo could be sold, but to-day the specifications of the consulting engineer and architect pretty closely define the type of dynamo which will be accepted by them, and that type which has for its field piece a ring with radial poles projecting inward encompassing an armature with its winding buried in slots has come to be practically specified. They even go further and specify the detailed construction of the armature and say that the armature and commutator shall form a single unit so built up on a sleeve as to permit of readily assembling on the engine shaft. They name the material of which the commutator bars shall be composed, and will have nothing but carbon brushes. They state the efficiency, heating limit, current density in brushes, regulation required and what material shall be used for insulation. They dispose of the question of brush movement by stating that there shall be none at all. We expect they will soon state the weight of the machine. All this is good for the honest manufacturer. It shuts out inferior competition, and in spite of the severe conditions the field is far more attractive than before; there is a possibility of reward for merit. Price alone is not the basis of awarding contracts for this class of dynamo electrical machinery.



THE NEW C. & C. SIX-POLE GENERATOR.

The consulting engineer and architect having therefore settled the general design it remains for the manufacturer to work out the details of the problem. After all it is the working out of the details that determines success or failure, and it is only with the aid of that engineering judgment that comes from experience that the best results are obtained. No set formula can produce a good dynamo any more than it can a good steam engine, and yet without the formula we could not begin. It is possible to design so that the dynamo will have a high efficiency at all loads, which is better than a high efficiency at full load and a low efficiency at one-half load. Every practical engineer knows that a dynamo under average conditions is not fully loaded.

The net commercial efficiency of the C. & C. six-pole direct connected dynamo, which is a recent example of new and careful design, is 92 or 93 per cent. at full load, in the larger sizes, and careful tests show a falling off of only 3½ per cent. at one-half load. An efficiency curve taken from a 60-kilowatt C. & C. direct connected generator showed a net commercial efficiency of 80 per cent. at ¼ load.

The reader may be interested to know how the design of this dynamo was worked out. In the first place it was decided that there should be no skimping of material, either in quantity or quality, to secure low cost. All attempts at economy in construction were therefore directed toward the labor side of the problem. On this account, while the electrical designers were given free rein to produce the highest efficiency, the mechanical designers applied as careful study to the problem as they would to the construction of a steam engine, reducing the number and expense of the operations wherever possible without reducing the quality of the workmanship. There was no haste in the designing; ample time was given to study the "machine problem." The result was highly creditable from a mechanical standpoint; the new dynamo proved to be a handsome machine, which the writer claims is an indication of good design. A machine that properly combines simplicity and strength pleases the eye.

The armature coils are form-wound, the slots being separately insulated with fireproof insulation. The field coils are reinforced for protection, and are interchangeable. The air gap is sufficiently small to avoid the necessity of large magnetizing currents, and the flux densities determined with a special view to sparkless commutation. In this respect the results are very flattering. The 60-kilowatt machine already mentioned, was loaded up to 75 kilowatts and ran several hours at that load with practically no sparking, and without shifting the brushes. Our friends, the consulting engineer and architect, having frequently specified that machines shall carry an overload of 25 per cent. have disposed of the question of sparking, since a dynamo that is inside the sparking limit at 25 per cent. overload will certainly be so at normal load, or under average running conditions.

It has been stated that people frequently do not recognize facts until they come into violent collision with them, but the fact regarding direct connected dynamo design of to-day is that only a high grade machine like the one described can fill the requirements of the market, which are more exacting than ever, and which tend to make dynamos of American manufacture the best in the world.

MUNICIPAL LIGHTING MUDDLE AT MIDDLEBORO, MASS.

The municipal lighting of Middleboro, Mass., has now reached another deadlock, and the town is likely to be in darkness unless some steps are taken immediately to straighten out the matter. The town got discouraged recently over the costly maintenance of the plant, and a special investigating committee consisting of Dr. E. S. Hathaway and John A. Miller was appointed. After going into the matter carefully they reported to a town meeting recommending many decided changes in the running of the department, and also a reduction in the number of arc lights, substituting incandescents for the arcs dispensed with. At present they have about 100 arcs and they propose to change these to 25 arcs and a proper number of incandescents. Their recommendations were adopted.

A few weeks ago the Hon. N. F. Ryder, who is a member of Governor Wolcott's executive council, resigned from the Lighting Board, and Commissioner J. B. Ryder, who is also manager of the lighting plant, called a halt, as the recommendations and changes made by the special committee could not be carried out for the amount stated in the estimates they submitted. Mr. C. Sparrow did not agree with Mr. Ryder, and promptly resigned from the Board of Commissioners.

What legal complications, if any, may arise, no one can tell. In the meantime, as the manager, Mr. Ryder, is the only commissioner left in office, the prospect is that the lights will go out, he being unable to draw funds from the city treasury to pay the current bills, as the checks require the signatures of at least two commissioners. Such a state of things could hardly exist if the plant were operated by a private corporation.

WHAT A CITY PLANT IS.

The Cumberland (Md.) Times volunteers the following definition: A city electric light plant will only be another handle to the political pump for politicians to work.

MANHATTAN ELEVATED.—It is now stated that the New York Elevated will not adopt electricity until further developed and perfected! The company is worse off for courage even than for money. Waiting for the perfection of electricity is too funny.

LETTERS TO THE EDITOR

RANKINE AND WEISBACH AS AUTHORITIES ON HYDRAULICS.

YOUR issue of May 12 contains an article by W. E. Wines on "The Principles and Construction of Water Wheels," in which the following words are used:

"It has been overlooked by such authorities as Weisbach and Rankine, who insist that the velocity of the wheel-vanes and jet should be equal, to avoid what they call shock, but which in reality causes the loss of the impulse action of the water. The honor of correcting this error and building turbines which utilized both the impulsive and reactive effects of the water, belongs to two Americans, Uriah A. Boyden and James B. Francis, whose improvements have been universally accepted and followed, at least in this country."

The undersigned has no doubt but that every professional reader of the article has had the same experience as the undersigned had, when reading the quoted lines. I had to re-read them twice to arrive at the conclusion that my eyes did not deceive me, that there was, in fact, in existence a writer on matters of hydraulics, who possessed sufficient temerity to accuse the two greatest mechanicians of the century of ignoring the very first rudiment in hydraulics.

Both Weisbach's and Rankine's works contain pages and pages on the true conditions on which the absorption by a power wheel of the force evolved by weight and motion of water ejected under head or pressure rests. It is not true that these authorities overlooked that both the impulse and reaction have to be beneficiated for the purpose of securing highest efficiency, nor has either of the two ever claimed that the said force could be at all absorbed, when the circumferential velocity of the wheel and the velocity of the ejected liquid or fluid mass is equal. Nobody can claim an honor in presuming to correct an error which was never committed.

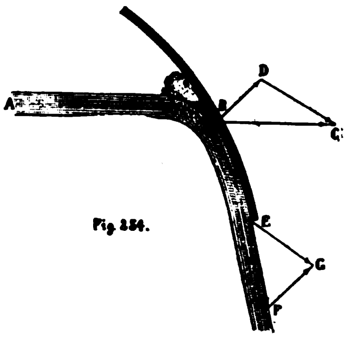


Fig 254.

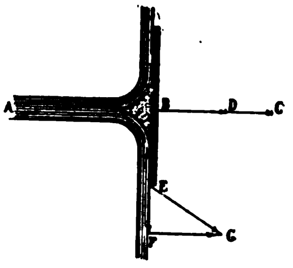


Fig 255.

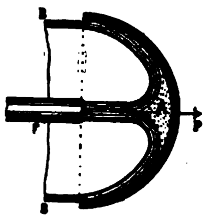


Fig 256.

I quote below the two authorities whom your contributor has tried to put to shame, in their own words, in order to show conclusions on their part, which could never have been arrived at by them had they not taken the precisely adverse position assigned to them by Mr. Wines.

The quotations alluded to read as follows:

W. J. M. Rankine, Professor of Civil Engineering and Mechanics in the University of Glasgow, asserts: (p. 594, 14th Ed. London, 1895.)

"If $B = 90^\circ$, as in Fig. 255, the maximum energy transmitted is $e. Q. v^2 \div 4. g.$ or half the original actual energy of the fluid. If $B = 180^\circ$, as in Fig. 256, the maximum energy transmitted is $e\ Q.\ v^2 \div 2\ g$, or the whole of the original actual energy of the fluid, which, after the collision, is left at rest."

Dr. Phil. Julius Weisbach states on page iii., § 24, Am. Ed.: "The water produces its maximum mechanical effect, when $v = \frac{c}{2}$, or when the surface struck moves in the direction of the stream with half the velocity of the stream. The maximum work is then

$$Pv = (1 - \cos. a)\ \tfrac{1}{2} . \frac{c^2}{2g} . Q = (1 - \cos. a)\ \tfrac{1}{2}\ Qh.$$

Now, if $a = 180^\circ$ — i. e., if the motion of the water is reversed by the impact, we have for the work done, $2 . \frac{1}{2} Qh = Qhy$; but if $a = 90^\circ$ — i. e., if the stream strikes against a plane surface—the work done is only $\frac{1}{2} Qh$, and the water transmits to the surface only one-half of its actual energy, or but one-half of the mechanical effect corresponding to its vis viva."

If it is honor to carry out in practice, what great men have laid out in theory, then this honor belongs to the American Impulse Wheel Company of New York, manufacturing a water wheel, the vanes of which precisely perform, and perform precisely in all their positions while revolving, the inversion of direction of flow for the liquid or fluid current that impinges the wheel, as was well illustrated by the article descriptive of that wheel published in The Electrical Engineer of April 14, 1897, page 413.

No other wheel ever offered for use, whether it be a submerged turbine or a free jet impulse wheel has complied or does comply with the theoretical conditions to highest efficiency, as the wheel of the above company does.

F. M. F. CAZIN.

New York.

THE UNSETTLED BERLINER CASE.

My opinion, personally, having been asked upon the recent decision of the Supreme Court, I beg to state, briefly: The Supreme Court decision in the Berliner patent case was a victory for the people and a defeat for the Bell Company. There were four points of contention, any of which might have been a defeat for the Bell Company, in case of favorable action. Upon these three points the Bell attorneys fought with all their vigor against adjudication, indicating their absolute fear of the result. If they had had confidence in it, they would have brought an adjudication upon all of them. If they had had confidence in any one of them, they would have endeavored to take advantage of it by getting a favorable decision. Their whole effort was to prevent a decision upon any other point than that of alleging fraud upon their part in delaying the issue of the patent. They gained upon this point, but lost upon the three others, for there is hardly a doubt that they could have had an adjudication by the Court of Appeals upon the other points, if they had not fought it so severely.

Therefore, their fears are substantiated by facts, and, taken all in all, the farcical litigation between the Bell people and the Government, is, in fact, a victory for the people.

J. E. KEELYN, President.
West. Telephone Cons. Co.

Chicago, Ill., May 17, 1897.

THREE MOTORCYCLE INVENTIONS.

As an evidence of the attention inventors are giving to motorcycle transportation methods, it may be noted that the U. S. Patent Office has granted patents this week on three widely differing modes of travel. These include a marine velocipede, a motor-driven sleigh and wings for aerial flight.

WOMEN "ELECTRICAL WORKERS."

"Cleveland, O., has a large number of ladies who are connected with the electrical business, and who are first-rate manipulators of electricity," says Business Agent Connelly. "The electrical workers have a strong union, but in its formation they overlooked the women. It is now proposed by the Electrical Workers' Union to request the ladies to come in with them. It may be necessary to form a separate union. The matter has been broached to the women, and they are heartily in favor of it. An effort will be made to get them together and instruct them in the principles of unionism. With both male and female electrical workers organized, the people of that trade would be invincible."

TELEPHONY AND TELEGRAPHY

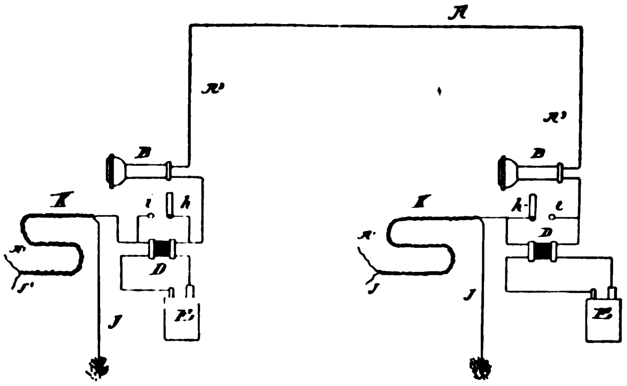
THE ABSTERDAM SYSTEM OF "MAGNETIC" TELEPHONY.

SOME time since Mr. John Absterdam, of this city, brought out a system of telephony in which the line is claimed to be discontinous, in order to demonstrate that a continuously closed circuit was not necessary to the transmission of articulate speech. In this system, it may be recalled, Mr. Absterdam employed at each end of the line coils wound with two conductors, side by side; but the opposite ends of the conductors connected to the receiver and to the line, respectively, were left open ended, as shown in the accompanying diagram.

Recently Mr. Absterdam has been at work on another part of the problem of telephony, which has resulted in what he terms a method of transmitting speech "magnetically."

The accompanying diagram illustrates the arrangement adopted for this purpose. A represents a single conductor extending from a telephone station A^2 to a second telephone station A^3 and including at each end a telephonic instrument B. At each station there is an induction coil D and a local battery E, the poles of which are connected in circuit with the primary wire of the adjacent induction coil, so that the battery current flows continuously and uniformly through the primary wire of the induction coil.

At each station the secondary wire of the induction coil is connected into the main line A. The respective ends A' of the main line A instead of being grounded or otherwise connected are terminated at each station adjacent to a wire J, one end of which is grounded. The ends of the wires A' and J' may be twisted together into a cord, K, and are insulated from each other, thus leaving the line A open at both ends, as shown at A' A', so that it is impossible to pass a current directly over the line or to operate telegraph instruments, bells, or analogous instruments thereon.



ABSTERDAM'S SYSTEM OF "MAGNETIC" TELEPHONY.

Mr. Absterdam extends the cord formed by the wires A' and J' into a coil of a considerable length, taking care at all times to maintain a perfect insulation between them, so that they shall not form in any sense or possess any of the peculiarities of condensers, according to his idea.

In practice he finds that although the line may be open at both ends, as above described, and although there may be no battery current upon the line and no interruption or pulsation of the primary current through the induction coils, as is generally believed to be necessary to set up secondary or induced currents in the line, nevertheless there exist in the line conditions such that articulate speech or other sounds uttered at a telephone at either station will be heard and understood in the receiving telephone at the other station.

As will be seen, the general arrangement of apparatus somewhat resembles that of an ordinary telephone line in that an induction coil, local battery, and telephone receiver or transmitter are used, but differs essentially therefrom in that the local battery is not used to set up the speech vibrations or variations, but the local current is allowed to flow without interference from any transmitting devices upon the local circuit which maintains the magnetic field in inductive proximity to the line, while the magnetic variations corresponding to speech are originated at some other portions of the circuits or apparatus independently of the local.

A CALL FOR AN INDEPENDENT TELEPHONE CONVENTION.

PRESIDENT J. E. KEELYN, of the Western Telephone Construction Co., Chicago, has issued, under date of May 18, the following call:

The action of the Supreme Court upon the Berliner patent has been so erroneously published, that the people, generally, have been seriously shaken in their confidence in the Independent Telephone movement. It is a satisfaction to know that there is little or no loss of confidence among the best informed of our telephone exchange people. We have been flooded with telegrams from all directions asking what effect the Supreme Court decision upon this Berliner patent would have. Most of these telegrams came from people whom we have little or nothing to do with and to whom we are under no obligations. They, undoubtedly, could get no information from the sources they had relied upon, as these very sources were in the foremost ranks of those to apply to us.

The very first people to call upon us for help and information were so-called manufacturers who heretofore have shown a spiteful jealousy of our success. In order to set this matter clearly before the public—in order to bring harmony out of chaos, and to strengthen the general business—a meeting was held at the office of the writer yesterday and he was advised to call a general meeting of all the Independent Telephone Exchanges in the United States to be held in the city of Chicago, Thursday, Friday and Saturday, May 27, 28 and 29. This is a short time in which to give notice, but prompt action is desired.

The Bell Company, undoubtedly, will bring action on this Berliner patent, therefore a united policy will be beneficial. The envious and jealous bickerings between other manufacturers, because of our success in these matters, have led us to believe that there is little to hope for from them in any combination of interests. They are always anxious to get all the benefit, but unwilling to make any expenditures for it. The ingratitude, and spiteful disposition of some of those mostly benefited by our victories in the Watson, Roosevelt, and other patent cases, has concluded us to refuse the use of our legal information on this Berliner patent, excepting to our friends. We are absolutely certain of our ability to defeat the Berliner patent, if a suit is brought against us or our guaranteed customers. We do not propose to be small about it, and shall, as in the past, extend a sheltering wing to all those who are kindly disposed. We positively will not be a party to any arrangements with a certain set of envious and jealous manufacturing concerns, who, for nearly a year past, have been in an underhand combination to fight us, but who were among the very first to beg us for help, notwithstanding that they represent themselves as being the "largest manufacturers," etc., when, as a matter of fact, their ability to defend a customer in court amounts to nothing.

The writer has therefore thought it best that the operating exchanges should get together in representative form and determine upon a proper policy to follow, and act in unison, and create an organization of a national character which will tend to the mutual advantage of all, not only upon this Berliner patent question, but upon all general matters affecting the Independent Telephone Companies.

This call is not to be misconstrued as a call for financial assistance. Our company has never asked it, and never will, as it is the duty of the manufacturer to provide the defenses and the means in accordance with his guarantee.

BELL TELEPHONE STOCK AND ITS HOLDERS.

There are 213 sheets of foolscap paper in the statement of the stockholders of the American Bell Telephone Company, says the Boston Journal. There are 236,500 shares of stock with about 6,600 different stockholders in the company. Last year it required 190 pages, showing there were then about 5,400 stockholders, which shows that there has been an increase during the year of about 1,200 stockholders.

Last year Mr. William H. Forbes was the largest stockholder with 3,329 shares to his credit, but he has decreased his holdings to 1,742 shares, and this year Mr. Theodore N. Vail, who has held no stock during the past four years, appears as the largest stockholder with 4,805 shares. The thirteen directors this year hold 5,651 shares of the stock, compared with

7,770 shares last year. Of the thirteen directors, five, whose holdings have been the largest, have decreased, five show no change, while three show a combined increase of 237 shares.

The fact that the name of Mr. Vail appears upon the stockholders' list of the American Bell Telephone Company this year as the largest holder of the stock causes considerable surprise and much surmising. Mr. Vail was formerly general manager of the American Bell Telephone Company, and since his retirement it has been understood in Boston that he has not been in a financial position to become, as he has, the largest stockholder of the Bell Company, with 4,804 shares to his credit. At $235 per share this stock has a value of $1,128,940, and at the present rate of dividends, $15 a year, the stock receives $72,060 annually in dividends. It is alleged that Mr. Vail, who lives in New York, has been closely identified with the Western Union Telegraph Company, and that he is especially intimate with President Thos. T. Eckert. This gives the impression in some quarters that the Western Union Telegraph Company has been buying Bell Telephone stock through Mr. Vail.

THE TELEGRAPH CONCESSION IN VENEZUELA.

According to the Venezuelan Herald of May 8, the concessions for the working of the government's telegraph system, which were granted to J. Schwed of this city, have been rejected by the Venezuelan Congress. The Herald says that when Mr. Schwed obtained the concession he arranged for a deposit with the United States Legation on April 13 of $25,000. It also says that Mr. Schwed went to Caracas as the representative of Henry Clews & Co. When April 13 passed and the deposit was not made, according to the Herald, the government withdrew the concession.

When asked about this matter last week a representative of Henry Clews & Co. said: "The report in the Herald is incorrect in several particulars. Mr. Schwed did not go to Venezuela as our representative. He is an employé of this company and has desk room in our office, but before going to South America he left on a vacation. He went over to Germany, and there organized a company or syndicate to operate the telegraph lines of the Venezuelan government. Upon submitting his proposition to that government it was accepted, and a concession for working the lines for thirty years was granted to him. The capital was arranged for in Europe, and Mr. Schwed is well able to carry out his part of the contract.

"So far as we know, there is no truth in the statement about a deposit being required. We have seen Mr. Schwed's contract, and no deposit is mentioned. He was allowed, moreover, six months in which to take charge of the lines, and should now have a margin of nearly five months.

"Instead of a deposit being demanded of him, the Venezuelan government contracted to pay him a subsidy of $150,000 a year for transmitting its messages. Mr. Schwed is ready to comply with all the terms and conditions of his contract. We wish it understood, however, that he does not represent us in this matter, but is acting for himself and for the German capitalists with whom he has made arrangements."

THE GOVERNMENT AND RAPID TELEGRAPHY.

Senator Pettigrew has introduced a bill in the U. S. Senate authorizing the Postmaster General to acquire for the United States the invention of Prof. Crehore and Lieut. Squier for rapid telegraphing by alternating currents, and also to construct a line between Washington and New York for the purpose of experimenting with and perfecting the use of rapid telegraphy.

THE POLES of the telegraph lines in Europe are said to have cost $50,000,000. The basis of this curious estimate is not given.

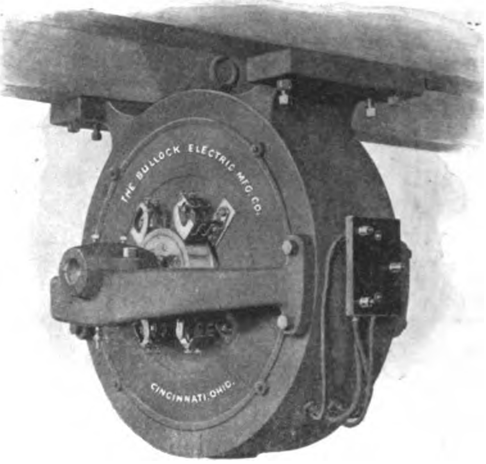
ROCHESTER, N. Y.—The Bell Telephone Company is trying to shake out the deadheads, and has issued positive orders that only subscribers are to be allowed to use its telephone service. The statement is made that out of 10,000 calls in a day, the company found lately that 4,000 were by persons whose voices were unknown as those of regular users entitled to the service.

SAN FRANCISCO, CAL. The John L. Klein Electrical Works have been formed at San Francisco with a capital stock of $50,000, subscribed $2,700. The object is to make and sell electrical supplies. The directors are J. M. Klein, San Rafael; C. W. Nevin, H. A. Sayles, J. Stone and J. W. Felt, of San Francisco.

POWER TRANSMISSION

NEW BULLOCK MOTORS.

THE advantages of the new types of direct connected line shaft and ceiling motors recently put on the market by the Bullock Electric Manufacturing Company, of Cincinnati, O., which was formerly known as the Card Electric Motor and Dynamo Company, of the same city, are becoming very generally recognized. It will be remembered that this company has always made a specialty of equipping printing establishments and machine shops with motors directly attached to the presses or tools. They are now enlarging the scope of the field of motor application by providing each counter shaft or line shaft with slow speed direct connected motors, which run at the same speed as the shafts, and are connected to them by special jaw couplings. It has long been recognized by mechanical engineers that the transmission of power by means of vertical shafting or belting has been a source of wastefulness; besides rendering the establishment liable to breakdowns which might seriously affect the output of the factory. The electrical engineer has now come to their assistance by supplying the only correct medium of transmitting power throughout a factory with the smallest loss of energy in so doing.



THE NEW BULLOCK CEILING MOTOR.

The motor herein illustrated shows the type, and particular attention is called to the compactness, strength and correct mechanical design, combined with high electrical efficiency and simplicity. The brushes are fixed, and since the limits of commutation are so broadly defined, these motors operate noiselessly and sparklessly under varying loads, and with perfect regulation. A great feature of slow speed direct connected motors is one very seldom considered by those making a cursory examination of the subject. We will take for comparison motors running at 180 r. p. m. (a speed which is easily obtained by the Bullock motors), direct connected to line shafts or tools and other motors belted to line shafts or machinery and therefore running at, say, 1,000 r. p. m. Although of equal horse power, these motors differ greatly in their capacity of starting under load, for while the slow speed motor attains its full speed at 180 r. p. m., the high speed motor must revolve 1,000 times before it reaches its capacity. The slow speed motor, due to its characteristics, has a greater reserve capacity for overload and starting, as compared with rated horse power of the high speed one. Furthermore, the slow speed motors are so designed that their life and usefulness is much greater than that of the high speed ones, owing to heavier carrying capacity and low temperature limits.

While the cost of the direct connected motors is somewhat greater than that of the belted or geared motors, still the advantages are so considerable as to more than offset the extra expense.

At the present day, manufacturers are confronted by many problems which must be solved before the success of their undertaking is assured. The profits made are not so often in the articles manufactured, as in the small savings in power, and in the bi-products. The advantages of electrical transmission are most apparent in those cases where power is used intermittently, for, with the stopping of the motors, all expense for power ceases; whereas, belt transmission necessitates the operation of long lines of shafting and belting, even if but a small part of the tools or presses are at work.

The progress of science and of civilization all illustrate most positively the fact that the welfare of the human race depends on the elimination of useless or wasteful methods of production. To this end we see marvelous automatic machinery for turning out an infinite variety of articles. The prime movers, such as steam engines and water wheels, have become extremely economical in the use of coal and water power. It is now necessary to connect the prime mover to the machine by some means which does not nullify the good features of the prime mover and the machine, for which so much has been spent to obtain the highest efficiency. It is astounding to think that for years thousands of tons of coal have been expended for the mere friction load of shafting and belting, but the industrial world is now realizing most emphatically the necessity for retrenchment.

According to the tests made by Prof. Benjamin, of the Case School of Applied Science, Cleveland, O., the general average of power lost in factories and other establishments throughout the United States equals 51 per cent. of the total horse power generated by the prime movers in these establishments. Numerous examples of electrical transmission by direct connected motors have proven that one-half of this 51 per cent. can be saved, and it is in view of this wide margin of improvement, and the crying necessity for this new system of power transmission, that these electric motors have been designed and operated.

Among the numerous power applications in the East which the Bullock Electric Manufacturing Company has installed may be mentioned: Mergenthaler Linotype Company, Ryerson street, Brooklyn, N. Y.; Henry Heide, 78 Vandam street, New York; Young & Smylie, Brooklyn, N. Y.; New York Journal, direct connected motors operating three Hoe sextuple color presses; New York Herald, New York Sun, New York Times, Paterson Chronicle, Toronto Globe, San Francisco Examiner, Chicago Journal. Among the printing establishments may be noted: Frank A. Munsey; Kaufman & Strauss Textile Publishing Company; Winthrop Press, American Book Company, etc.

The Bullock Electric Company has done a large export business, and reports many favorable inquiries from England, France, Germany, Australia, Japan and China.

ELECTRICITY IN THE WOODWARD MINE, PA.

The Woodward mine of the Delaware, Lackawanna and Western Railroad at Kingston, Pa., is about to be equipped with electric haulage by the General Electric Company. The generating plant will consist of one 165-kilowatt dynamo directly connected to an American Ball engine. The circuits will be three in number. The first will pass down a vertical shaft 725 feet deep and will operate one ten ton locomotive in the Cooper vein. The two others will be carried down another vertical shaft 1,026 feet deep to operate two ten-ton locomotives in the Red Ash and Baltimore veins. These locomotives will be equipped with two 40-horse-power G. E. motors, and will handle trips of loaded mine cars each loaded car weighing about four and one-half tons.

It is estimated that this installation will show in operation a net saving of 29.5 per cent. over mule haulage, including a large reserve for depreciation, interest and mixed charges. The total output of these three locomotives will be about 3,800 tons per day, and the total length of trolley wire in the gangway will shortly reach four and a half miles.

NEW JERSEY TROLLEY STATISTICS.

A report of the State Board of Assessors giving figures about the electric and street railroads in New Jersey for the year 1896, shows total receipts $5,770,171, against $5,056,598 in 1895, an increase of $713,573. The expenditures were $3,546,168, against $3,431,931 in 1895, an increase of $114,236, and dividends paid $124,220, against $117,320 in 1895, an increase of $6,900. The number of miles of track in the State is 613; capital stock paid in, $38,235,150; funded debt, $36,420,493, and other debts, $4,279,396; total of capital and funded and unfunded debt, $78,935,039. The total cost of railroads, including the equipment and appurtenances, is put at $80,011,559, an average of $130,000 per mile of track.

ROENTGEN RAYS

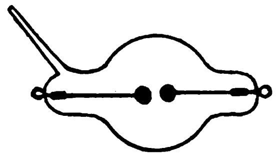
THE X-RAY ARC.

FRANCKE L. WOODWARD.

FOR the past three months I have been making a series of experiments in the X-ray field in the direction of obtaining the rays from the electric arc, and as the results obtained have at last been particularly successful, I thought the readers of the Engineer might be interested to know of them.

I believe it has been suggested that the ordinary arc light as used in our streets is a source of these rays. I have gone into the subject very carefully and under many different conditions, but have yet to find the slightest trace of the rays from this source.

I next turned my attention to the possibility of obtaining the rays from the enclosed arc in a high vacuum and my researches have led me to believe that this form of arc is the most plentiful and valuable source of X-rays to-day. I have used various forms of arc tubes, but the one shown in the accompanying sketch has given the best results by far. Platinum wires are sealed into the glass, but on the inside these are joined to aluminum terminals ending in a small bead of aluminum. The beads are separated a very small distance, varying from a sixteenth to half an inch, according to the strength of current used. This is one of the main points of difference from the ordinary Crookes tube.


WOODWARD X-RAY TUBE.

The second difference is the nature of the current. Instead of using the long spark from the secondary of an induction coil, or from a static machine, I pass this current of high potential through powerful condensers and use the short, thick, disruptive spark obtained therefrom. This necessitates that the anode and cathode be in close proximity in the tube. On the passage of a current of thin nature, the whole tube lights very brilliantly and an arc is produced between the anode and cathode which is the most intense source of Röntgen rays I have discovered.

The rays appear to have almost twice the penetrative power of any of the old type Crookes tubes which I have used, while the arc tube has the greater convenience that it may be made very small without diminishing its efficiency. I have in these tubes introduced a V-shaped piece of platinum foil between the aluminum beads with good results as in the Thomson type of Crookes tube, but if this is done the space between the aluminum beads is slightly increased.

[An apparatus of similar design was described by Mr. R. W. Wood in The Electrical Engineer of April 28, 1897, Mr. Tesla has also used the arc in vacuo.—Eds. E. E.]

SOCIETY & CLUB NOTES

POLICE TELEGRAPHERS.

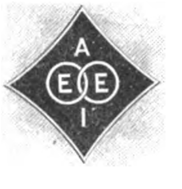
The executive committee of the International Association of Police and Fire Telegraph Superintendents met on May 17 at the Clarendon Hotel, Brooklyn, to arrange a place for the next annual meeting of the association. This association was organized last September, Frank Mason, superintendent, in Brooklyn City police telegraphs, being elected president. Those who attended the executive meeting included William Y. Ellett of Elmira, John W. Aydon of Wilmington, Del.; F. F. Zuleff of Paterson, Brown F. Flanders of Boston, H. F. Blackwell of Brooklyn, S. L. Wheeler of Springfield, Mass.; William Brophy of Boston, Adam Bosch of Newark, N. J.; Fred Pearce of New

York, R. W. Gordon of New York, W. L. Candee of New York, F. C. Mason of Brooklyn, N. Y.

President Mason welcomed the visitors and the business on hand was disposed of in short order. It was decided to accept the invitation to visit Nashville, Tenn., for the next convention, and Tuesday, September 8, was decided upon, this being the date of the "Old Time Telegraphers and the U. S. Military Telegraphers" meeting at the same place. The report of Treasurer Bosch shows the association to be in a good financial condition. The association is steadily growing in numbers. J. W. Aydon of Wilmington, Del., was elected a member of the executive committee.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the meeting of the Executive Committee of the institute on Tuesday, May 18, the following associate members were elected: William C. Banks, electrician, Gordon-Burnham Battery Company, 82 West Broadway, New York City; Edward C. Clement, assistant examiner, Electrical Division, U. S. Patent Office, Washington, D. C.; A. Davidson, cable engineer and electrician, Central and South American Telegraph Company, Lima, Peru; Constant de Redon, consulting engineer, 27 Thames street, New York City; Sidney Hosmer, superintendent Underground Cable Department, Boston Electric Light Company, Ames Building, Boston, Mass.; Carl Kinsley, teacher of electrical engineering, Washington University, St. Louis, Mo.; John Neilson, superintendent of Interior Wiring Department, Larchmont Electric Company, Larchmont, N. Y.; Albert S. Richey, electrician, Citizens' Street Railway Company, 403 West Adams street, Muncie, Ind.



Ground of Dark Blue Enamel. The Interlocking Rings Represent Electricity and Magnetism.

The following associate members were transferred to membership: W. W. Nicholson, general superintendent Central New York Telegraph and Telephone Company, Syracuse, N. Y.; R. E. Richardson, electrical engineer, Chicago, Ill.; Edward B. Rosa, professor of physics, Wesleyan University, Middletown, Conn.

The annual business meeting of the institute was held at 12 West Thirty-first street, New York City, and was called to order by President Duncan at 4 P. M. The counting of the ballots by Mr. Hamilton and Dr. Pupin, who were appointed tellers, resulted in the announcement of the election of the council ticket as follows: For president, Dr. Francis B. Crocker, of New York City; for vice-presidents, Dr. A. E. Kennelly, of Philadelphia, Pa.; Mr. Chas. S. Bradley, of New York City and Mr. Dugald C. Jackson, of Madison, Wis.; for managers, Dr. Alexander Macfarlane, of South Bethlehem, Pa.; Mr. Gano S. Dunn, of New York City; Mr. W. F. C. Hasson, of San Francisco and Mr. Herbert Laws Webb, of New York City; for treasurer, Mr. George A. Hamilton, of New York City; for secretary, Mr. Ralph W. Pope, of New York City. The officers whose terms have not expired are: Vice-presidents, Chas. P. Steinmetz, of Schenectady, N. Y.; Harris J. Ryan, of Ithaca, N. Y.; Wilbur M. Stine, of Chicago, Ill. Managers, Chas. F. Scott, of Pittsburg; Bion J. Arnold, of Chicago; Carl Hering, of Philadelphia; Cary T. Hutchinson, John W. Lieb, Jr., and F. A. Pickernell, of New York City; Wm. L. Puffer, of Boston, and L. B. Stillwell, of Niagara Falls.

The reports of the council and the treasurer showed a net gain during the year of 38 members, the number in good standing on April 30 being 1,073. The treasurer's balance for the year on a balance sheet of $10,193 was $1,284. The institute has in property, $4,260; in the building fund, $956, and all told $6,662. The Institute having received $2,300 in life memberships since its foundation, and used the amount as current income, the treasurer is to set apart each year as long as necessary, the sum of $500 to be invested in a compounded membership fund.

The report of the committee on a new design for the Institute badge, which had been referred to this meeting by the Executive Committee, was taken up and thoroughly discussed resulting finally in the adoption of the new design recommended by the committee. Arrangements for the withdrawal of the old design and substitution of the new one will be made at an early date.

The paper on "The Synchronograph," presented April 21 by Dr. Crehore and Lieut. Squier, was then taken up for discussion. Mr. F. W. Jones opened the discussion, which was participated in by Dr. Kennelly and Mr. Delany. A paper on "The Application of Hyperbolic Analysis to the Discharge of a Condenser" was presented by Dr. Macfarlane. Owing to lack of time discussion was postponed until the general meeting, July 26.

The announcement by the tellers of the election of Dr. Crocker was greeted with hearty applause, and the president-elect was escorted to the chair where he acknowledged briefly his appreciation of the honor bestowed upon him.

At 7 P. M. the meeting adjourned and the members immediately reassembled at the "Arena," 41 West Thirty-first street, where arrangements had been made for the annual dinner under the direction of Mr. Herbert Laws Webb, chairman of the Committee on Papers and Meetings, and Mr. T. C. Martin. Although a sudden increase of about 50 per cent. of the number of guests necessitated the laying of 93 covers, the overflow was provided for, and the event passed off very pleasantly. Toasts were responded to by Dr. F. B. Crocker, Mr. F. W. Jones, Dr. M. I. Pupin, Dr. C. E. Emery, Dr. A. E. Kennelly, Mr. Ralph W. Pope, Mr. J. W. Lieb, Jr., Mr. Herbert Laws Webb, Mr. Nelson W. Perry and Mr. Joseph Sachs.

The exercises were interspersed with instrumental music by Mr. George Heli Guy and songs by Mr. Charles McL. Paine. Mr. Guy played a waltz of his own composition which he dedicated to the American Institute of Electrical Engineers.

ANNUAL MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

MR. H. B. COX ON THERMO-ELECTRIC GENERATORS.

THE New York Electrical Society held its annual meeting at Columbia University on Thursday, May 20. The officers elected were: President, Dr. M. I. Pupin; vice-presidents, Gano S. Dunn, Max Osterberg, W. W. Ker, A. L. Riker, Willard E. Case, H. B. Coho; secretary, George H. Guy; treasurer, Henry A. Sinclair. The society has now 397 members. The president read a letter from the treasurer, in which was stated that a large number of members had failed to pay their dues. The president urgently requested that these arrears should be remitted forthwith, as the society has plans for extended work for next season, the carrying out of which will be impossible without proper funds. After the disposal of the business part of the meeting, Mr. H. Barringer Cox lectured on "The Direct Conversion of Heat Into Electricity," showing the present conditions of the practical relations between heat and electricity in regard to the direct conversion of the energy of fuel into current.

Following up the meeting which has attracted so much attention, at which Mr. Case experimented with his carbon consuming cell, Mr. H. Barringer Cox, who for many years has been working on the development of thermopiles, gave a very interesting lecture, which he illustrated with three of his thermo-electric generators, using gas flame as the source of heat. These generators, which have already been described in detail in The Electrical Engineer, consist of a number of thermo-electric couples of ingenious construction, grouped circularly around the flame, in which hangs a deflector or series of baffle plates. The elements are encased in fire resisting clay, backed up by a metal case, which forms the water jacket. From this small contrivance, which is about half the size of a silk hat, sufficient output is obtained upon the consumption of 2½ feet of gas per hour to run a small ordinary fan motor, or to operate such devices as electromedical sets, telegraph keys, X-ray apparatus, gongs and other devices.

There was an animated discussion, which was participated in by Dr. Emery, Dr. Crocker, Dr. Pupin, and Messrs. Mailloux, C. S. Bradley, Sachs, Ward Leonard, Lieb and others. Mr. Gano S. Dunn made some readings in testing the operation of the thermopiles, as there was a brisk dispute as to what the theoretical and the actual output of such devices ought to be, but it cannot be said that any clear result was reached. One of the thermopiles shown, a high voltage type, was rated by Mr. Cox at 10 volts and 3 amperes: two other of his ordinary smaller low volt type he rated at 4 volts, giving about 3 amperes, when measured on open circuit. One of Mr. Dunn's readings, short-circuiting the device through the Weston ammeter, showed 2.53 watts; another with the instruments and the running fan motor in circuit showed 3.75 watts.

AMERICAN STREET RAILWAY ASSOCIATION.

The sixteenth annual meeting of the American Street Railway Association is to be held in Convention Hall, Niagara Falls, N. Y., October 19 to 22, inclusive. A building 120 x 154 feet is being erected for the exhibition of street railroad supplies and for the meetings. Those attending the convention will secure their return ticket for one-third the price of the round trip fare. Mr. T. C. Penington, secretary-treasurer, 2020 State street, Chicago, will give full information in regard to accommodations and other particulars. Papers will be read on the following subjects: "Municipal Ownership of

Street Railways," "Modern Electric Railways; their Construction, Operation and Disadvantages," "Application of Electricity to Railroads now Operated by Steam Power," "The Best Method of Settling Damage Cases, and the Prevention of Accidents by the Use of Fenders and Otherwise," "Producer Gas for Use in Street Railway Power Houses and Gas Engines," "Storage Batteries for Street Railways," "Discipline of Employés," "Long Distance Transmission and the Use of Multiphase Current for Ordinary Street Railways."

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Secretary G. F. Porter writes us: "Mr. Frank W. Hawley, chairman of the committee to receive and entertain Governor Morton at the opening of the electrical exposition last year, and whose energetic efforts in connection with the gun firing and the sending of messages around the world contributed so largely to the success of the exposition, has just called at this office upon his return from a trip to California. Mr. Hawley happened to be in San Francisco on the anniversary of the opening of the exposition, and in commemoration of the government gun firing on that occasion, which gave rise to so much agitation on the part of the city fathers of San Francisco, the military commandant at that post gave Mr. Hawley a very elaborate dinner at the Presidio, which was so timed as to be served at the exact moment at which the gun was fired just one year before. Mr. Hawley says that San Francisco is still talking of the excitement produced on that occasion, and also says that there is a strong feeling in that city in favor of an electrical exposition there next year."

PROGRAMME OF THE N. E. L. A. CONVENTION AT NIAGARA.

Secretary G. F. Porter has issued a very handsome pamphlet giving the programme of the convention. The assignments are as follows:

Tuesday, June 8, 1897. Meeting of the Executive Committee, at 9 A. M. Morning session, 10:30 o'clock. Address by President, Frederic Nicholls; report of Committee on Standard Candle-Power of Incandescent Lamps, Louis Bell, Chairman; report of Committee on Data, H. M. Swetland, Chairman; report of Committee on Rules for Safe Wiring, William Brophy, Chairman.

Afternoon session, 2 o'clock. Report of Committee on Finance, John A. Seely, Chairman; paper by J. B. Cahoon, "Standardizing Prices for Incandescent Light and Power;" topic, "Theft of Current and How to Deal With it;" paper by W. Worth Bean, St. Joseph, Mich., "Municipal Lighting;" questions and answers? ? ? What is it you wish to know? Executive session.

Wednesday, June 9, 1897. Morning session, 10 o'clock. Paper by C. L. Edgar, Boston, Mass., "Correct Method of Charging for Product;" paper by J. G. White, New York, N. Y., "The Niagara Power Transmission Line;" paper by Arthur Wright, Brighton, England, "Profitable Extensions of Electricity Supply Stations;" topic, "Commercial Results with Inclosed Arcs."

Afternoon session, 2:30 o'clock. Paper by Professor Chas. A. Carus-Wilson, McGill University, Montreal, Can., "The Induction Factor, a New Basis of Dynamo Calculation and Classification;" paper by Professor Elihu Thomson, Lynn, Mass., "Recent Progress in Arc Lighting;" paper by T. C. Martin, New York, N. Y., "The Daylight Work of Central Stations." Questions and answers? ? ? What is it you wish to know. Executive session.

Evening session, 8 o'clock, Lyceum Theatre. Paper by L. B. Stillwell, Niagara Falls, N. Y., "Niagara Power." (Illustrated with stereopticon).

Thursday, June 10, 1897. Morning session, 10 o'clock. Paper by B. F. Lamme, Pittsburg, Pa., "Polyphase Motors;" topic, "Best Efficiency for Incandescent Lamps;" paper by Lieut. F. Jarvis Patten, New York, N. Y., "Frequency Transformation;" topic, "Are the Large Arc Lighters Commercially Desirable?"

Afternoon session, 2:30 o'clock. Topic, "Lamp Carriers Other Than Ordinary Posts;" paper by C. F. Scott, Pittsburg, Pa., "Rotaries for Transforming Alternating into Direct Current." Executive session. Reports of secretary and treasurer of Executive Committee. Election of officers.

TEXAS ELECTRICAL DEALERS.

The electrical dealers and contractors of the State of Texas held their annual meeting on May 10, at Dallas. It was well attended. The officers elected were: President, J. E. Johnson, of Austin; first vice-president, C. W. Hobson, of Waco; secretary, W. G. Schuwirth, of San Antonio; treasurer, Thos. Hummell, of Dallas.

CANADIAN ELECTRICAL ASSOCIATION.

This body has arranged to have its annual meeting June 2, 3 and 4 at the Dufferin Cafe, Queen Victoria Park, Niagara Falls, Canada, and has provided an excellent programme.

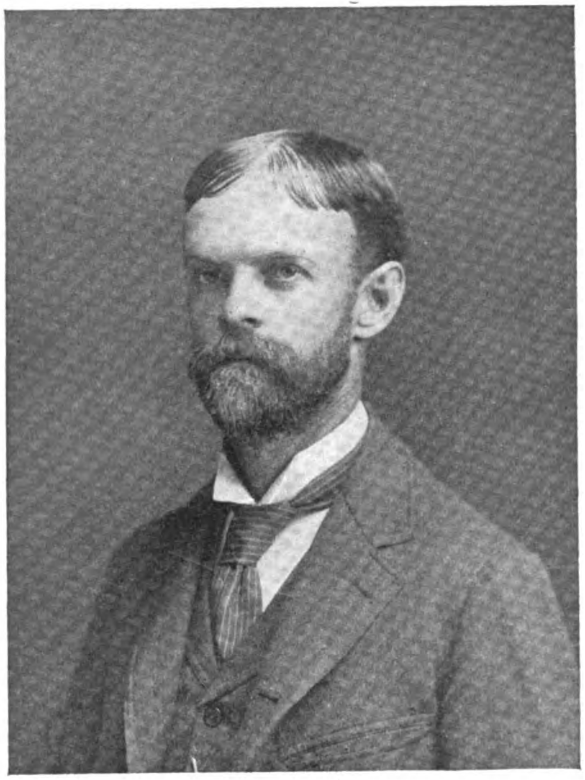
CHICAGO ELECTRICAL ASSOCIATION.

As a conclusion to one more year of serious work, the Chicago Electrical Association held its annual dinner last week, when 25 members were present out of a total of 45 in good standing. Mr. T. G. Grier presided as toast master, and speeches were made by Messrs. W. Clyde Jones, T. C. Gage and C. Marshall. After these set toasts, impromptu speeches and reminiscences were indulged in for some time, and before adjournment the association accepted the kind invitation of Mr. W. A. Harding, electrical engineer of the Calumet Electric Railway Company to a trolley party on that road, to take place some time in the summer.

PERSONAL

PROF. F. B. CROCKER.

We present herewith the latest portrait taken of Prof. F. B. Crocker, of Columbia University, New York City, who on May 18 was elected president of the American Institute of Electrical Engineers. The new president was born in New York on July 4, 1861, graduated from the School of Mines at Columbia, in 1882, with the degree of E. M., and received the degree of Ph. D. in 1895. He is well known as one of the designers of electric motors and other apparatus, and his name is borne to-day by the large enterprise known as the Crocker-Wheeler Electric Company, of Ampere, N. J. He has also written largely upon these subjects both in articles and in books. Prof. Crocker has been in charge of the electrical studies at Columbia ever since their separate establishment, first as chief instructor and now for some years as the Professor of Electrical Engineering. He has of late had a great deal of special and responsible work in connection with the engineering plant for the new university buildings on Morningside Heights. For two years Prof. Crocker was president of the New York Electrical Society, and he has for many years been in the active service of the institute, filling all the offices



Professor Francis B. Crocker.

except those of secretary and treasurer. In 1893 he did excellent work as general secretary of the International Electrical Congress at Chicago and editor of its transactions. In fact, there is no call to public duty in the line of his profession that Prof. Crocker has not responded to with zeal, intelligence and success of the highest order.

FRANK X. CICOTT.

Mr. Cicott is to resign his present position with the Ansonia Brass and Copper Company, this city, July 1, and will then carry out a plan he has been at work on for some time past of organizing a European company to handle the latest American electrical and street railway apparatus, as general agents abroad. Mr. Cicott, it will be well remembered, has had several years of commercial and journalistic experience in Europe and has exceptional facilities for embarking on this enterprise, for which he now deems the times ripe. He can be addressed for the present at 19 and 21 Cliff street.

MR. G. FRED PACKARD, until recently connected with the Fort Wayne Electric Corporation, as designing engineer, has severed his connection with that company and accepted a position, May 1, as electrician for the Akron Electrical Manufacturing Company, of Akron, O. While with the Fort Wayne company, Mr. Packard has designed a line of multipolar direct connected generators. Mr. Packard is now designing a new line of multipolar generators for direct connection and also a line of slow speed, belt-driven multipolar generators and motors soon to be placed on the market by the Akron Electrical Manufacturing Company.

MR. C. W. PRICE is the subject of a very cordial notice in the Fourth Estate, the article being accompanied by a nice half-tone portrait plate.

LEGAL NOTES

OKONITE CO. vs. HOLMES, BOOTH & HAYDENS.

A suit as above in regard to failure to deliver copper was recently disposed of in the New York Supreme Court by discontinuance. The complaint showed that in June, 1895, the Holmes, Booth & Haydens Company, as wire drawers, sold to the Okonite Company 300,000 pounds of copper at 12¼ cents, and after delivering 50,500 pounds, stopped further delivery The Okonite Company then, in September, 1895, purchased elsewhere the balance of the copper at 14 cents, and then sued the Holmes, Booth & Haydens Company for about $4,500, the difference.

An order discontinuing the suit has been entered, and we are informed that the Holmes, Booth & Haydens Company paid the Okonite Company about $2,800 in settlement.

ELECTRIC TRACTION ON THE NEW YORK METROPOLITAN.

Justice Beach in the New York Supreme Court has handed down a decision in three suits brought to restrain the Eighth Avenue Railroad Company, owned by the Metropolitan Company, from changing its motive power from horse power to electricity, and also raising the question as to whether the city has the right to purchase the road under the resolution of 1851, under which the franchise was granted to the company. Justice Beach denies the motion for the issuance of temporary injunctions, pending the trial of the suits, debarring the company from constructing the underground trolley, and holds that the city's right to purchase is "dead beyond hope of resurrection." He also says that the State Board of Railroad Commissioners has control of the regulation of street railroads, and that the Board of Electrical Control has no jurisdiction in the matter.

REED ELECTRIC CO.

Elmer D. Wilt has filed a bill in equity in Common Pleas Court No. 3, Philadelphia, against the Reed Electric Company, in which the court is asked to appoint a receiver to take charge of the affairs of the company and continue the business. The bill sets out that the company has expended over $50,000 in perfecting an electric storage battery invented by Charles J. Reed, who alone has the secret, and now alleges that the corporation has forfeited its right to his invention under the letters patent. It is asserted that the battery has proved successful and would earn large profits, but that the company is insolvent and has no more money with which to pursue experiments.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

Edited by HERMAN A. STRAUSS.

Dynamos and Motors:

STARTING RESISTANCES.—By E. A. N. Pochin, B. A. Author considers at some length the different actions of motors when controlled by a liquid resistance, or when controlled with the usual multiple contact switch and a wire resistance. Elaborate example is given of a hundred ampere shunt motor working off 100 volt mains and having a load of such a nature that it will only start with the full working current. Author states following five desiderata of an ideal controlling switch: 1. It must prevent sudden switching on. 2. It must admit of slow switching off for regulating. 3. Instant switching off in cases of emergency. 4. It must automatically switch off the motor in case the supply fails. 5. It must be capable of the above operations without arcing at the main contacts. Author adds that many switches fulfil almost any three of these conditions, but none fulfils all five.—Lond. "Elec.," May 7, '97.

POLYPHASE MOTORS WITH VARIABLE NUMBER OF POLES.—By Rob. Dahlander. Author remarks that the methods in vogue for altering the number of poles of an asynchronous polyphase motor and hence altering the number of revolutions by changing the connections of the windings have been developed for motors with ring windings only and in the present article he explains with several very clear diagrams such a method for drum windings. Examples are cited and the advantages of the method here explained are said to lie in greater simplicity and the possibility of applying it to any polyphase motor by merely altering the winding.—"Elec. Zeits.," Berlin, May 6, '97.

Materials:

MICA: ITS UTILITY AND VALUE.—A short article defining mica, enumerating its various commercial uses and giving the general results of a few "breaking down" tests. Mica refuse, when passed through a disintegrator, and reduced to a flaky state, and then mixed with a proper adhesive substance, is found to be a most efficient covering for steam boilers or pipes. It is compared with "diatomite" and asbestos—equal thicknesses of each material being used and a gain for the mica covering of 12-lb. pressure, and 15 per cent. less heat outside the cylinders is obtained in one experiment. It is stated that mica in powdered form when properly prepared makes a lubricant which is unrivalled for all machinery requiring high speed, as it keeps the bearings absolutely free from heat, even at the greatest speed, while in the form of axle grease for railway cars and ordinary vehicles, it fills every possible requirement.—Lond. "Elec. Rev.," May 7, '97.

Traction:

MECHANICAL PROPULSION ON CANALS.—By Leslie S. Robinson.—Abstract of paper read before Inst. of M. E. Summary of the four different methods in use for the mechanical traction or propulsion of boats upon canals, viz.: 1. Propulsion of screws worked either by steam, by petroleum motors or by electricity. 2. Hauling upon a submerged chain or wire rope lying along bed of canal. 3. Attachment to an endless running rope working along canal bank. 4. Towing by a locomotive running along canal bank. Author considers the determination of the general resistance of a boat in a channel of restricted section. The resistance depends in some way upon the ratio which the wetted cross section of the canal bears to the immersed midship section of the boat and cites experiments. Permissible speeds are then considered and finally cost of such traction, the following table being self-explanatory:

Relative Cost of Transport by Railway and Canal.

	Railway.	Canal.
Maintenance of way	13	0
Maintenance of works	7	2. 3
Repairs of rolling stock	19	6.
Traction	16	8.
Traffic expenses	30	6.
General charges	15	15.
Interest on capital	100	33. 3
Total	200	70. 6

A second table of comparative costs of different modes of traction on canals is given. Author expresses no definite conclusion.—Lond. "Elec.," May 7, '97.

Wiring:

UNINSULATED PIPE FOR INTERIOR WIRING.—By V. Zingler. Author discusses the virtues of the different systems of interior wiring, stating that in such work there are two broad questions at issue, viz.: (1) Shall the pipe have an interior insulation? (2) Shall the pipe have no interior insulation? He states that the chief points under which any system of conduits should be discussed are the following: Cost of material, cost of labor, mechanical strength, chemical and electrolytic action, insulation, accessibility, durability. These various points are each considered.—Lond. "Elec. Rev.," May 7, '97.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 18, 1897.

Batteries, Secondary:

ELECTRODE. W. Majert, Falkenberg, Germany, 582,936. Filed May 5, 1896.

Method of constructing electrodes for storage batteries providing a space between the frame and the mass allowing for the expansion of the latter.

Conductors, Conduits and Insulators:—

ELECTRICAL CONDUIT. J. J. Groshans,, Buffalo, N. Y., 582,910. Filed December 5, 1896.

Consists of two series of pipes one within the other, one series being sealed by a meterial impervious to moisture and the other series by a non-conductive material.

Dynamos and Motors:—

MACHINE FOR FORMING ARMATURE COILS. G. A. Grisell, Madison, Wis., 582,640. Filed November 16, 1896.

Details of construction.

BRUSH HOLDER. S. H. Short, Cleveland, Ohio, 582,883. Filed January 2, 1897.

Details of construction.

BRUSH HOLDER FOR DYNAMOS AND MOTORS. S. H. Short, Cleveland, Ohio, 582,884. Filed February 16, 1897.

Details of construction.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. J. A. Mosher, Chicago, Ill., 582,664. Filed December 17, 1892.

Comprises a solenoid, a movable core within, an armature under the influence of the magnetized core, but separated from it, and a spring acting upon the armature.

ELECTRIC ARC LAMP. J. A. Mosher, Chicago, Ill., 582,665. Filed January 19, 1894.

The regulation of the upper carbon is effected by means of a thermo-expansive wire.

ELECTRIC SEARCH LIGHT. S. W. Rushmore, Brooklyn, N. Y., 582,694. Filed January 11, 1896.

Carbon supporting and feeding devices.

Miscellaneous:—

ELECTRIC LOCK. H. Bezer, New Rochelle, N. Y., 582,615. Filed October 25, 1892.

A lock normally held in locking position, and remotely controlled means for retaining the lock out of locking position.

ELECTRIC ADVERTISING AND DISPLAY APPARATUS. J. L. Killmer, New York, 582,649. Filed March 2, 1896.

Comprises Geissler tubes arranged to represent letters and having a portion of the letters of a word different in color from the remainder of the word.

ELECTRODE. J. A. Deuther, Boston, Mass., 582,721. Filed August 19, 1896.

Electrodes with renewable sections at the point where the arc is formed.

GARMENT HOOK. J. J. Horan, New York, 582,742. Filed July 31, 1896.

Means whereby upon the removal of an article from the hook an alarm will be given.

MEANS OF AND APPARATUS FOR PREVENTING FORMATION OF ARCS WHEN OPENING CIRCUITS. T. Von Zweibergk, Cleveland, Ohio, 582,772. Filed October 29, 1896.

Consists in establishing a shunt circuit around the contact to be broken, then breaking the main circuit, then gradually commutating the current through the shunt circuit, and finally breaking the shunt circuit.

METHOD OF AND APPARATUS FOR TANNING. E. Worms, Paris, France, 582,891. Filed October 11, 1895.

The hides are immersed in tanning liquid in a closed drum submitted to agitation and to a gradual heating by electricity.

ELECTROLYTIC APPARATUS. A. E. Hunt, Pittsburg, Pa., 582,923. Filed December 4, 1895.

Comprises a number of vessels electrically connected in series, the several vessels having platforms in electrical connection therewith, so that they shall be maintained at the same electrical potential as the pot.

SLEIGH. J. S. Fritz, Columbus, Wis., 582,635. Filed December 30, 1896.

Embodies a motor driven traction wheel hung in a frame pivotally suspended beneath the body of the sleigh.

AUTOMATIC ELECTRIC GATE. J. M. Williams and T. P. Kinney, Danville, and H. W. Kinney, Lynchburg, Va., 582,889. Filed August 18, 1896.

A railway crossing gate operated by a motor in circuit with a generator, the motor circuit being controlled by track instruments.

ELECTROPNEUMATIC ORGAN-ACTION. H. E. Hobbs, Weston, Mass., 582,918. Filed May 21, 1896.

Details of operation.

Railways and Appliances:—

ELECTRIC RAIL BOND. G. H. Scott, Worcester, Mass., 582,698. Filed July 17, 1896.

Consists of the connecting rod and two bushings which fit over its ends and are adapted to be driven into the openings in the rails.

RAIL BOND. F. H. Daniels, Worcester, Mass., 582,849. Filed February 10, 1897.

Comprises a flexible body portion, and two terminals made separate from it and secured to it by pressure.

CIRCUIT BREAKER FOR TROLLEY WIRES. C. Hoff, Cincinnati, Ohio, 582,862. Filed January 22, 1897.

Composed of a suitable frame having downwardly turned forked ends; a pair of contact levers in the forked ends inclined toward each other and operated on by springs to open the circuit when the tension of the wire is lessened by breaking.

TROLLEY FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, Ohio, 582,882. Filed December 22, 1896.

Adapted for construction employing two overhead conductors.

INSULATING FISH PLATE. F. T. Fearey, Newark, N. J., 582,907. Filed March 22, 1897.

A fish plate having at its lower edge a hollow flaring extension to receive the flange of the rail, and provided with an insulating lining plate extending over the bearings and into the extension.

Switches, Cut-Outs, Etc.:—

ELECTRIC CONTROLLER. W. H. Morgan, Alliance, Ohio, 582,663. Filed November 14, 1896.

So constructed that the contact arm of the rheostat will be turned in the same direction when the operating lever is moved in either direction from its normal position.

ELECTRIC SWITCH. E. H. Wright, Chicago, Ill., 582,840. Filed March 13, 1896.

Especially designed for use in arc lighting.

Telephones:—

TELEPHONY. J. Absterdam, New York, 582,773. Filed May 27, 1892.

Consists in maintaining a magnetic field in suitable inductive relation to the line and setting up in the line independent, magnetic variations corresponding to speech. See page 569.

RECEIVER FOR TELEPHONES, PHONOGRAPHS, OR SIMILAR INSTRUMENTS. C. W. Dennis, King's Ferry, N. Y., 582,901. Filed August 7, 1896.

The receiver tube is provided with a hollow bulb, placed therein and with which the receiver proper is connected, the effect being to intensify the sound.

TELEPHONING FROM CARS. M. Garl, Akron, Ohio, 582,913. Filed January 10, 1896.

Comprises a field telephone, a portable pole provided with arms forming terminals of a circuit and arranged to make contact with terminals on the pole in close proximity to contact springs adapted to keep the circuit normally closed.

TELEPHONE TOLL APPARATUS. F. M. Archer, New York, 582,714. Filed April 30, 1896.

Operated by the insertion of a key; a main shaft adapted to send in a call when rotated in one direction and to entrap the key when rotated in the opposite direction.

THE STOCK MARKET

SLIGHT IMPROVEMENT.

THERE was very little improvement in general trade last week, but curiously enough it came from quarters that have long been stagnant, the northwestern cities of the Pacific slope. The average movement of merchandise was slow and dull. The like was true of the stock market due to tariff uncertainties, and anxiety about our relations with Spain.

During the week, Western Union sold to the extent of 22,405 shares and gradually regained its old status, rising to 78⅜ and closing at 77¾. General Electric was active, under bear attacks as to loss of certain desirable contracts, and went off to 28⅝, but closed at 30, there being sold in the week 22,308 shares. On the Boston market, American Bell stock has naturally become far more active than usual. The last two weeks have seen 3,348 and 1,146 shares dealt in, and the price shows a tendency to stay above 230. There is great curiosity as to the movements in the stock and its accumulation in certain hands.

In New York City, Metropolitan Traction stock has advanced as a result of the court decision which enables it to go on with its electrical equipment of Eighth avenue. The equipment of Manhattan elevated roads with electricity while not confirmed has been hinted again, giving strength to the stock up to 85⅝.

GAS ENGINES AND THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

We have received a communication from the Climax Gas Engine Company, Brooklyn, N. Y., in which they offer to place all the facilities of their shops at Erie, Pa., at the disposal of a committee of the National Electric Light Association about to meet at Niagara Falls. The company will furnish all instruments necessary to make a complete and accurate test of their gas engines, as well as of those of other makes to be found at Erie.

As Erie is only 100 miles from Niagara Falls, the Climax Company hopes the association will avail itself of this offer, made in good faith.

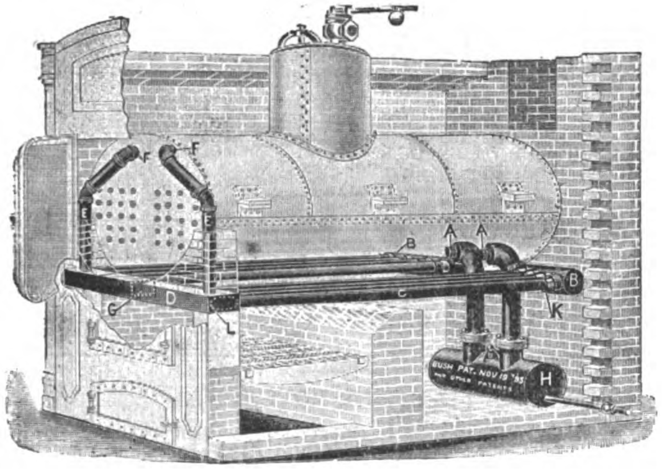
TRADE NOTES & NOVELTIES

THE HASCALL STEAM GENERATOR.

THIS is the name given the device shown in the engraving, designed to be placed under steam boilers generally, to increase their generating capacity and to make steam in the quickest, most economical and efficient manner. In this is comprehended a very great saving in the use of fuel, a dryer and more commercially profitable quality of steam than can be produced by any other means, an absolute freedom from scale or sediment formation in boiler, with a consequent longer life of the same.

While the engraving is self-explanatory to a large extent, we may say in addition that the generator is simplicity itself in its construction and principle of operation and presents no change of conditions to the engineer as regards firing or running the boiler to which it may be applied. It is accessible at all times without disturbing the boiler setting and the parts can be readily taken out, examined and replaced should this at any time be deemed necessary.

In attaching the generator, the rear head of boiler is tapped and connections made with close nipples at A A, which communicate with back headers B B. Expansion joints K permit the tubes to expand and contract freely without injury in any way to the boiler connections. The tubes C are screwed at the front into the water box or arch D, which is divided by a partition as shown by the dotted line at G. The front riser tubes E E, extend from the ends of the water box and enter the front head above the fire tubes and water level at F F.



The Hascall Steam Generator.

Circulation of water commences as soon as the fire is started, entering from the lower portion of the boiler into the generator at A A, and passing through the back headers B B, thence forward through the tubes C, which are immediately over the fire, into the water arch D, and up the risers E E, discharging at F F, into the steam space of the boiler. This circulation is constant and extremely rapid and always in the same direction, viz., from the lower point at the back end of the boiler to a point just above the water line in the front head. Such sediment as may be contained in the water tends to precipitate as soon as the temperature reaches the boiling point, and is carried in at A A by the rapidly flowing current, and, being of a greater specific gravity than water, continues on its downward course to the mud drum H, while the water turns to right or left, flowing through the piping as already described.

Thus, after heat has precipitated the foreign matter contained in the water, it is removed and isolated by reason of very rapid circulation and gravity, and the boiler and the generator remain perfectly clear and free from scale. In fact, every point of the interior of the generator and boiler is thoroughly washed by the rapid circulation of the water.

A section of piping was recently taken from one of these generators that had been used under a boiler in the building at the corner of Reade street and West Broadway, New York City, for four years. It was practically free from scale. In boilers where incrustation has already become a serious obstacle the attachment of the Hascall generator will, it is claimed, remove the incrustation and entirely prevent any further accumulation.

The generator is constructed of high grade material throughout and to meet all requirements of service for which it is designed, and is approved and insured by the representative boiler insurance companies. Data at hand covering an extensive use of the Hascall steam generator show that there is no difficulty in keeping steam at the pressure desired, that the saving in fuel is 10 to 30 per cent., or, using the same quantity of fuel as formerly, the capacity of the boiler is increased in the same proportion.

Substantiating this are the results obtained with the Hascall generator by many prominent users, among others the Standard Rock Candy Company of Brooklyn, N. Y. This concern has had one of these machines under a boiler 6 x 18 feet, and before its installation usually burned about 60 tons of coal per month. The generator has reduced this by 15 tons or 25 per cent., making the saving in fuel alone enough to pay for the generator in twelve months' time. Where formerly it took the engineer an hour to get up steam, but half that time is now required, and much less trouble is experienced in keeping up to the required pressure.

At Tarrytown, N. Y., one of these machines installed under one of the boilers at the water works pumping station, showed an increased efficiency in the boiler of nearly thirty per cent. A test made with the generator by the Brockton Last Company of Brockton, Mass., showed a saving in coal of over 20 per cent., and an increase of power considerably beyond anything the boilers ever produced before. This entire plant is now equipped with the device. It is claimed by engineers who have had experience that a horizontal tubular boiler with generator attached is the equal of the water tube type.

The Hascall Steam Generator Company, sole manufacturers, have branch offices in all the principal cities of the United States. The executive headquarters are at 66 Broadway, New York City, where models are at hand to demonstrate the principle of the generator and show its operation.

A LONG LIST OF SALES MADE BY THE ELECTRICAL EXCHANGE, CHICAGO.

THE Electrical Exchange, Chicago, report that their business is still on the increase, so much so as to render it necessary to have their hands work considerable overtime for some time past while in their repairing department they have been obliged to run day and night for over a week in order to get through the work in that branch of their business.

They have made the following shipments within the past few weeks: Marais Lumber Company, Grand Marais, Mich., one 1,000-light National alternator; Junction Iron and Steel Company, Mingo Junction, O., one 50-light Standard arc dynamo; Chicago Illuminating Company, Chicago, one 60-light Western Electric arc dynamo; one 750-light Slattery alternator; Mount Clemens Electric Company, Mount Clemens, Mich., one 50-light T. H. 12,000-c-p. arc dynamo; Lake Geneva Ice Company, Lake Geneva, Wis., one 25-light Western Electric arc dynamo and complete plant; Kenosha Electric Light Company, Kenosha, Wis., one 60-light Western Electric arc dynamo; F. D. Phelps, New Haven, Mich., one A-35 650-light T. H. alternating generator and complete plant; John A. Stewart, Cincinnati, O., one 60-light, 2,000-c.-p. Wood arc dynamo; Harrison Electric Light Company, Allegan, Mich., one 100-kilowatt 500-volt power generator; F. C. Stanford, Chatsworth, Ill., one 35-light Western Electric arc dynamo and lamps; Savannah, Thunderbolt and Isle of Hope Railway Company, Savannah, Ga., four W. P. 30 T. H. railway motors; Eastern Electric Equipment Company, Cleveland, O., two W. P. 30 T. H. railway motors; Raymond Bros. Impact Pulverizer Company, one 25-h.-p. 110-volt Westinghouse motor; Village of Mingo Junction, O., complete arc light plant; Sampson Steam Forge Company, Chicago, one 25-light Ball arc dynamo and complete plant; Boepple Button Company, Muscatine, Ia., one 18-h.-p. 110-volt Edison motor; Leslie & Gilbert, Hopkinsville, Ky., one 1,300-light Slattery alternating generator; Rockport Water Works Company, Rockport, Ind., one 1,000-light Brush alternating generator; Chicago Armature Company, Chicago, Ill., one 200-light T. H. incandescent dynamo; one 3-h.-p. 220-volt Jenney motor; H. E. Peltz, Cross Fork, Pa., one 225-light Sperry incandescent dynamo and complete plant, Herbert Simmons, Wellston, O., one 65-light incandescent dynamo; De Land & Co., Fairport, N. Y., one 7½-h.-p. 220-volt Eddy motor; R. W. Schmelz, Jacksonville, Fla., one 250-light incandescent dynamo and complete plant; Charles Doutz, South Clinton street, Chicago, one 10-h.-p. 500-volt Eddy motor; McPherson

Water and Electric Company, McPherson, Kan., one 250-light incandescent dynamo; Harris Automatic Press Company, Niles, O., one 100-light incandescent dynamo; Lyon & Healy, Chicago, one 5-h.-p. 125-volt C. & C. motor; Specialty Manufacturing Company, Milwaukee, Wis., one 10-h.-p. 220-volt Belding motor; Libertyville Electric Light Company, Libertyville, Ill., one 400-light Brush incandescent dynamo; Standard Lamp Company, Marion, Ind., one 400-light Brush incandescent dynamo; E. C. Bennett, Monadnock building, Chicago, one 75-light 110-volt Detroit dynamo; Carbondale, Ill., Electric Company, one 45-light 1,200-c.-p. T. H. arc dynamo. Also motors and dynamos of various units to the following: J. W. Berry, E. Washington street, Chicago; Elizabeth Iron Bridge Works, Elizabeth, Ill.; Fleager & Whittenberg, Georgetown, Tex.; Charles Gorton, Racine, Wis.; Pliny Norcross, Janesville, Wis.; Galveston City Railway Company, Galveston, Texas; Hoyt & Jackson Company, Norwalk, O.; Keelyn & Smith, Milwaukee, Wis.; John McQueen, Kirkland, Ill.; W. A. Mercer, Dawson, Ga.; Savannah Street Railway Company, Savannah, Ga.; Edison Vitascope Company, Water Valley, Miss.; Charles Wormley, Muscatine, Ia.; Pioneer Electric Works, Chicago; F. K. True & Co., Caxton building, Chicago.

WARD LEONARD ELECTRIC CO.

The factory of the Ward Leonard Electric Company was entirely destroyed on May 20 by a serious fire, which began in some adjoining buildings, and did great damage throughout the neighborhood. The Ward Leonard Company was well insured, and within 48 hours had leased a new factory building at the corner of Seventh and Clinton streets, Hoboken, which has ample facilities and is equipped with a first-class power plant. The Ward Leonard Company placed orders while the fire was in progress for tools and supplies required for beginning business in their new factory, which will be running with full force by the end of this week. The fire began between 7 and 8 o'clock in the evening. Fortunately for the Ward Leonard Company they were running night and day on account of having a large and increasing volume of business. This fact made it possible for the company to save all of its books, records, data, and other similar records, which are of the greatest importance to the company in its business, and which it would have been impossible to replace. On account of the preservation of these records the customers of the company will not experience any embarrassment in securing promptly any rheostats which have ever been heretofore made by the company. This is fortunate, since the company, in addition to its regular lines, did a very large business of a special nature for various electrical concerns.

WESTERN TELEPHONE CONSTRUCTION CO.

The Western Telephone Construction Company reports contracts for seven new telephone exchanges, involving the use of over two thousand telephones, since the decision was published. Some of these contracts are for furnishing apparatus in place of other makes. Among the contracts are 300 for Spartansburg, S. C.; 150 for Florence, Ala.; 300 for a new branch exchange at Fort Wayne, Ind.; 100 for Aledo, Ill.; 200 for Cameron, Mo.; and other places which the company does not care to disclose at present.

It is asserted by the Western people that their business will show a very large increase in the next three months, and, as an evidence of it they are putting in a large amount of new machinery and extending their capacity, once more, one-third their present manufacturing ability.

B. & O. MOTOR SERVICE EXTENDED.

The electric service of the Baltimore and Ohio Railroad Belt Line, which has heretofore run from the power house, corner of Howard and Hamburg streets, to the Mount Royal station, Baltimore, has been completed to Waverly, a distance of two miles. Hereafter freight trains will be drawn to that point by the electric locomotives. The object of the extension is to do away with the smoke nuisance in the annex, and also to enable rapid transit over the heavy grades which lie between North avenue and the York Road.

ESTIMATES WANTED FOR NEWPORT, IND.

What we would like to find out is what it will cost us to install an electric light plant. Ours is a small town of 700 or 800 people and has only two main streets running through the wn east and west, the cross streets being short. The east d west streets are about one mile long and in the main par the town there is about as much territory south and north here is between the two streets. The creek is on the north and a large hill on the south preventing it from ever being any wider. From this description if you or your readers can give us an approximate estimate of the cost of putting in such a plant as will light our town and cost of running it after in and the cost of arc lights and incandescent lights per month it will aid us very materially in arriving at a definite conclusion.

WM. RHEUBY,
By Order of Committee.

Newport, Ind.

RUSHMORE MARINE DYNAMOS AND PROJECTORS.

THE Rushmore Dynamo Works, of Jersey City, who have for years made a specialty of marine equipment, have brought out a line of direct connected sets or steam dynamos in which every detail has been perfected to meet the exacting requirements when working in cramped quarters in hot, damp engine rooms where the temperature is often beyond human endurance.

Fig. 1 shows one of the new generating sets of 20 kilowatts capacity built in the same frame with their new type engine of 25 horse power at 350 revolutions per minute. The magnet is a continuous steel casting with form-wound coils. The armature is of the iron clad type wound with continuous copper bar on a new wave system, insulated with mica, and is guaranteed against short circuit when saturated with sea water. There is no shaft from the rear of the armature, but the engine flange couples directly to the armature core body, insuring perfect alignment. The dynamo has but one bearing which is self-oiling, of large capacity with patent settling chamber.

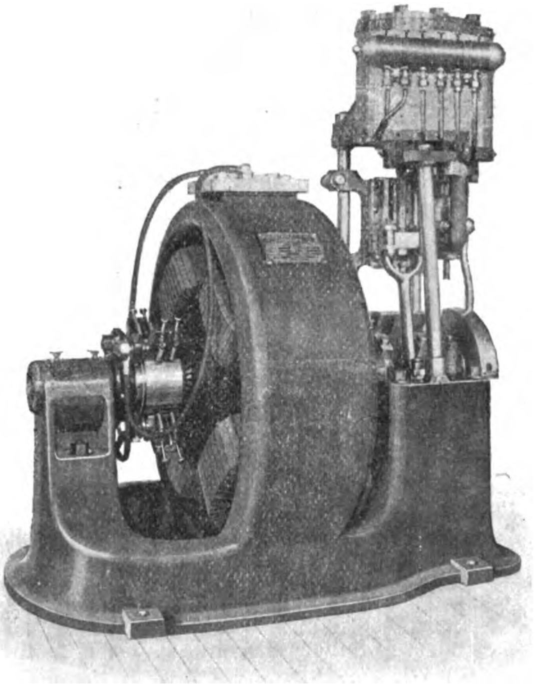


FIG. 1.—THE RUSHMORE MARINE GENERATOR.

The engine is of new design with the frame of steel forgings, highly finished. The crank shaft with counterweights and couplings is forged in one piece, machined all over and drilled hollow. The coupling which is forged with the shaft bolts directly to the armature and the bearings are extra large to carry the extra weight. The automatic cut-off governor is very powerful and regulates within one per cent. All wearing surfaces are lubricated from a single tank oiler with sight feeds leading to every wearing surface. Machines are so perfectly balanced that they will run at double the rated speed without vibration and may be mounted on bulkhead or grating without foundation. The same type of generator is also made for belt driving in sizes up to 150 kilowatts.

As is well known, the Rushmore Works build a complete line of high power projectors and they now have a complete line ranging in sizes from 10 to 72 inches in diameter, taking from 5 to 300 amperes. They are now building a number of 30-inch naval projectors with electrical distant control mechanism for the large battleships.

Fig. 2 shows one of the latest type projectors with parabolic lens as used on the transatlantic liners. The Rushmore Works have the only lens making plant in the country and they have recently completed a magnificent machine weighing several tons which will grind lenses up to 6 feet diameter with an accuracy heretofore considered impossible, and they will shortly complete a 72-inch light for long distance signalling which will take a current of 300 amperes.

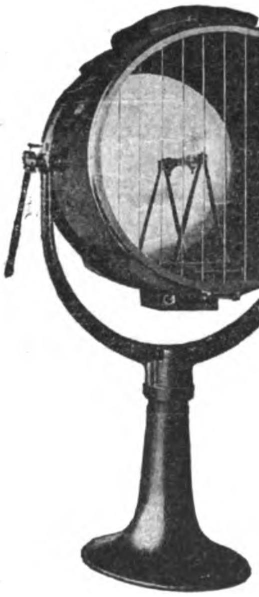


Fig. 2.—The Rushmore Marine Projector.

ADVERTISERS' HINTS

H. T. PAISTE COMPANY, Philadelphia and Chicago, observe that "money saved is money earned," and that one of the surest ways of saving it is by buying their cut-outs, of which they carry as many as twenty-six styles of open and covered.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., quote from the report of the superintendent of the Carnegie Library Building in which are installed three 12" and 20" x 12" Westinghouse compound engines. The entire plant represents an outlay of $60,000 and but $71.43 was expended on repairs, or less than 20 cents a day for the year.

THE GENERAL ELECTRIC COMPANY call attention to the fact that 33,000 of their magnetic blow-out lightning arresters are in use.

L. A. CHASE & COMPANY, 161 Fort Hill Square, Boston, Mass., publish a very gratifying letter from the Summerside Electric Light Company, Summerside, P. E. Island, on the merits of their circuit breaker.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., give several sound reasons why their renewed lamps are fully equal to new lamps.

BULLOCK ELECTRIC MANUFACTURING CO. continue to advertise direct connected motors for machine tools. This company have made this branch a special study from the start and they are better than ever qualified to equip plants of any size at short notice.

C. H. McEVOY, Lowell, Mass., furnishes cords for a large variety of purposes, such as telephone, medical battery and switchboard uses.

THE BOSTON GEAR WORKS, 34 Hartford street, Boston, Mass., manufacture gears of every style and size.

KROTZ, ALLEN & KELLY, Springfield, O., advertise the K. A. K. system for street, elevated and trunk line electric railways. Its details are described more fully elsewhere in this issue.

MR. ELMER P. MORRIS, of 15 Cortlandt street, New York, has a useful little wire calculator, which he is sending out to the trade as a novel advertisement. It consists of two dials, and gives the number of lamps and distance in feet that the current has to be transmitted; the size of wire necessary can readily be discovered. Mr. Morris will send one of these calculators to anyone sending him a stamped envelope.

NEW YORK NOTES

MR. ROBERT B. COREY, of New York, who is so well known in the electrical business, has just been appointed by the Simplex Electrical Company, of Boston, as sales agent for their wires and cables in New York City and State, Pennsylvania, New Jersey, Maryland and Delaware. Mr. Corey will have his office at 711 Havemeyer building, New York, and will be pleased to hear from any of his numerous friends in want of quotations on this class of goods. Mr. Corey's large acquaintance amongst the electrical fraternity throughout the whole country should make him a valuable acquisition to the staff of the Simplex Company.

THE ROUSSEAU ELECTRICAL FACTORY, beyond the Harlem, was visited by fire on Friday last, when about $5,000 damage was done. Two of the men were badly burned. The fire was due to an explosion of kerosene in the bicycle plant. Mr. Rousseau has energetically gone ahead in resuming his electrical and other work.

WARREN WEBSTER & CO., manufacturers of feed water heaters and proprietors of the Webster system of heating for buildings, have removed their New York office to 322 Broadway.

THE ELECTRO-VISUAL TELEGRAPH COMPANY, of New York City, has been formed with a capital stock of $50,000, by M. C. Ebel, F. S. Pierson, G. L. Mason and C. Spriggs, of New York City, and M. G. Walford, of Hackensack, N. J.

DR. W. M. HABIRSHAW, of the India Rubber & Gutta Percha Insulating Company, has just returned from a long European trip in good health and spirits.

MR. R. EDWARDS, JR., of Edwards & Co., has just returned from an extended trip through the West and reports having met with unusually good success, booking a large number of orders for their new fog motor gong of which they are making a specialty. Edwards & Co., have accepted the agency for the American Electric Fuse Company, manufacturers of Maxstadt fuses and fusible cut-outs.

MR. H. F. NOYES, patent solicitor, Syndicate Building, New York City, has brought out an excellent little brochure in stiff linen cover, giving a great deal of useful and practical information as to patents and patent office procedure. No fewer than 33 forms are included.

MR. A. D. FRENCH, 200 Broadway, New York, has removed to larger offices in the Edison building, 44 Broad street, where he can be found between 10 and 4 in regard to all matters connected with lumber supplies for electrical work, such as octagonals, cross arms, creosoted lumber, piling or conduit. He has put on storage in New York a large supply of octagonals and cross arms for immediate delivery.

AMERICAN IMPULSE WHEEL COMPANY 120 Liberty street, New York City, will be glad to send to any address a copy of their very interesting pamphlet on water wheel work, and a copy of their form for filling up with data by any one desirous of making an inquiry as to the use of a water power anywhere.

MR. H. A. STRAUSS has been awarded the contract for the electric wiring installation of the Essex County (N. J.) Hospital for the Insane, at Overbrook, N. J. The contract calls for complete installation of basement, first and second floors, including the dome. Mr. Strauss is in the market for material for the above installation. Iron armored conduit will be used throughout.

Mr. Strauss is also in the market for materials for a 4½-mile electric railway complete, including track, overhead construction, and power station with engines, boilers, dynamos, etc.

BUFFALO, N. Y.—From their St. Petersburg office the Buffalo Forge Company, Buffalo, N. Y., have recently received an order for two engines of the inclosed type running in oil. Both are of the same size (8 x 10), and they are to be shipped to St. Petersburg, Russia. These engines will be used for electric lighting. The engine department of this company has been very busy and unable to keep up with orders. A new five-story building, 210 x 60 feet, is being built.

MR. F. R. UPTON, general sales manager of the National Tube Works, McKeesport, Pa., was in New York City last week. He has recently issued an admirable little book on their steel trolley poles, and finds daily more demand for their tube specialties in electrical lines, where his great familiarity with the questions arising gives him a great advantage.

THE ELECTRO-CHEMICAL STORAGE BATTERY CO have removed their factory from Belleville, N. J., to 35 Ge street, New York City. They will retain their offices in Johnston Building, Broad street. The company report ar cellent demand for their batteries.

THE KINGS COUNTY ELEVATED ROAD, in Brooklyn, is to be reorganized and equipped with electricity, using Mr. F. J. Sprague's system of "unit" control.

THE GOODYEAR VULCANITE COMPANY, 353 Broadway, New York, report installing a 200-horse-power steam engine in their works at Morrisville, Pa. The demand for their hard rubber goods for electrical and mechanical purposes is steadily increasing necessitating enlargements of their factory in all directions.

NEWARK, N. J., is rejoicing in some beautiful new Brill cars put on by the Consolidated Traction Company. The old cars seat only 21 passengers; the new ones are 25 feet long and seat 36 people.

ST. LOUIS, MO., is renewing its lighting contracts and has before it a proposition to buy a city plant in 20 annual instalments.

WESTERN NOTES

THE WESTERN ELECTRIC COMPANY, Chicago, owing to the great increase of business in their electrical supply department, are making considerable extensions in their warerooms so as to enable them to give adequate space to that part of their business. They are fitting up in very tasteful style quite a considerable part of the second floor of their South Jefferson street building for this purpose. One room in particular, in which samples of the great variety of supplies carried by this company are to be displayed, will be illuminated by handsome chandeliers which will show off the goods to advantage.

THE MIDLAND ELECTRIC COMPANY, a new manufacturing concern just formed in Chicago, has opened an office at 1564 Monadnock Building. Mr. Joseph Kettlestrings, the manager of the company, has long been identified with electrical interests in Chicago, and withdraws from a large electrical manufacturing company to take charge of the interests of the company he now represents. The new firm will manufacture a superior line of alternating arc lamps and transformers, as well as give their attention to general electrical engineering work.

MR. GEO. F. BRUNT, of East Liverpool, O., has purchased the entire interest of his partner, Mr. C. F. Thompson, in the porcelain electrical supply business formerly carried on by Brunt & Thompson. His intention is to continue the business with a full line of high grade porcelain supplies, and to win for them a reputation higher even than that already enjoyed by these specialties.

OKOLONA, MISS., is about to put up a water works and electric light plant. The engine contract for the electric plant has been awarded to the Ball Engine Company, Erie, Pa.

THE F. & C. MOTOR SWITCHES make up a new line of goods which the Electric Appliance Company have recently added to their already complete and extensive stock. The F. & C. switches appear to fill the bill for a low-priced motor switch in capacities of 35 and 65 amperes. The Electric Appliance Company will be pleased to send special prices on these goods on application.

MR. CHARLES A. ARCHER, who was formerly with the Edison General Electric Co., in Chicago, and also the Adams-Green Co., has become associated with the Electrical Construction Co., of Madison, Wis., which has its office in the same place as the Electrical Supply Co., of which Mr. S. W. Burch is manager. Mr. Burch, whose energy is well known throughout the Northwest, is working as hard as ever for business, and states that they are getting a good share of what trade there is to be had in their territory.

THE DAYTON FAN AND MOTOR COMPANY, Dayton, Ohio, report business very good. Large orders have been received this season, and their products are enjoying everywhere well-deserved commendation.

MASSILLON, O.—A. Y. Gordon, manager of the Farmers' elephone Company, and the inventor of an adjustable transter bracket, has sold the exclusive right to use his patent he American Electric Telephone Company of Chicago.

ORED LAMPS.—A satisfactory coloring for incandesamps has been long sought. The Electric Appliance y are placing on the market a new coloring, known as ctrical Chemical" lamp coloring, which it is claimed lamps in such a way that it is difficult to distinguish n genuine colored glass lamps. An examination of done with this coloring shows that it is a superior

M. HAMILL, Jr., vice-president of the Brush Elecpany, was in New York last week. He has accomery successfully the heavy task of transferring the Brush manufacturing plant and several hundred men to Lynn, and has already got the wheels going, to fill recent large orders for Brush apparatus, particularly the big arc lighters.

THE CHRISTY FIRE CLAY COMPANY, St. Louis, Mo., have recently undergone a reorganization of their management, on account of the death of Mr. J. B. Clements, the vice-president and general manager. The officers now are: C. M. Christy, president; C. T. Farrar, vice-president; W. C. Morris, general manager and treasurer; F. P. Jones, secretary; R. D. Hatton, assistant secretary, and V. P. Ring, traveling representative.

ST. LOUIS, MO.—The bondholders of the Edison Electric Illuminating Company, of St. Louis, have voted overwhelmingly in favor of a plan of reorganization to be perfected by the issuance of $4,000,000 in bonds, the plan being to give a 5 per cent bond and ten shares of cumulative 5 per cent preferred stock for two 6 per cent outstanding bonds. Of the new issue, $2,000,000 will be devoted to taking up present bonds; $1,100,000 to taking up the bonds on the Missouri Electric Lighting and Power plant; $400,000 to providing for the floating indebtedness, and $500,000 to the construction of the company's conduits. Of the $4,000,000 new stock, $2,000,000 is to go to the present bondholders; and $2,000,000 will go to the present stockholders on their payment of $6 per share. The latter payments will liquidate the interest which became due in February last.

THE AMERICAN ELECTRIC VEHICLE COMPANY is to have a new factory, it is said, at New Chicago, Ind., between Hobart and Liverpool, where a new town is being laid out. They are said to have orders on hand for $50,000 of electric carriages. The Excelsior Carbon Works are also to go to New Chicago, it is stated.

INDIANAPOLIS, IND.—The Commercial Telephone Equipment Company, with a capital of $25,000, has filed articles of incorporation. The object of this company is to build and equip local telephone exchanges throughout the States of Indiana, Michigan and Kentucky. The following are the officers and directors: President, Delos Thompson, of Rensselaer; vice-president and general manager, Edgar H. Andress, of Lafayette; secretary, Charles E. Mills, of Rensselaer; treasurer, Thomas J. McCoy, and superintendent of construction, James F. Watson, both of Rensselaer.

H. B. CAMP COMPANY, Aultman, O., writes us: "We have the contract for furnishing, laying and doing the complete subway work for the Delaware and Atlantic Telephone Company, at Wilmington, Del. We have our men now on the work. We are also at present shipping our vitrified clay conduit pipe to Dallas, Texas; two companies in Boston, Mass.; three companies in Chicago, Ill.; to Buffalo, Des Moines, Pittsburg, Cincinnati, Cleveland, Philadelphia, Detroit and Toronto. Our manufacturing capacity is 35,000 feet daily at our three plants. The prospects are quite flattering for a large business this season."

MR. FRANK J. SPRAGUE will be in charge of the electrical equipment of the Chicago South Side Elevated Road, and will there demonstrate his plans for the operation of such roads under the varying conditions of large and small loads, with single and multiple car units. Sargent & Lundy are the construction engineers.

MR. H. W. KILBOURNE, general sales agent of the Ohio Storage Battery Company, Cleveland, O., reports an increasing demand for the Ohio battery, and that the factory is busy filling orders.

MR. J. L. MORGAN, city electrical inspector of Kansas City, Mo., has been instructed to make a series of careful tests on the electrolysis of the local water pipes, with a view to their better protection.

DIXON, ILL.—The Dixon Power and Lighting Company have just installed a 16-horse-power Edison motor in Baldwin & Son's grist mill in this city.

MR. THOS. G. GRIER, of the Western Electric Company, Chicago, has been experimenting on Babbitt and composition metal for street car bearings and has succeeded in producing a high grade, long-wearing bearing. Mr. Grier has recently issued a new edition of Wiring Tables, in which is explained how they are made and how to use them. The book has met with very well deserved success, and is highly creditable to the author.

BROWNLEE & CO., of Detroit, the well-known manufacturers of wooden poles and cross arms, report a very active demand for cross arms this spring. Their sales during April were over one hundred carloads.

THE DYER ELECTRIC COMPANY, of Chicago, has certified to a change of name to the Dyer Tower and Motor Company, and to an enlargement of the objects of incorporation.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY of Cleveland, O., has been incorporated by F. M. Kirk, S. D. Latty, H. T. Latty, J. A. Williams, S. B. Abbott and S. Albert, Jr., with a capital stock of $10,000. Its intention is to manufacture telephone supplies.

NEW ENGLAND NOTES

ARMINGTON-SIMS ENGINE COMPANY, of Providence, R. I., have received an order from the Edison Electric Illuminating Company, Bellefonte, Pa., for engines to replace those destroyed in their recent fire. An order has also been received from Columbia University, New York City, for two heavy duty self-oiling cross compound direct connected engines, for the new university buildings on Morningside Heights.

BOSTON EDISON COMPANY. The stockholders of the company have subscribed for 3,240 shares at $120 per share, for the extension of the business. Another annex station is to be built.

BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have a contract for furnishing the steel roof for a large store house which is to be erected by the Waterbury (Conn.) Manufacturing Company. This building is 54 feet wide and 144 feet long. The side walls are of brick. The roof will be supported by steel trusses. The covering is to be corrugated iron lined with the Berlin Company's patent anti-condensation fireproof roof lining.

PHILADELPHIA NOTES

THE RIDGWAY DYNAMO AND ENGINE COMPANY, Ridgway, Pa., in addition to the large list of sales published a week ago, report the following business: One 15 x 16 engine, Wellston Coal Company; one 13 x 12 D. C. engine to 60-k. w. generator for Lester Manufacturing Company, Lestershire, N. Y., and two 100-k. w. generators for David S. Brown & Co., New York City.

ERIE, PA.—The Erie City Iron Works will, it is stated, add dynamos and motors to their boilers and steam engines. The new machine will be the design of Mr. C. J. Sturgeon, formerly of the Keystone Electrical Works, and Smith Hill Elevator Company. The building of motors is to begin at once.

SOUTHERN NOTES.

VIADUCT MANUFACTURING COMPANY, Baltimore, Md., are pushing the sale of their warehouse or interior telephone system, in its improved automatic form. After the conversation is over, the act of placing the receiver where it belongs, automatically moves the switch to its normal position. Any station can call any other independently. Desk sets or wall sets are supplied with this system, as desired.

SUMTER, S. C.—C. T. Mason, of Sumter, and P. E. Blow, of Knoxville, Tenn., have incorporated as the Telephone Manufacturing Company, which will make telephones at Sumter. The capital stock is $5,000.

GALVESTON, TEX.—The Brush Electric Light and Power Company have placed their order with the Ball Engine Company, Erie, Pa., for a 450-horse-power horizontal cross compound engine, which is to be direct connected to a Stanley alternating machine.

JOHN WEDDERBURN & COMPANY, 618 F street, Washington, D. C., have issued some very interesting literature in regard to patents and their own large share in securing them for hundreds of clients. One pamphlet, illustrated with views of their offices and of Federal buildings in Washington, tells how to get a patent. The other suggests 1,000 lines to work on. Both contain numerous testimonials for clients and well known public men.

SAVANNAH, GA. is to have a new electric light and power plant. A petition for the incorporation of the Edison Electric Illuminating Company of Savannah has been filed in the Superior Court. The petitioners are Charles A. Stone and Edwin S. Webster, of Boston, Mass., and George J. Baldwin, of Savannah. The period of incorporation named is twenty years with the privilege of renewal. The pincipal place of business is to be in Chatham county. The amount of capital stock to be actually paid in is stated at $100,000, and the company is to have the privilege of increasing its capital stock to any sum not exceeding $500,000.

BALTIMORE, MD.—The Blue Line is now being transformed from cable to electricity, and the old cable power house will be converted into a car barn. The American Car Company of St. Louis is supplying 16 new open cars.

CAMPBELL & ZELL COMPANY, Baltimore, Md., have sold 1,200 horse power of boiler capacity to the Metropolitan Traction Company, Washington, D. C. This is their fifth order from that source.

MR. E. J. WESSELS, General Manager of the Standard Air Brake Company, sails for Europe on the steamship Majestic on June 2, in the interest of the air brake business which has substantially increased from the time he first went over the ground in person. The Standard Air Brake Company closed the month of May by securing an additional order from the Colonies for twenty-eight air-brake outfits for electric motor and trail cars, and another order for additional motor-car air brakes. In view of the fact that their air brakes have been in use in the Colonies for nearly three years, this latest order emphasizes the success of the apparatus.

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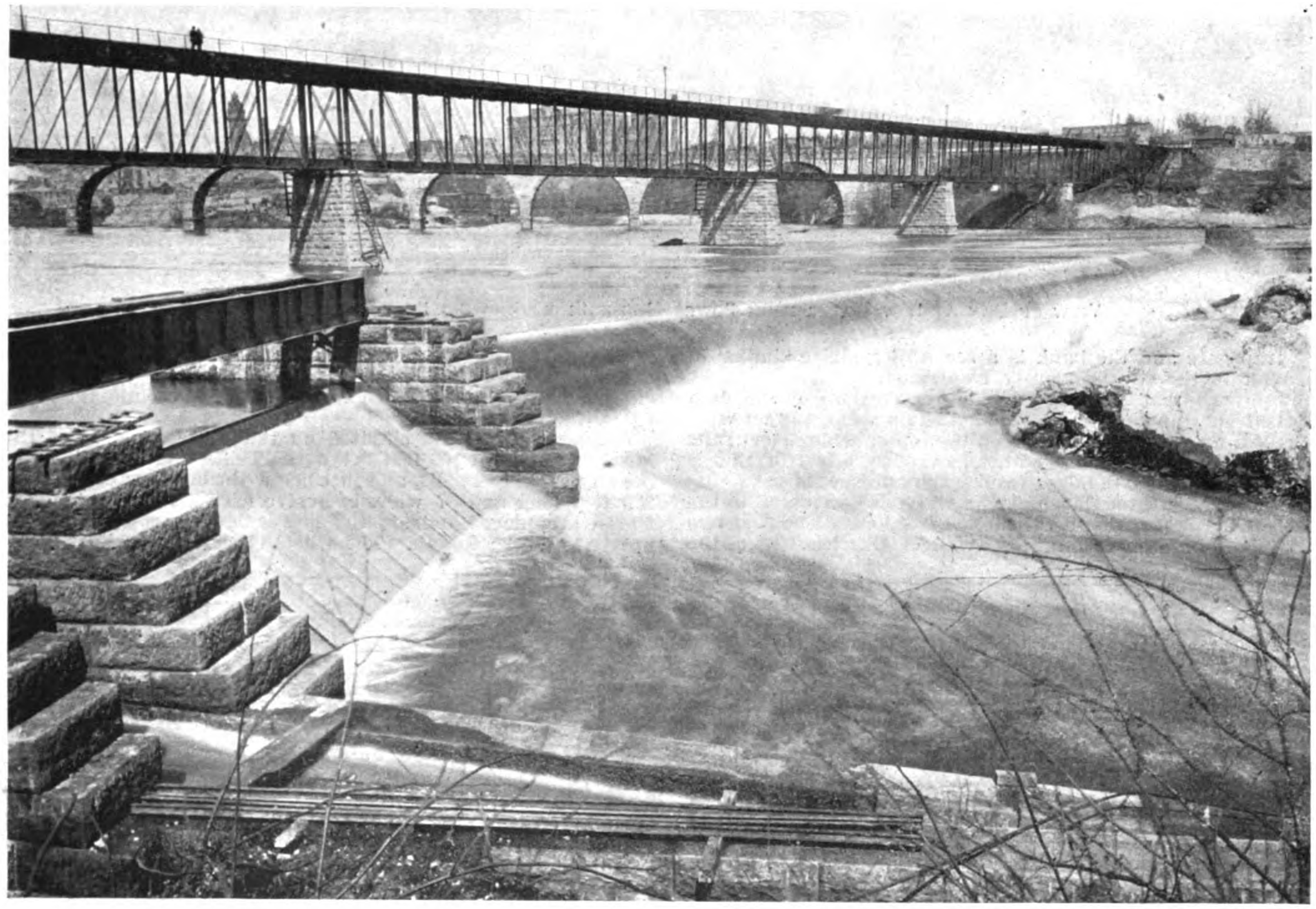
Vol. XXIII. JUNE 2, 1897. No. 474.

POWER TRANSMISSION

THE ST. ANTHONY FALLS ELECTRIC POWER TRANSMISSION AT MINNEAPOLIS.

THE completion of the hydraulic work at the Falls of St. Anthony has been announced. It marks the achievement of a great enterprise, in scope and character second only, perhaps, to the hydraulic work which has made the waters of Niagara the servant of a vast territory. Within a short time the waters of the Mississippi will be propelling the street cars of two cities with an aggregate population of 360,000 and will, at the same time, operate large electric lighting plants and furnish current to large motors in the big mills, as well as to innumerable smaller motors in Minneapolis and St. Paul. In 1895 the Pillsbury-Washburn Flour Company, of Minneapolis, commenced the construction of a dam for the purpose of utilizing the fall of 20 feet in the rapids of the Mississippi River immediately below the Falls of St. Anthony. During the past winter the 10,000 horse power to be generated by a dam was leased for forty years to the Twin City Rapid Transit Company. That corporation being desirous of making an early use of the power, the work was pushed vigorously.



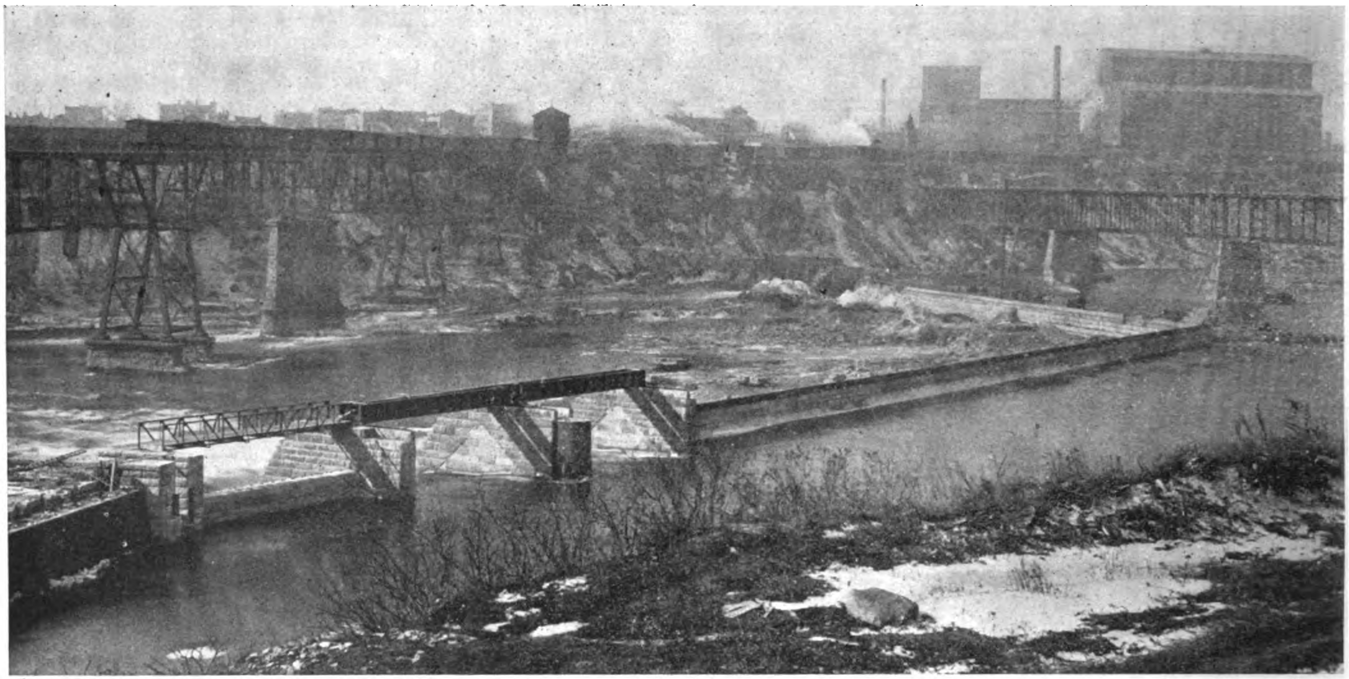
View of Dam at High Water from West Side of Mississippi.

The enterprise has been carried out by the St. Anthony Falls Water Power Company, which owns a strip of land on the north side of the Mississippi stretching from north of Sixth avenue to south of Eleventh avenue. It is along this strip, between Sixth and Eighth avenues that the head race has been built while from Eighth avenue to the opposite point of the river, between the Western Railway Bridge and the Tenth Avenue Bridge the dam has been thrown.

The engineer in charge of the work is Mr. De La Barre, who for many years has had charge of the extensive improvements of the St. Anthony Falls Water Power Company. The hydraulic motor equipment, that is, the turbines and accessories, are from the works of the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O. The electrical equipment will be furnished by the General Electric Company, and the system of generation and distribution will be a combination of the direct current and the three-phase alternating current system.

THE POWER HOUSE.

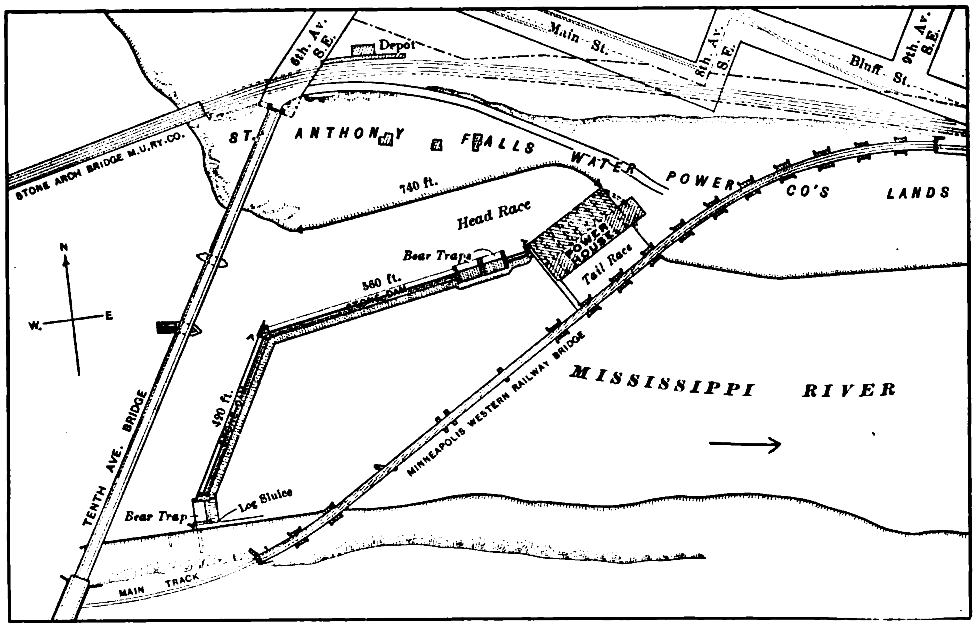
The power house is built out in the river in a southwesterly direction. At the river side of the power house and just outside is a log sluice, six feet wide and 200 feet long with stone wall and concrete bottom covered with railroad iron laid in cement. From the log sluice the dam starts in a westerly direction up the river. This section is 50 feet long, 12 feet 6 inches above the bed of the river and extends below the bed of the river 16 feet. Between this section and the second are two bear trap gates each 50 feet long operated by water-pressure. They are built of steel decked with wood and move between solid stone piers 8 feet in width, 40 feet long and 25 feet high. The first section of the dam is of solid masonry, the coping and down stream face being laid on granite; the balance of the wall is of blue limestone. The second section is 444 feet long and 14 feet high above the river. Its construction is similar to that of the first section, the coping, however, being of steel and concrete in lieu of granite. The third section runs in an almost southerly direction for a distance of 366 feet. It is 13 feet above the bed of the river and has about the same general construction as sections one and two, granite coping being used. Between this section and the bank of the river is another bear trap gate 50ft. wide, similarly constructed to the two on the power house side of the river and between the bear trap gate and the bank is a second log sluice similar in character to the one previously mentioned.



View of Dam at Low Water from Power House Side, Showing Bear Trap Gates.

The down stream face of each of the sections of the dam and the bear trap gates is provided with an apron 15 feet wide made of a level bed of concrete on the top of which steel rails have been laid and securely anchored. The effect of this is to protect the top of the dam from wash and scouring.

The head race through which the water is conducted to the wheels is 217 feet wide and about 600 feet long. The first two sections of the dam forming one wall of this head race, the retaining wall on the northeast side of the river forming the other.



Map of St. Anthony Falls Power Transmission Plant, Minneapolis.

Where the head race meets the wheel chambers a substantial steel racked frame the full width of the race is erected. This supports a rack 207 feet long which is constructed to prevent the passage of floating material to the wheels. In order, furthermore, to prevent the clogging of the rack with the natural accumulations of floating material in the race an automatic rack cleaner will be installed which will travel the entire length of the rack and will be operated by an electric motor directly attached to the machine. The dèbris gathered by this machine is deposited on a traveling belt conveyor and discharged into a sluice which in turn discharges into the river below the power house.

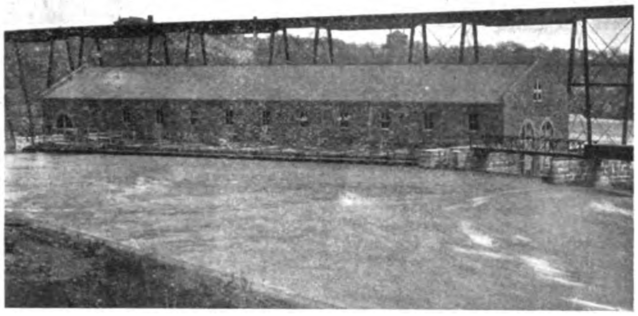
The power house is situated on the northeast side of the Mississippi, about 100 feet below the Tenth Avenue Bridge, in the city of Minneapolis, and just below the milling district. It is 250 feet long and 57 wide, exclusive of the wheel chambers. These are placed outside the power house proper and run nearly its entire length. The wheel chamber is 43 feet wide, making the width of the power house and wheel chamber 100 feet. The building is of substantial fireproof construction, the frame work and roof trusses being of steel, the walls of hollow tile 16 inches thick and the roof of tile covered with cement, finished with roofing slate and galvanized iron cornices.

In the building on the upper side of the wheel chambers, 18 feet above the generator floor is a gallery. This is 207 feet long and 10 feet wide and in it will be erected the switchboards, the transformers and electrical instruments together with the general offices, and the drafting room. The gallery is reached by two iron stairways, one at each end of the building. The interior of the building will be finished in hard wood and the walls in white. The main building is lighted by 15 windows, each 12 feet wide and 25 feet high. The switchboard gallery is lighted by 10 windows, 4 feet wide and 7 feet high.

To facilitate the handling of the machinery a 20-ton traveling crane will run on girder rails the full length of the building. It will be operated from a small cage built on the crane itself.

THE WATER WHEELS.

The capacity of the plant will be 10,000 horse power in 10 units of 1,000 horse power each. Each power unit consists of four horizontal Stilwell-Bierce & Smith-Vaile turbines, each 42 inches in diameter and running at a speed of 130 revolutions per minute. In addition two pair of 21-inch horizontal wheels will be used to drive two exciters. These are so arranged that they can be operated independently of the other machines.


BACK OF POWER HOUSE DURING HIGH WATER.

The turbines will be governed by Lombard governors.

The wheels are erected in chambers, four wheels in each; these chambers are of masonry with partition walls 4 feet thick; the flume head walls are each 7 feet 6 inches thick and hold flume head thimbles each 8 feet in diameter closed with heavy cast iron covers which carry the stuffing boxes through which the wheel shafts pass to the generator couplings. The wheels are supplied with water through two head gates in each chamber, each gate being 8 feet wide and 9 feet high, raised and lowered by a hoisting attachment on the deck of the wheel chamber. Each wheel chamber is provided with a separate and independent tail race, the full width of the wheel chamber, 100 feet long. The tail race passes underneath the power house and discharges into the main tail race below.

This is 207 feet wide and 100 feet long. The bottom or floor of the tail race, together with the foundation for carrying masonry in the building foundations is a solid bed of concrete 220 feet square and 2 feet thick.

THE ELECTRICAL EQUIPMENT.

The electrical equipment will consist at first of seven 700-kilowatt generators and two 100-kilowatt exciters, all directly connected to the turbine shafts. Five of the 700-kilowatt machines are three-phase alternators furnishing current at 3,450 volts; two are direct current generators furnishing current at 650 volts. The current from three of the alternators is intended for St. Paul and passes to the high tension switchboard and thence to step-up transformers where it is raised to 12,000 volts. At St. Paul it is stepped-down to 387 volts and is turned into rotary converters, which furnish direct current at 600 volts to the St. Paul Railway system. For the Minneapolis line the current at 3,450 volts is passed through step-down transformers and through rotary converters reaches the railroad feeder circuits also at 600 volts. Five rotary converters, each of 600-kilowatt capacity, are installed at the Third avenue power house, and the Thirty-first street and Niollat Station in Minneapolis, and at the Eagle street station at St. Paul, a distance of ten miles from the power house, and all run in parallel with the present generators.

The direct current machines are of the standard General Electric Company eight-pole railroad type. The main switchboard in the generating station will be of the panel type and will consist of two generator panels, eight feeder panels and one totalizing panel for the direct current system, one panel for each exciter, a panel for each alternating current generator and six alternating current feeder panels. The lightning arresters which will be employed to protect the transmission, are of the Wirt alternating current type made up of large metal cylinders mounted on porcelain base with a spark gap of 1-32 in. between each cylinder. The transformers are of the air blast type each of 233 k. w. capacity, to be erected upon platforms beneath which will be a chamber air tight with the exception of the ducts leading to the interior of the transformers. The air will be furnished by a 60-inch blower driven by a 5-horse-power 4-pole motor.

The rotary converters are 12-pole machines running at 400 revolutions and both transformers and rotary converters are very similar to those used in the transmission between Niagara Falls power house and the power house of the Niagara street station of the Buffalo Street Railway. The transmission will be through underground cables laid in 4-in. conduits of vitrified clay, and this is not the least unique feature of the whole transmission.

The power will be used primarily to drive the cars of the Twin City Railway Company, but in addition an extensive power service will be taken by the mills of the Pillsbury-Washburn Company. At present 750 horse power will be taken for the "A" Mill and 250 horse power for the "B" Mill. Furthermore, it is probable that the pumping of the municipal water system will also be operated by motor, driven by power from St. Anthony's Falls.

MECHANICAL

THE PRINCIPLES AND CONSTRUCTION OF WATER WHEELS.—IV.

BY W. E. WINES.

(Concluded.)

THE governor shown in Fig 13 is one of the eight distinct types of water wheel governors made by the Lombard Water Wheel Governor Company. Their three distinctive features are as follows:

First—There is at all times a reservoir of energy in the shape of air compressed under high pressure, which can be used instantly to move the water wheel gates, whether the water wheel is running or not; from this it follows that the time occupied in moving the gates to the correct position is independent of the speed of the water wheel itself.

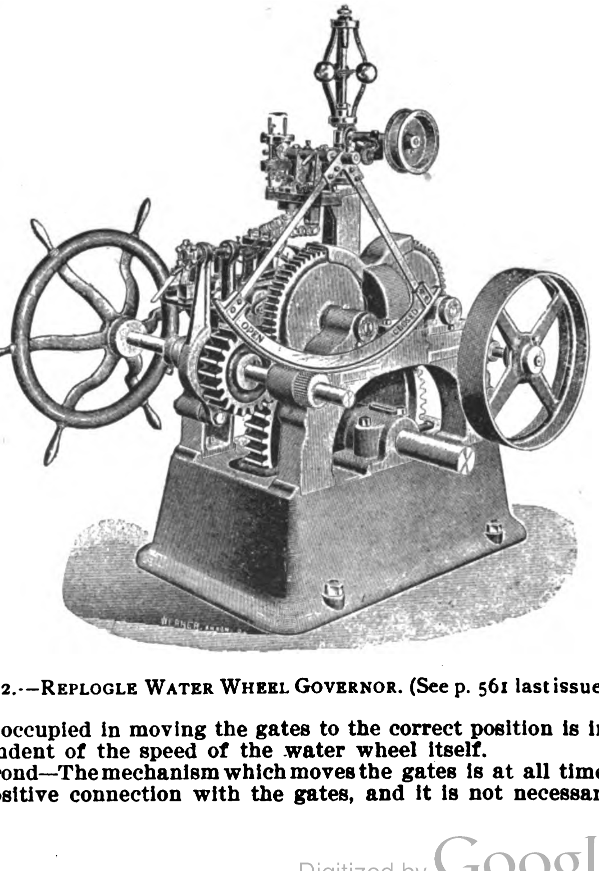


FIG. 12.—REPLOGLE WATER WHEEL GOVERNOR. (See p. 561 last issue.)

Second—The mechanism which moves the gates is at all times in positive connection with the gates, and it is not necessary to engage ratchets or clutches when a load change occurs, and the position of the gates must be changed. An hydraulic piston moving in an incompressible fluid is at all times positively connected with the water wheel gates and moves them with great promptness when occasion requires. Upon the whole load going instantly off a water wheel these governors will close the gates in about three seconds and the motion is smooth and easy and entirely free from hammering effects.

Third—These governors do not race. That is, no matter how great the load change they will not open nor close the water wheel gates too far, but will stop them at the correct position for the new load.

The makers claim for these governors that with well designed water wheels properly set they can give a speed regulation equal to that which could be obtained with a first-class steam engine working under like conditions of load variation.

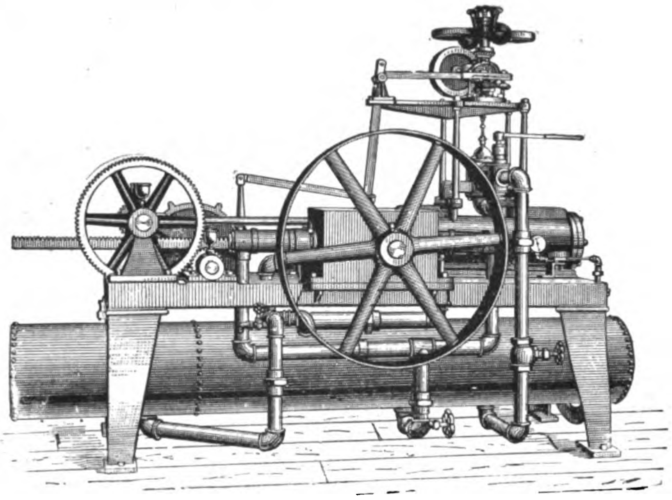


FIG. 13.—LOMBARD WATER WHEEL GOVERNOR.

To sum up briefly it may be said that the modern water wheel is vastly more efficient than any steam engine that ever has been or probably ever will be constructed; that it is equally reliable, less bulky, lighter in weight, less expensive both in first cost and in maintenance, and is capable of such nice regulation as to compare favorably with the best steam engine practice. When it is remembered that an insignificantly small portion of the world's water power is at present developed and that by the aid of electricity this power may be transmitted any distance that is ever likely to be required, it is seen that the water wheel is destined to become a potent factor in our industrial development and as such is well worthy the study of those who either are or aspire to be members of the engineering profession.

ELECTRIC TRANSPORTATION

THE TROLLEY CAR AFTER A DAY'S RUN, AND ITS REPAIRS.

BY DANIEL O'MAHONY.

IN car barns containing fifty or sixty cars there are usually three cars, or sometimes more, pulled in off the road for "trouble," and a number reported by the motormen for the same cause; a car is kept on the road so long as the trouble is not serious enough to disable it. When trolley cars came into to use at first, with the old systems, it looked as if they were going to be a failure. It was not strange to see fifteen cars pulled in on a wet day for controller trouble alone; but there have been great improvements made and it is astonishing how small an amount of trouble is now experienced in keeping them in order, considering the mechanical and electrical details, which are liable to get out of order.

When a car comes in after the day's run, it is not necessary to inspect every part of it, as some parts only require inspection twice a week, but such parts as brushes, etc., require inspection every night. The parts of a car that are liable to get out of order and require constant looking after, are the controllers, motors, lights, switches, rheostats, wiring, brakes, trolleys, wheels, sand boxes, fenders, journal boxes, gongs, bells, registers, etc. Some of those have many individual parts; for instance, the motor has the armature winding, commutator, shafe and bearings, brush holders and brushes, fields, motor leads, etc.

At present the motor gives more trouble than any other part. The armature often gets grounded either in the winding or the commutator; the band wires come off by touching the fields, when the bearings become worn; the fields get grounded; short circuit in the fields, armature winding or commutator; lead wires burned off, etc. The magneto is usually used to locate trouble, excepting short circuits in winding, which, of course, must be found with a Wheatstone bridge, or some other apparatus for measuring resistance.

The controller, which of course is a most important part, was at first of a very poor design. A shower of rain would often cause it to be charred or burned out; the mechanical parts were clumsy and weak, and it took a great amount of time and labor to keep them in condition for the road. The controller now in use is the best part of the equipment. There are several types on the market at present. I believe a certain make to be the best, for the following reasons: It has the least number of parts, it cannot be reversed with the power on; it starts on the first point with either motor cut out; the rheostat also being in the circuit, it can be used to stop the car in case of emergency, without reversing the motors, and having electric magnetic devices for blowing out arcs, it very seldom gets burned out. There is only one slight fault found in it by the repairmen. That is the ratchet pawl, which is not an essential part. The wheel attached to the pawl or its spindle wears out in a very short time, and is sometimes difficult to replace, without taking the controller apart. The controller requires very little attention, if the contact fingers are properly adjusted so as to touch the rings on the drum as they ought; and these rings or segments of wire on the drum require to be rubbed with a bit of waste dipped in vaseline or common motor grease. If this is neglected the surface of the rings and contact arm get like files, and the friction becomes so great that it is very hard to turn the controller handle, and they will wear themselves out in a short time, while they will last about twelve months if lubricated. The controller never gets "charged," which used to be such a menace to motormen, as well as the passengers, as the back is grounded.

There are usually a number of jam nuts on the adjusting screws and binding post screws which, if left loose, will cause great trouble; in some cases the controller handle cannot be turned, which, of course, disables the car, and very often causes wires and parts of the controller to be burned off.

A car is sometimes pulled in for not starting on the first point of the controller. This is caused by a motor lead being burned off; the motor leads are the short wires leading from the cables to the motors. From constant shaking and vibration these wires get broken and arc, which in a short time completely burns them in two. If the car is properly wired this may be avoided to a great extent. This can be done by putting the wires in a short piece of hose, in place of bringing them through separate holes in the car body, and leaving them exposed to the rain. The wet weather very often will cause one of these wires to be burned off. The rain causes the wood work to be grounded, and when the insulation gets worn off the wire will keep arcing until its fuses. A car often gets "charged" in the same way, or any wire that may happen to get its insulation off and touch some metal part of the body will charge it, which will give a shock to anyone coming in contact with it. Sometimes a car will be charged so that every time a person raises his foot from the floor he receives a shock when the canopy switches are turned on.

There is not much trouble experienced with rheostats. A rheostat sometimes gets so hot that it actually sets fire to the car. This is caused by the motorman keeping the controller set on the rheostat points, which is against the rules.

The lights give a great deal of trouble, as they get out of order easily, usually in the chandelier. The wires get the insulation rubbed off and short-circuit the lamps. The lamp socket sometimes gets loose and arcs, burning itself out. The lamps themselves get bad, and as the lamps are in series an open circuit will, of course, prevent any of them lighting. In cars that are wired, however, without the chandelier, like the Brooklyn Bridge cars, the lamps last a long time without getting out of order. Lightning also damages the lighting circuits, but it usually fuses the lightning arrester, which of course disables the car, as the trolley wire and ground are connected when the switches are turned on. In some cases, although seldom, the controller is struck by lightning and very badly damaged. The trolley poles ought to be removed from the wires in the car houses during a thunder storm. A number of cars have been known to start out of a house and run some distance without the controller being set during a storm.

The repairs to the truck and mechanical parts are also considerable. The greatest trouble is experienced with the wheels, brakes, and bearings. The wheels get flat, which will often occur when sand has been used. When the wheels get flat the only remedy is to take the pair out and replace them with new ones; this requires considerable labor, and sand, therefore, should be used as sparingly as possible.

The brakes are reported for being out of order oftener than any other part of the car. Of course a bad brake affects the motorman more than any other part of the car; in fact, it would be hard to find a harder day's work than braking a car all day with bad brakes. The brakes should be inspected every night, as the constant wearing of the shoes necessitates a lot of adjustments, particularly as the shoes do not wear evenly, and as the shoes must be kept a certain distance from the wheels, the brakes will not work right if the shoes are too near or too far from the wheels, the chain too long or short. The brake chain sometimes breaks, which might cause a very serious accident, particularly on a hill. There is a way of stopping a car in case the brake and power give out together, which every motorman should understand. That is, with the canopy switch turned off, to reverse the controller and set it on the last point.

Another trouble experienced with brakes is the falling down of the brake rigging, which not alone disables the car, but is sometimes very dangerous for the motorman, as shoe, etc., may get under the wheel and cause the brake shaft to revolve with great force, the handle striking the man if he is near it.

The bearings also require a lot of labor and expense to keep them right. The armature bearings are of the most importance, as the armature has but a very limited amount of space to revolve in. The wearing down will, of course, cause it to rub against the field pieces.

A car is often reported for bad trolley. There is a great deal of work on trolleys; keeping them straight, replacing wheels, particularly in the case of sleet, when sleet wheels are put on to prevent the wire getting covered with ice. The jumping of the wire from the trolley is the greatest trouble with this part, and the repairman often makes a mistake in fixing this, believing it is due to a bad wheel. It is seldom a bad wheel that causes the pole to jump; it is usually in the base that the trouble lies. The tension may be too weak, and the springs may want to be taken up, so as to get a greater pressure against the wire.

The register for counting the fares often gets out of order, and is often the cause of having a car pulled in. It sometimes will not ring the bell, or register the fares correctly, and as the company believe that it is the most important part of the car, its getting out of order causes the car to be disabled as much as if the two motors were bad. The other parts of the car, such as the feeders, gongs, etc., require but little repairing.

In big companies the small repairs including the brake shoeing of cars is done in the car barn, but the heavy work is done in the repair shops. For instance, the Consolidated Traction Company of New Jersey, have their shops half way between Jersey City and Newark. In these shops the machinery and facilities are very perfect, and as the company has the services of a very competent electrical engineer (many of the labor-saving machines used in the shops being his invention), the expenses are reduced to a minimum. The cars are overhauled in these shops and all the heavy repairing is also done here, such as taking out armatures, winding armatures, taking out flat wheels, renewing bearings, turning down commutators, and all lathe work. There is also a large amount of carpentry, painting and blacksmithing work done here. In every car barn there is at least one man who thoroughly understands the wiring and mechanism of a car, and a number of men to do cleaning, greasing and oiling and small repairs, inspecting, etc.

When all the cars are in, the report book is looked at to find what cars are reported for trouble, which must get attention first. The particular part of the car that is bad is usually reported, but the motorman cannot be relied on, as he sometimes arrives at extraordinary conclusions. Thus, on one occasion, a man reported a gear wheel broken; he thought he could hear it pounding all day; nothing, however, was found to be the matter with it. A car is often reported for motor trouble, whereas the controller is to blame, or vice versa. The only time a motorman can really be depended on for information is when a car is "charged," particularly when he has no gloves on.

Sometimes a car which comes in "O. K." will not start in the morning. This may be fixed sometimes by all hands giving the car a push for a foot, when the car will be found all right. The trouble might have been a dead rail. Sometimes a bit of paper is put between the wire and the trolley wheel to try if the electrician is qualified. The cars begin to start in the morning from about five until seven. The car barn during these hours would be a good place for persons suffering from loneliness of spirits, etc. It is often a scene of confusion, particularly when the cars get blocked. Every one seems to be calling for something, trying his gong or his vocal qualities, in winter, the electric snow plow and sweepers of a bad car with its fireworks and explosions sometimes adding to the scene.

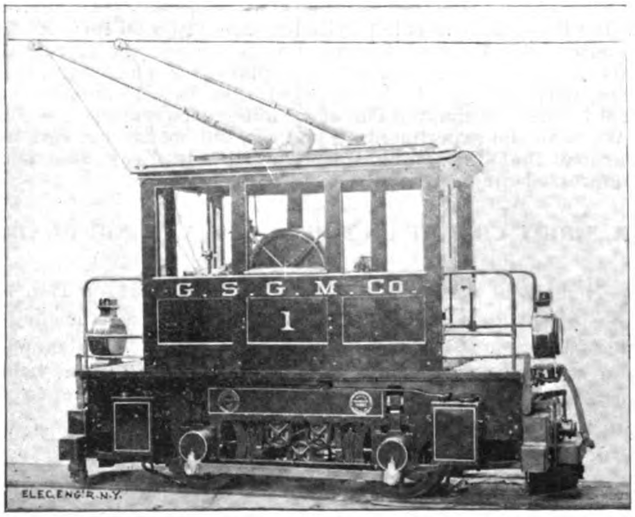
THE GOLDEN SCEPTRE MINE ELECTRIC RAILWAY.

THE accompanying engraving illustrates an electric locomotive designed by Mr. F. W. Darlington for the Golden Sceptre Gold Mining Company.

The specifications for this locomotive required it to have a capacity to haul a train of cars weighing in all 35 tons up a maximum grade of 5 per cent. The following data give the details:

Weight	not less than	30,000 lbs.
Drawbar pull at 8 miles per hour	" " "	4,500 "
" " at start	" " "	6,000 "
Diameter driving wheels		33 in.
Extreme width		52 "
Gauge		36 "
Weight of rail		45 lbs.
Two Westinghouse motors	each	50 h.p.

The grades of the road are excessively long and severe, the road being nearly eight miles in length. After about 1,000 feet of slight down grade, it begins to rise at about a 2.25 per cent. grade for 9,500 feet; then for 3,700 feet at 2.43 per cent., and beyond, 3,400 feet at 4.2 per cent.; finally the road takes a steady climb of 5 per cent. for a distance of no less than 20,400 feet, or nearly 4 miles. In fact the total rise is nearly 1,600 feet in less than 8 miles. For a steady pull this almost approaches the Jungfrau Railway in Switzerland, now in course of construction.

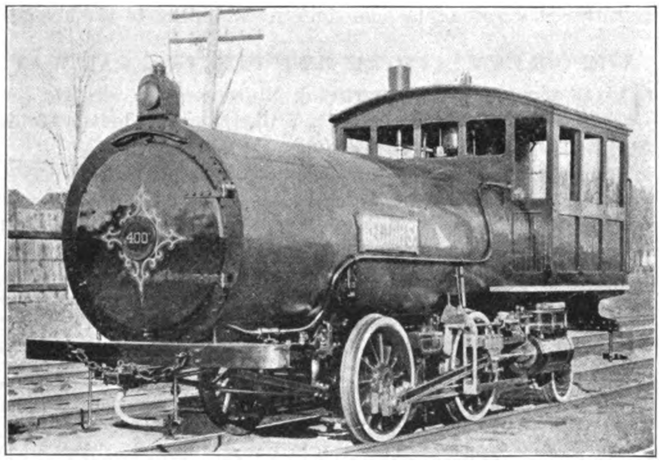


ELECTRIC LOCOMOTIVE, GOLDEN SCEPTRE GOLD MINING CO.

THE HARDIE COMPRESSED AIR LOCOMOTIVE FOR THE NEW YORK ELEVATED RAILROAD.

NOTWITHSTANDING the fact that even steam surface roads, such as the New York, New Haven and Hartford, and the Pennsylvania Railroad, have adopted electricity, on a part of their lines, and notwithstanding that elevated railways in Chicago and in Liverpool, England, have been in successful operation for years, the management of the New York elevated railway system still finds itself unable to make up its mind as to the "practicability" of electric traction. In the meantime it will give the use of its track to carry out an experiment with compressed air locomotives.

The accompanying engraving, taken from the Street Railway Review, shows the Hardie locomotive which will be shortly put to work on the company's system. In general appearance this machine much resembles the ordinary steam locomotive. The space usually occupied by the boiler, however, is taken up by the storage tanks for the air and by the reheater. On this locomotive the air is stored in 36 tubes of Mannesmann rolled steel; they are 9 inches in diameter and of varying lengths, from 13½ to 21 feet. The charging pressure is 2,000 lbs. per square inch. The air is led from these tanks through the reheater, in which water is stored at an initial temperature of 350 degs. Fahr., and after passing through three reducing valves is admitted to the cylinders at a pressure of 100 lbs. The working cylinders are 13½ x 20 inches. The American Air Power Company, which controls the Hardie patents has erected a compressing plant for charging at 100 Greenwich street. It is expected that this locomotive will haul 5 cars and make a run of 13 miles between charges.



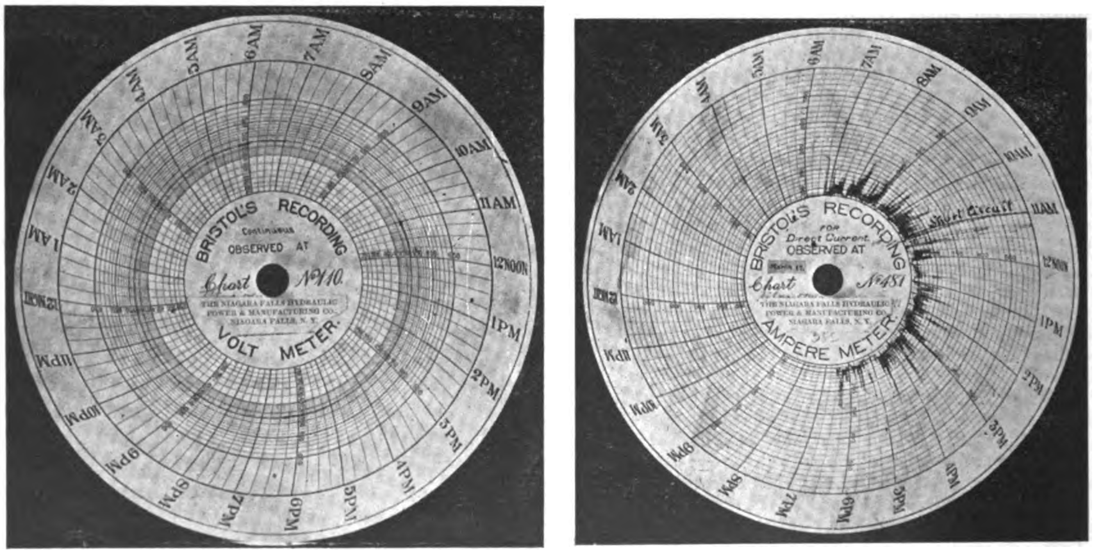
The Hardie Compressed Air Locomotive for the Elevated Railroad, New York.

We wish the experiment all success, but we are not seriously alarmed that the Manhattan Elevated Railway will adopt compressed air as its motive power.

A SHORT CIRCUIT ON THE NIAGARA GORGE ROAD.

BY ORRIN E. DUNLAP.

An incident occurred at Niagara Falls on March 17th last which goes a good way to show the high efficiency of one of the great power installations there. On that day while men were engaged in building the new steel arch bridge across the Niagara gorge, they let a large piece of steel fall into the gorge, and it dropped across the wires of the Gorge road, breaking them and causing a short circuit to exist for over half an hour. The current that supplies this road is furnished by the Niagara Falls Hydraulic Power and Manufacturing Company from their power house at the water's edge in the gorge, and is generated by two General Electric 750 horse-power machines operating at a potential of 500 volts, direct connected to a 2,000 horse-power turbine made by James Leffel & Company, of Springfield, Ohio, which is equipped with a governor made by the Lombard Water Wheel Governor Company, of Boston, Mass. The picture of the ampere meter chart in use at that time shows that the short circuit occurred close on to 11 a. m., its record being plainly discernible on the chart. The voltmeter chart of that day, also presented, shows how steadily the governor did its work at the time of the short circuit. It will be noticed that the recording line on the voltmeter chart is but a trifle heavier between the hours of 11 A. M. and 12 M. than it was all day, only the very slightest wavering being noticeable. Mr. F. G. Lott is the electrical superintendent of the plant, and he is delighted with the record made at such a trying time.



Record of a Short Circuit on the Gorge Road at Niagara Falls.

THE COST AND ADVANTAGE OF ELECTRICAL EQUIPMENT FOR RAILWAYS.—WITH AN ACTUAL EXAMPLE.

BY JOHN C. HENRY.

Some months ago I was strongly impressed with the broad gauge ideas emanating from Mr. Chauncey M. Depew, president of the New York Central Railroad Company, in regard to steam railway men and matters. He said they were living in a tunnel, and it was difficult for them to appreciate anything on the outside. I supposed from his language that the versatile gentleman who stands at the head of the highest order of steam railway development, was one of the exceptions, and that he was big enough to look at both sides, but a recent interview with him, an abstract of which appeared in some of the electrical papers recently, shows my mistake. He is reported to be looking for an electric motor that will transport passengers and freight cheaper than the steam locomotive. His condition reminds me forcibly of an incident I once heard about, of some poor, shipwrecked sailors who, with distress signals flying, were suffering for fresh water. On making known their wants to the officer of a vessel who had gone to their relief, he shouted back, "Drop your buckets, you are in the mouth of the Amazon."

Steam railway men have within convenient reach a force which is as irresistible as the Amazon at its mouth, but it is on the outside of their tunnel, and I fear our wee voice will never reach them without the assistance of The Electrical Engineer.

Railway men are not exempt from the old adage, "It is hard to teach an old dog new tricks." I am forcibly reminded of this in looking back over the early struggles in the trolley railway development. Street railway men fought very shy of the "new patented" transportation method. The historic roads, those built by Daft at Baltimore, by the writer at Kansas City, van Depoele at Appleton, Bentley and Knight at Allegheny, and Sprague at Richmond—all had grades on which it was impracticable to use animal power. Very little of the money to put those roads in operation was furnished by street railway men. With their success, however, the value of street railway franchises multiplied, and if the increased distance traveled, refinements added, and time saved, have measurable values, the expense of traveling on street railways has decreased in many localities not less than one thousand per cent., while that on steam railways, with their old methods has remained unchanged; in the face of these facts, is not the question of substituting electric motors for steam, a fitting subject for investigation by students in political economy, railway commissioners and legislatures?

A good deal has been written about "Electric Motors Under Steam Railway Conditions," but in the majority of cases the investigations have been carried along on well-known street railway lines, the investigators seeming to lack the dash and education in expedients which is so necessary in carrying out new problems.

Below I present the result of my investigation of what at first appeared to be a very difficult railway problem, i. e., the electrical equipment of the Florence & Cripple Creek Railway. If the work is carried out on the lines indicated, it will result in a saving over present earnings more than sufficient to pay desirable interest on the bonds and stock of the road; if any one will take the trouble to figure the same out on street railway or third-rail lines, they will probably find it to be a losing proposition.

Syl. T. Smith, Esq., President, Florence and Cripple Creek Railway.

Herewith I hand you some preliminary figures and information concerning the cost and advantages of an electrical equipment for your railway. They are based on the following data I have been provided with:

Distance, Florence to Cripple Creek, 40 miles.
Gauge, 3 feet.
Grades, Florence to Russell, 8 4-10 miles, 1¾ per cent.
Grades, Russell to Alta Vista, 23 miles, 4 per cent.
Grades, Alta Vista to Cripple Creek, 9 miles, level.

The road between Russell and Alta Vista has a great many 32 degree curves.

The present equipment consists of 12 steam locomotives, all of which are of the latest Baldwin pattern; cylinders 16 x 20, 8 wheel connected; drivers 36 inches; steam pressure 160 lbs.; weight, 73,000 lbs., without tenders; two of such locomotives are now required to haul 10 loaded cars, each weighing 37,000 lbs., complete, up the heaviest grades at a speed of 5 miles per hour.

In changing from steam to electric motors, assuming you are hauling the equivalent of 40 loads from Florence to Cripple Creek per day, together with your passenger trains, by using electric motors, the following expenses would be avoided:

Avoidable Expense per day:

8 Engineers at $4.68	$36.84	
8 Firemen at $2.78	22.24	
3 Engineers (Pass) at $4.68	14.04	
3 Firemen (Pass) at $2.78	8.34	$81.46
Coal on tender for 11 locomotives, 3½ tons each, at $2.75 per ton		125.62
3½ tons at $5 per ton, delivered on tenders at Cripple Creek		17.50
Expense of 6 water tanks, at $1.50 per day each		9.00
Attendance and repairs on 12 locomotives, including shop and roundhouse labor, superintendence and tools (material not included) at $6 per day		72.00
Total		$305.83

The Additional Expenses per day would be:

1 Electrician at $5	$5.00	
7 Motormen at $3	21.00	
1 Chief engineer at $100 per month	3.30	
2 Assistant engineers at $75	5.00	
2 Laborers (wipers) at $2	4.00	
Repairs and attendance on 7 motors at $1.20 (material not included)	8.00	
30 tons of coal under stationary boilers at $1	30.00	
Total new expense		$77.05
Saving with electrical equipment per day		$228.78

In addition to this, other savings of very considerable importance would be made, which are impossible to estimate.

The electric locomotive would have swivel trucks, with a wheel base of about 5½ feet, and would curve much easier than your locomotives on your many miles of 32 degree curves. The probabilities are that one-third of the power now absorbed by your locomotives with their 11 feet 9 inch driver wheel base, would be avoided, with a corresponding reduction in the wear and strain on the curved track.

As the weight of the electric would be very much less than the steam locomotives, the destructive effect of the track and the maintenance of way, would be more than correspondingly decreased. The rule is that this effect increases with the square of the weight (up to the elastic limit) which in your case is sometimes exceeded, as evidenced by bent rails, etc.

Another great saving would be effected in the rolling stock. Steam locomotives do their work by a succession of jerks, first on one side and then on the other. This effect is very pronounced on such roads as that up Pike's Peak; the tendency to rack and weaken the cars is much greater than where electric motors are used, as their strain upon the cars is without impulse or shock.

While your locomotives are doubtless the best steam ones that have been designed for severe mountain work, they are very inefficient machines, and there seems to be little chance to improve on them, as the manufacturers have already strained points in every direction to increase their force and efficiency. The boiler pressure, which is now 160 lbs., is really close to the danger line. The weight which is more than 50 tons, could not be increased without injury to the track. The leverage could not be increased by decreasing the size of the drivers, as they are now but 36 inches in diameter. The boiler could not be lengthened without increasing the wheel base, which your sharp curves would not permit. Notwithstanding all of this weight and strained engineering, the locomotives do not develop at the draw bar on your curves over 120 horse power at a speed of five miles per hour, cutting off at half stroke.

That most popular standard street railway motor known as G. E. 800, weighs about 1,600 pounds, with 33 inch wheels; at a speed of 11 miles per hour, it exerts a horizontal effort of 800 pounds, properly geared; it is consequently capable at a speed of 5 miles per hour of giving a draw bar pull about equal to its own weight.

I would propose in place of the steam locomotives to use electric locomotives of about double their capacity, so that one motor would handle 10 loads up to the 4 per cent. grades. After due consideration I have concluded the following installation would about fill the bill:

Although the equipment would be quite a departure from ordinary street railway practice, I am not straining any engineering possibilities, or proposing any plans which would not be approved by the best available talent, while they might be questioned by engineers of less experience. The steam power to generate the current would be located at the coal banks near Florence. The current would be transmitted to duplicate converters, located at the telegraph stations on the right of way along the railway, at a potential of 20,000 volts. Each standard direct current locomotive would have four 600-volt 100 horse power motors. The trolley wires would be supplied with direct current on the Henry three-wire commutative system (see U. S. Patent 545,158, of Aug. 27, 1895). One side would have a difference of potential of 800 volts, and the other of 1,200. The motors would receive current from either or both sides, i. e., at 800, 1,200 or 2,000 volts pressure, and be further regulated by connecting them in series or in parallel. In no case, however, would any one of the motors receive current at over 600 volts potential (this being the common trolley railway pressure). To prevent racing when the armatures are connected in series, the field magnets would be separately excited by being connected in series with a rheostat to the low voltage side. Owing to the high pressure on the mains and working conductors the losses would be less than on the ordinary street railway circuits. While the losses in regulating the motors would be about nihil at any speed up to the maximum, it is thought that these savings would more than compensate for the losses inherent in the transformers. The trolley wires and three-phase transmission wires would be carried on the same pole line. The method of suspension would be the combination diagonal span and bracket construction. (See The Electrical Engineer, March 31, 1897.)

The cost of the complete installation would be about as follows:

50 poles per mile, including brackets, insulators and setting at $5 each, total for 40 miles	$10,000	
For 3-phase current, 120 miles of No. 1, hard drawn insulated copper wire at 13c. per lb.; total	28,628	
For trolley circuit, 40 miles of 000 wire, and 40 miles No. 1	28,628	
Stringing wire and bonding track at $100 per mile	4,000	
Line construction complete		$71,256
7 locomotives at $6,000 each		42,000
4 400-k. w. dynamos, at $20 per k. w.		32,000
Converters		40,000
4 500-h.-p. stationary engines at $5,000		20,000

4 500-h.-p. water tube boilers, at $12 per h. p.	24,000
Electrical incidentals	5,000
Building power house and setting machinery	15,744
Total	$250,000

In figuring on the capacity of the machinery, we have aimed to have one of the 500-horse-power units in reserve; the balance would be quite sufficient to carry the maximum load. No estimate is made of the value of the 12 steam locomotives, which could be disposed of.

This electric plant could be used to advantage in operating the proposed Florence Southern road, without much additional expense, as current can be distributed from the central point with much less loss than from the ends of the line. Besides these there need be no additional expense for station attendance.

The distribution system could also be amplified and used to great advantage in furnishing the mining camps with light and power. It would not require, comparatively speaking, much more of an outlay to deliver 1,000 electrical horse power at the mines, which would doubtless sell at very high prices, where it could be used to operate pumps, hoisters, etc.

AN ELECTRIC ROAD FOR NICARAGUA.

A dispatch from Richmond, Ind., of May 26 says: Announcement was made here of the formation of a company to build a 150 mile electric railway line in Nicaragua. Isham Sedgwick, of this city, is president; Peter Baches, Trenton, N. J., secretary, and C. H. Hall, Trenton, N. J., treasurer. The nominal capital is $100,000 and the name of the company is the Atlantic and Lake Nicaragua Railroad and Navigation Company. The company gets numerous concessions from the Nicaragua Government, among which are 250,000 acres of land. There is only one short railroad in that country now.

ROENTGEN RAYS

THE DENNIS FLUOROMETER.

Experimenters in X-ray work will welcome the apparatus which has been perfected by Mr. John Dennis, of Rochester, N. Y., and which has been called the fluorometer.

Mr. Dennis was one of the earliest to recognize the characteristic distortion of the Röntgen shadow and set about devising an appliance which would make certain diagnosis of the presence of bullets, needles, calculi or other foreign objects which are more impermeable to the X-ray, than the tissue of the human organism.

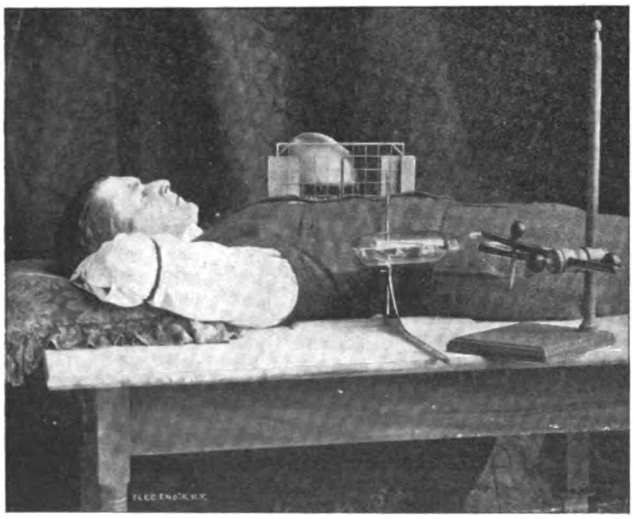


Fig. 1.—The Dennis Fluorometer—First Position.

Very early in the history of the X-rays it was realized that it could be made a very valuable adjunct to surgery. At the same time, however, there came the disappointing conclusion that no matter where a Röntgen ray picture apparently located a bullet, a needle or other foreign object in the human body, it was frequently not where it appeared to be.

Mr. Dennis' appliance establishes a definite cross section of the body by means of an angle piece which is impermeable to the rays. As will be seen by the accompanying engravings, the fluorometer is so constructed, as to fit any portion of the human body, neck, arm, limb or trunk, thus enabling the observer with the fluoroscope to determine the exact location of the foreign object.

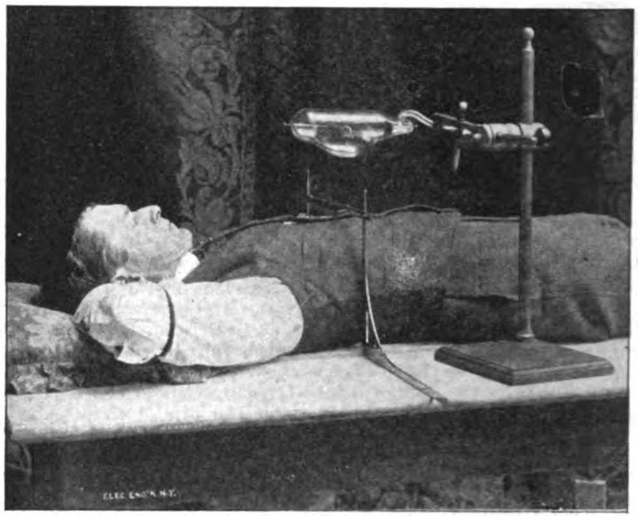


Fig. 2. The Dennis Fluorometer—Second Position.

It must be remembered that all that is produced by means of the Crookes tube is a shadow. The object of the fluorometer is to enable the surgeon to control this shadow and produce an accurate right angle by taking two views, the foreign object being located at the point of coincidence.

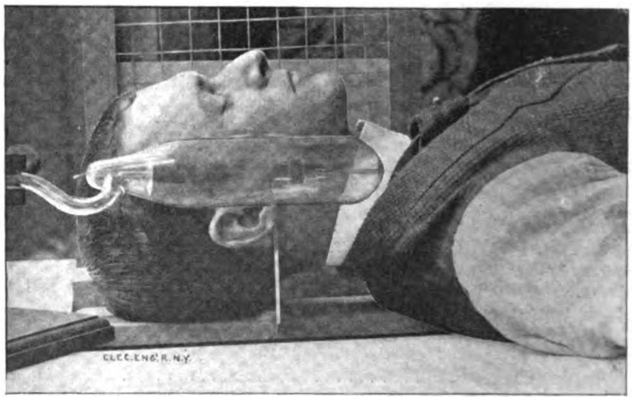


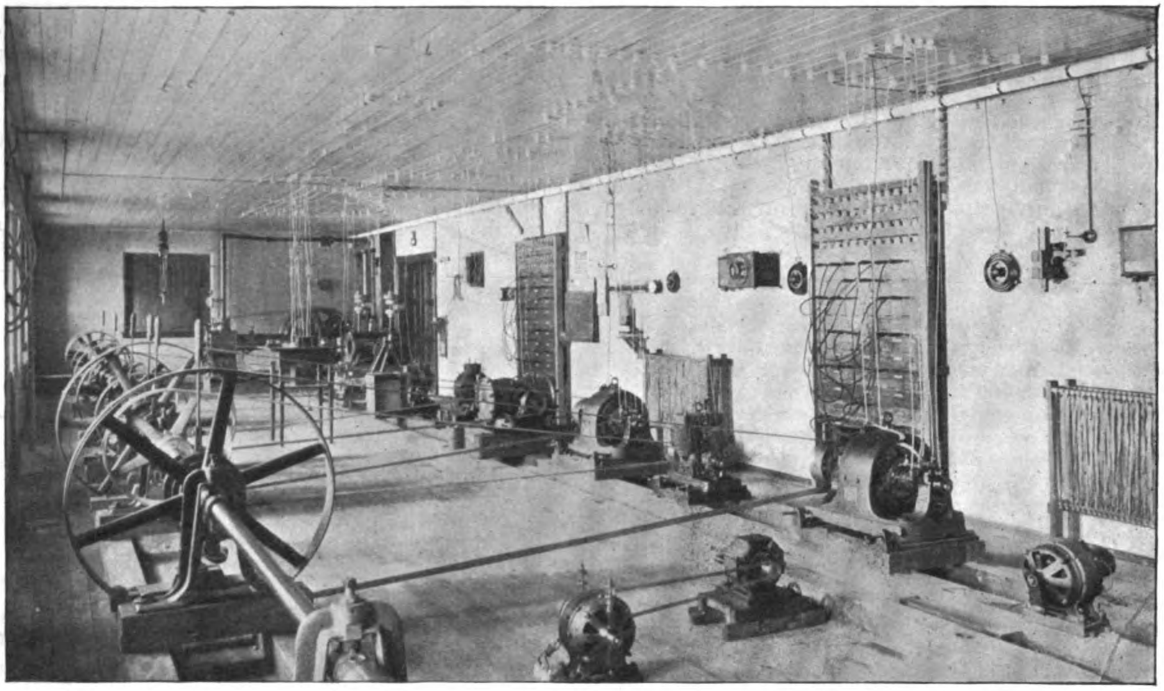
Fig. 3.—The Dennis Fluorometer as Applied to the Head.

Early in his experiments Mr. Dennis discovered that the distortion in a Röntgen ray photograph was as one to thirteen in the distance of twenty inches; this distortion is corrected by the fluorometer. Incidentally the fluorometer demonstrates that the source of the energy is at the center of the platinum plate, which forms the anode of the tube, as will be seen by the engravings. The fluorometric appliance is brought within the parallelism of the rays, until it shows a single characteristic straight line on the field of the fluoroscope. By means of what may be called sights, a cross section of the subject is brought absolutely in line with the foreign object under observation, with the result that a second view by use of the sights discloses the exact location without the necessity of a long exposure required for the taking of a picture.

By means of a simple adjustable table, as shown in the engravings, Mr. Dennis controls the character of the Röntgen shadow. The table is provided with an aperture by means of which the second view is taken from below, the same as from the side. The metallic grating enables the observer to measure the distance from the base line to the foreign object at a glance, the meshes of the grating being exactly one inch apart.

ELECTRICAL ENGINEERING AT LEHIGH UNIVERSITY.

At the Lehigh University electrical engineering and physical science are taught in the physical laboratory, erected in 1893. The building is of stone, 235 feet long, 44 feet wide, and four stories in height. The two lower floors are devoted to electrical engineering. On the west side of the first floor is the dynamo laboratory, comprising dynamo room, store room, workshop, battery, computation and cloak rooms, etc. The dynamo room is 70 feet long and 20 feet wide. A 50-horse-power Straight-Line steam engine drives a ground line shaft, to which the several dynamos are connected by belts and clutch pulleys.



Dynamo Laboratory, Lehigh University, Bethlehem, Pa.

Electrical Laboratory, Lehigh University, Bethlehem, Pa.

The electrical plant consists of two Westinghouse rotary transformers, two Edison dynamos, Thomson-Houston arc dynamo, Richter arc dynamo, Wenstrom incandescent dynamo, Westinghouse alternator, two Tesla induction motors, several small motors, ten alternating-current transformers, etc. The laboratory is supplied with ammeters, voltmeters and wattmeters of various types, Kelvin balances, Brackett cradle dynamometer, standards of capacity, etc. The battery room contains an 80-cell Chloride accumulator, which supplies current for experimental or testing purposes at times when the engine is not running. By means of switchboards located in the battery and dynamo rooms, current is made available for use in any of the laboratories or lecture rooms throughout the building.

On the east side of the first floor is the Thesis Laboratory, comprising eight separate rooms of uniform size, office, balance room, and constant temperature vault underneath. Each of the separate rooms is furnished with three stone tables resting on foundation piers; one is specially fitted up for arc light photometry; in all the use of iron has been avoided in order to make them suitable for magnetic measurements. The room underneath is similarly furnished, and is specially suitable for accurate measurements of resistance.

On the west side of the second floor are the designing room, blue printing room, offices, reading room and apparatus rooms. The designing room, 56 feet long by 44 feet wide, provides ample accommodation for designing and draughting. It is well lighted and contains the beginnings of an electrical museum. The reading room contains a collection of works of reference, and sets of several electrical journals. On the table will be found the current numbers of the leading electrical journals.

On the east side of the second floor are the laboratory of electrical measurements, magnetic room, office, comparator room, store room, etc. The electrical laboratory, 60 feet long by 44 feet wide, provides desks with drawers and lockers for eighty students. Like the Thesis laboratory below, it is entirely free from iron, the gas and heating pipes being made of brass. Slate shelves fastened to the walls provide suitable support for delicate instruments. A selection of the best books on electrical measurements is kept at hand, and references are given to such of these as treat a particular problem in the best manner. The laboratory is well supplied with sets of the more common instruments, and recently a number of instruments have been added comprising Anthony form of Wheatstone bridge, megohm resistance box, Crompton potentiometer, Ryan electrometer, standard condenser, Weston ammeters and voltmeters etc. The magnetic room has been fitted up and set apart for measurements of the magnetic qualities of iron and steel.

During the past two years the course in electrical engineering has received great development under the direction of Dr. Alexander Macfarlane.

MEXICO.—J. A. Carrigan of New York, John H. Foy and Michael O'Boyle, of Pittston; George E. Giles and G. P. Rogers, of Carbondale, Pa., by the trip in Mexico expect to secure contracts from the city of Pueblo aggregating $6,000,000. The work will consist of laying twenty-five miles of electric railroad, putting down 300,000 square yards of asphalt pavement, sewering the city and putting in a public water works.

ELECTRIC LIGHTING

MOORE VACUUM TUBE LIGHTING PROGRESS.

At the invitation of the Moore Electrical Company a party of about seventy-five ladies and gentlemen gathered at the Moore laboratory, at Newark, N. J., to witness the latest results obtained by Mr. D. McFarlan Moore with his system of vacuum tube lighting.

The room in which the demonstration took place was 10 by 25 feet in area, and was lighted by fourteen tubes, placed close under the ceiling in the position occupied by a picture molding in an ordinary room. These tubes were 7 feet 6 inches long and 2½ inches in diameter, and were in fact the same tubes used by Mr. Moore last year, at the Electrical Exhibition, in this city.

In a short address by Mr. E. J. Wessels, president of the company, it was pointed out that the great improvement made by Mr. Moore on his work of twelve months ago lay in the substitution of a rotary current interrupter in place of a vibrating interrupter. With the vibrating interrupter it will be recalled, only 6,000 breaks per minute could be obtained, whereas with the present rotator 50,000 breaks per minute are easily attainable. The effect of this increased rate of vibration was very marked in the great steadiness and evenness of tone of the light emitted by the tubes. An improvement of equal importance to the substitution of the rotator for the vibrator, is, that by the use of the rotator practically any number of tubes can be operated together, whereas formerly as many vibrators were required as there were tubes. Of course this means an enormous reduction in the amount of apparatus and current necessary to operate the system.

ELEC. ENG'R. N.Y.

Picture Taken by Moore Vacuum Tube Light at Newark, May 27, 1897.

The Moore system therefore at present is in practically the same condition, so far as working and general distribution are concerned, as ordinary incandescent lighting, i. e., it is run on the multiple arc system, in which any number of lamps can be run connected across two wires.

Another fact of paramount importance consequent upon the use of a high number of breaks in the rotator is that the power consumed for lighting a given number of tubes is greatly reduced. Indeed, according to Mr. Moore, the power now required is only one-half as much as that previously required with the vibrators.

The new rotator consists of a revolving switch or commutator upon which bear a series of brushes. The segments are placed on the periphery of a revolving cylinder which, with the brushes, etc., are enclosed in a vacuum tube about 12 inches long and 3 inches in diameter, which also contains the armature of the motor that drives the switch cylinder. The field magnets which influence the armature are placed outside of the vacuum tube.

The current for lighting the tubes was taken from a very unsteady 220-volt street circuit.

Mr. Moore also showed a number of very interesting experiments illustrating the use of the light in decorative work. Among these was shown "The Candlestick of the Future," consisting of a glass tube six feet high, carried in a candlestick of corresponding proportion. This tube was lighted up by induction, having no connection with any wires whatever. A photograph of those present was taken by the light of the tubes, and is here reproduced. Mr. Moore also showed that he had worked out some of the practical details of his system by placing a push button on the wall, by which the tubes could be lit and extinguished.

The walls of the room were hung with a number of vacuum tube advertising signs, which showed the possibilities which lie in this direction. All present expressed themselves as highly pleased with what they had seen.

LIGHTING INSTALLATION IN THE KINGSTON, N. Y. CEMENT QUARRIES.

An interesting electrical installation has recently been made in the quarries and mills of the F. O. Norton Cement Company, at Binnewater, N. Y., situated in the Rosendale cement district about seven miles from Kingston. This company manufactures the natural cement as distinguished from the Portland, the bulk of the latter consumed here being imported from Europe. The deposit from which the Norton (natural) cement is made is bluish gray magnesian limestone or cement rock found in strata of between fourteen and seventeen feet in thickness, constituting the hills along the valley of the Roundout Creek. The process of manufacture consists in quarrying the stone in the ordinary manner with powder and dynamite. From 120 to 125 tons of cement rock is disengaged at each blast. The average result is about 4½ barrels of cement to one ton of rock.

The stone as taken from the quarries is broken up into pieces of about a cubic foot each, and laid upon small cars. The cars are then hauled to the kilns which are cylindrical structures built of stone. These are about nine feet in diameter and twenty-eight to thirty feet in height, the sides converging at the bottom. In these kilns layers of stone about 6 to 10 inches are placed each alternating with a layer of pea coal. The stone is then thoroughly burnt to remove the carbonic acid gas and the calcined produce is drawn from the bottom of the kilns twice every 24 hours. After careful inspection, the over burnt and under burnt stones are separated and the properly burnt product is wheeled to the cars and carried to the crushers, which reduce it to a suitable size for grinding. From these it passes to the mills immediately underneath, where it is reduced to powder and is conveyed by machinery to another portion of the mills, where it is fed into barrels lined with paper to exclude dampness.

At the quarries about sixteen hundred barrels of cement are manufactured per day, running 300 pounds to the barrel. The galleries have 50 feet face. The veins are known as the dark vein 17 feet in thickness and the light vein about 14 feet in thickness. The two qualities of stone are mixed in a stone crusher producing a uniform grade of cement. The galleries are upheld by pillars 20 feet square and 30 feet apart.

The power plant consists of four horizontal steel tubular boilers, 16 feet by 17 feet, furnishing steam at 100 pounds pressure to a 750-horse-power Harris-Corliss cross-compound slow speed engine. This power is used to operate sixteen cracker mills, the crushers, etc., etc.

The electric plant consists of a 30-kilowatt alternating current incandescent dynamo, manufactured by the General Electric Company, as, in fact, are the lamps and wiring devices of which the plant consists. This machine is driven by a 10 x 12 horizontal automatic Ball engine. There are now installed 103 incandescent lights, lighting the kilns shed, where the calcined product is taken to the crushers, the mills, the packing rooms, the shipping rooms and various other departments of the factory.

The quarries are lighted by 40 incandescent lamps and 14 arc lamps. The current is used at a pressure of 300 volts, being reduced by transformers to the necessary voltage for arc and incandescent lamps. Each arc lamp is operated by its individual transformers. In addition one or two incandescent lamps on flexible cords, protected by wire cages will be operated from the same transformer where particularly close light is required. Arc lamps are also connected by flexible cord to the transformers, which are placed back of the nearest pillar to the face of the gallery. The lamps are supported from the roof of the gallery by means of rope and pulley and give a most satisfactory general illumination for the whole work. The men have suspended a light for handling the drills and shoveling the broken stone in the loaded cars, etc., etc. Incandescent lights fixed in position are placed at the main platforms, turn table, etc., etc., while lamps for the purpose of general illumination are also placed at moderate intervals along the galleries now being operated. When the blasts are fired, the lamps are unhooked and taken behind the pillars.

The above installation has entirely done away with oil lamps the use of which in many cases rendered work almost impossible, it being necessary to place the drills at the very top of the gallery on a shelf sufficiently below for the erection of the drill. In the days of oil lamps the room was so filled with smoke and fumes that the men could only work there for a short time; in fact, the whole mine was rendered murky and disagreeable to work in by the odor from the lamps.

The circuits are carried into the quarries from the power house, a distance of about 400 feet in one direction and 1,500 feet in the other. They are carried along the galleries fastened to insulators fixed to plugs driven into holes in the roof of the worked-out galleries. From various points main loops are carried to the galleries where the work is going on.

According to the manager and engineer, no considerable difference can be detected in the amount of coal used since the introduction of electricity, and they are fully satisfied that it costs no more than they were obliged to pay each month for oil under the old method. They are equally certain that the amount of work which can be done by means of electric illumination is greater while far more easily performed. The present electric plant is only working to about one-half its capacity and lights will be added as the work is extended.

THE GROWING BURDEN OF MUNICIPAL DEBTS.

The following is taken from the St. Louis Globe-Democrat: "The Greater New York will begin business as a municipality, so to speak, on January 1, 1898, with a municipal debt in excess of $200,000,000, a debt larger, according to the New York Sun, than that of any four other cities of the country. There is a general opinion, for which, however, there is no real warrant, that the debt of American municipalities is based upon their population, area, age and resources; but the fact is that while these elements regulate the running expenses of American cities, the debt is fixed rather by the form of government they have enjoyed or suffered from in the past. Boston and St. Louis are cities of the same size nearly (the difference in population between the two was less than 3,000 by the last census), yet the municipal debt of Boston is three times greater than that of St. Louis, while, on the other hand, the tax rate in St. Louis is 50 per cent. greater per $1,000 of valuation than it is in Boston. Louisville, a city of 200,000 population, has a debt of nearly $9,000,000, but Covington, in the same State, with a population of 37,000, by the last census, has a debt of $2,400,000, and Newport, Ky., a city of 24,000, has a debt of $1,100,000. Chicago, which has a population considerably in excess of 1,250,000, has a municipal debt of $17,000,000, whereas New Orleans, which has a population of 250,000, one-fifth of Chicago, has a debt of $15,000,000, and some local improvements under way will materially increase it. Indianapolis, with a population at the last census of more than 100,000, has a debt of $1,108,000, whereas, Evansville, which by the last federal census had a population of only 50,000, half as large, has a debt of $2,100,000. The municipal debt of Kansas City is $4,000,000 and Sioux City, Ia., owes $1,200,000. The municipal debt of Philadelphia is $2,000,000, and of Pittsburg $12,000,000, but Providence, which has about one-half the population of Pittsburg, has a municipal debt of $13,250,000. Milwaukee and Detroit are two cities having almost the same population—205,000 by the census of 1890. Since then Detroit has increased more rapidly in population, and the area included in it is somewhat larger than is the area of Wisconsin City. Yet the debt of Detroit is $4,800,000, whereas, the debt of Milwaukee is $6,200,000. San Antonio, Texas, an ancient town of less than 40,000 persons, has been wide awake enough to contract a municipal debt considerably in excess of $2,000,000, whereas the city of Fort Worth, which has been generally alluded to as being a thriving and enterprising settlement, has a debt of $1,300,000 only. In New York State, Buffalo has a bonded debt of $12,000,000, Syracuse of $5,800,000, Troy of $1,200,000 only, Long Island City of $3,500,000, Yonkers of $3,000,000, Albany of $4,100,000, Rochester of $8,400,000, Utica of $360,000, Poughkeepsie of $1,700,000, Dunkirk of $275,000, and Mount Vernon, N. Y., of $800,000.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico	per year.	$3.00
Four or more Copies in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies		.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, JUNE 2, 1897. No. 474.

VERTICAL ENGINES IN CENTRAL STATIONS.

THE advantages of direct connection for dynamos are such that this method of driving may now be considered the standard. Where the space available permits of it, modern practice, as a rule, calls for the installation of horizontal engines, but where land is valuable the vertical engine has come to be the only alternative. In the design of vertical engines for direct connection in such plants, marine engine practice has been very closely followed with such modification of details, of course, as the differing nature of the two kinds of work have dictated. But in every case the general type of construction with the cylinders standing above the driving shaft has been retained without exception, so far as we are aware. But is it safe to assert that this type of vertical engine will continue to hold undisputed supremacy? Already we note tendency to change, brought about by the experience had in the past few years. In the opinion of at least one well-known engineer, there are distinct gains afforded by not having the cylinders and steam work and oiled surfaces above the generator. In support of this contention, it is pointed out, first, that none of the electrical manufacturing companies will guarantee the insulation of their armatures if the latter are subjected to oil soaking; yet it is almost impossible by any method of screening to prevent oil being drawn into the machine. All vertical engines of the type now generally in vogue have their steam cylinders arranged above the armatures, and possess oiling devices and exposed oiled surfaces that cause a continuous spraying of oil, as any one familiar with this type of engine must be aware. By reversing the relative positions of steam cylinder and generator, several distinct advantages are claimed to be obtained. In the first place, by lowering the steam plant, the pistons receive a greater pressure when they most need it, that is, when working on the up-stroke against gravity. With the present arrangement, just the reverse is the case, due to the reduced area of the crank end piston area, caused by the piston rod, and when one considers that the pistons, rods, and other dependent devices, may, and often do, weigh several tons in large engines, this loss of pressure is by no means a negligible quantity. But the most important feature is, that it brings all oiling devices and oiled surfaces well below the armature and all steam connections below the dynamo, virtually separating the station into a steam and an electrical section, or rather level. This arrangement is also claimed to allow of more compact construction, as the armatures can be readily removed from the bearings of the engine with the shaft and crank, which could be interchangeable for the different engines of the same size. It is maintained that by adopting an arrangement such as that outlined above, the rate of depreciation of generators in central stations which is now calculated at from 10 to 12 per cent., can be reduced to from 4 to 6 per cent. That this plan of engine and dynamo arrangement for central stations is not purely speculative, is shown by the fact that designs for such a construction are now actually being made which will shortly be in the hands of the engine builder.

THIRD RAIL PROGRESS.

THE third-rail system of electric railroading, which was first tried in actual practice by Daft fifteen years ago, has again come to the front and, if all signs are not misleading, will maintain its position as the method, par excellence, for converting steam roads into electric. The most recent conversion of this kind, that of the Berlin Branch, of the New York, New Haven and Hartford Railroad, has set the managers of other roads thinking, and dubious rumors are heard to the effect that the Erie and Long Island roads are contemplating similar changes. While every attempt of this kind is deserving of all encouragement, it is in no spirit of disparagement that we venture to raise the question, once again, whether the third rail as at present employed, namely fully exposed, will be found to answer all the requirements of American railway traffic. Where, as in the majority of roads in Europe, there are no grade crossings, and where, in addition, the entire track is fenced or hedged in so as to shut out all trespassing of man or beast, an exposed third rail offers no difficulties; but where an unprotected track is the rule, as in America, experience will show that some methods must be adopted to avoid annoying, and possibly serious, consequences. We are led to these reflections by a perusal of the accounts of the daily and frequent accidents on the new third rail electric branch of the New York, New Haven and Hartford Railroad, which have reached us ever since the opening of the road. Now, it is a carpenter disabled by his hammer coming in contact with the rail; next the dropping of a brake bar from a freight car causes a short circuit, which results in a damaging burnt-out at the station; and again a girl is shocked, horses are disabled and dogs killed. Indeed, only last week one of the members of the American Society of Mechanical Engineers, who had been invited on an inspection run over the new road, saw his steel-stemmed umbrella go up in a blinding flash of light. Luckily no human lives have yet been lost, but there is no telling when a combination of circumstances may bring about such a result. That such a condition of affairs can continue indefinitely in a thickly populated district, or wherever animals are apt to stray on the track, is hardly probable, and it is greatly to be hoped that those in authority in the New Haven road will give this matter their serious attention, not only for their own sake, but for the effect which a continuance of these mishaps will have on the adoption of the third rail by other roads. The problem of protecting the third rail from accidental contact is comparatively simple, and we could, in fact, point to more than one method which, it seems to us, would answer all the requirements of practice. But after all, the mishaps above quoted are of the class of children's diseases. All new ideas of far-reaching importance must pass through perils not fatal, before reaching their full maturity, and, far from being disappointing, the results already accomplished are enough, in our estimation, to set at rest all questions as to the adaptability of the third rail for railway traffic, the belated and timid New York Manhattan Elevated Railway to the contrary notwithstanding.

"NIAGARA FOR BOILER FEEDING."

THE above whimsical topic was assigned at the Institute dinner the other night to Dr. Charles E. Emery, the engineering expert, whose familiarity with questions of power is regarded as enabling him to find, as he did, some new way of looking at Niagara. He certainly did not disappoint his auditors. In responding he said that he did not at first think he could treat the toast seriously, as the conception apparently led to such enormous and preposterous figures. The subject, however, was not one calculated to suggest merely a humorous reply, so finally calculations were made along the lines possible and revealed some relations of an interesting character. With 150 feet fall, which can be obtained with the canal, though not utilized in connection with the tunnel, one hydraulic horse-power requires 33,000 ÷ 150 = 220 pounds of water per minute, or about 440 pounds per electrical horse-power delivered at a distance. With a compound steam engine requiring 16 pounds of water evaporated into steam per horse-power hour, Niagara would furnish feed water for steam power for 60 x 27½ times as many horse-power as if the weight and fall of the water were utilized. Such power would not, however, be developed in a non-condensing engine, but in a condensing engine requiring condensing water. In such case there would be used on the average about 27½ times as much water for condensing purposes as for feed water, or 440 pounds per hour, the same as would be required per minute to develop one electrical horse-power at the end of a long electric line. In other words, the water required to generate 100,000 electric horse-power with water power at a distance having 150 feet fall is practically the same per minute as would be required by a compound condensing engine per hour to develop the same power.

Dr. Emery called attention also to the many interesting problems in connection with the hydraulic development of Niagara. The power must be sold in competition with steam power and supplied at Buffalo, where coal can be brought for about ½ cent per ton per mile or only $1 per ton for 200 miles transported. Such coal can doubtless be loaded into the cars for about 40 cents per ton so that it should be sold in Buffalo for about $1.50 per ton in large quantities. Under such circumstances water power transmitted as electrical energy can only compete with steam power by reason of the great amount of power developed which reduces the unit cost in a surprising degree. The cost per horse-power delivered is, of course, materially increased by the expense of transmission. Still the water power can compete with steam power where the high tension lines can be run direct to the exact locations where the power is utilized. He had not been able, however, to satisfy himself that the development of Niagara would greatly cheapen power in small quantities distributed at different points about Buffalo and the vicinity, for the reason that naturally the transmitted power would be supplied to stations already delivering power in small quantities which had to pay interest on a capital very much in excess of that required to generate and transmit the water power, a condition which would prevent important reductions in the cost of power to the smaller consumers. Dr. Emery's points are always well made, and it will be interesting to see how his conclusions work out in results.

THE BENEFICENT TROLLEY.

At a recent meeting of supervisors in convention at Los Angeles, Cal., Mr. John Mitchell bore strong testimony to the influence exerted out on the Pacific Slope by the trolley in enabling people to live comfortably in their own homes in handsome suburbs adjacent to the large cities. This phenomenon is evidently not restricted to any locality in this country, and should be observed presently in Europe, if a flat rate of fare is adopted that invites to the full trip and does not discriminate against the suburbs by increasing the fare for every mile. "Between the City of Oakland and the City of San Leandro," said Mr. Mitchell, "some eight miles, a stranger would suppose he was passing through a New England town, so thickly has it become settled. One great benefit has been that it has enabled poor men who were unable to have their homes in the city, owing to the high price of real estate, to locate outside the incorporated cities, by reason of rapid transit and convenience afforded by electric car systems, buy lots, build little homes and yet reach their places of employment in Oakland and San Francisco without difficulty." Mr. Mitchell mentions an increase of about a million dollars in the assessments of two townships in about two years, due to the electric lines, and he adds that between given points travel has been four times as great as it was when the community had to depend on steam railroads.

A LARGE RAILWAY ORDER ABROAD.

It must be a matter of gratification to all American electrical engineers that a large contract for electric railway apparatus has come to this country from England. The General Electric Company last week took an order from the London Central Underground road for $500,000 of railway motors, etc., and will proceed at once to fill the contract. It is true, this is not the first order to reach this country from Europe, as we have lately noted other sales by American electrical manufacturers, but it is by far the largest we know of. We hope soon to see such an order repeated. Last year, no less than 25 per cent. of American exports was of manufactured goods, and we believe that the growing export of electrical apparatus will soon raise the figures to an even higher point unless by extremely high protective tariffs we nip such trade in the bud by making the cost of production too great. Incidentally we are glad to learn that the firm of Morris, Tasker Company have secured an order for 38 miles of poles. American cars are also going into England, on their merits, as the recent discussion in the House of Commons proved very conclusively.

MUNICIPAL LIGHTING FIZZLE AT ALEXANDRIA, VA.

From a report of the recent meeting of the city authorities of Alexandria, Va., we gather that the city electric lighting plant and gas works are now running behind, and that the electrical service alone shows a loss of $1,000 per annum. The plant was put in with the usual hurrah and promise of the millennium, but to-day the authorities have been driven to consider plans for taking light even for the streets, from a private company. It is said that many members of the council favor selling both the electric light plant and the gas works, so that the city would get for $2,000 a year what is now costing it nearly $8,000. Not alone is there a financial difficulty, but the citizens complain of the inadequacy of the service. "Many times have the citizens wanted incandescent lights for their houses and places of business, but the city has never been able to furnish them, and, it seems, never will with the present facilities." In the interests of economy and better lighting, we trust that the city will soon sell out.

MOORE'S VACUUM TUBE LIGHTING.

Although very little has been chronicled regarding the work of Mr. D. McFarlan Moore since his unique demonstration of vacuum tube lighting at the Electrical Exhibition last May, that inventor has not been idle by any means. He proved this by the demonstration made last week, an account of which appears on another page. The substitution of a rotary interrupter instead of a vibrator has unquestionably brought with it a most marked improvement both in the efficiency and the quality of light produced in Mr. Moore's tubes, and after witnessing a continuous run of these lamps for over an hour, and noting the ease of control, we have no hesitation in saying that the Moore system is now in at least as good, practical, commercial shape as the Edison incandescent system was in 1880. With the further improvements which time and experience will indicate, the Moore system will surely make a place for itself, and a prominent one at that.

TELEPHONE OPPOSITION.

In another part of this issue is given a report of the meeting of independent telephone interests held at Chicago last week. It will be seen that the practical outcome for the present is a decision to hold a national telephone convention at Detroit on June 22. If organized opposition is ever to amount to anything that convention should be a critical point in its history. It will be noted from our columns this week that separate bodies have been meeting in different parts of the country. This is a sure way to encounter defeat especially in face of an enemy so splendidly equipped and so admirably trained and led as are the Bell forces. Jealousy of the promoter of the Chicago meeting is said to have kept other interests away from it, but it must certainly be recognized that if organized independent telephony is to carry any weight and exercise any influence with the public, it must be united, harmonious and aggressive.

It is interesting to note that there is an ordinance of the city of Salem, Mass., requiring that no pole erected on the streets shall be of any other wood than hard pine, finished square. The experience of the Salem Electric Light Company with poles of this kind has demonstrated to their satisfaction that hard pine is not suitable, and they have therefore petitioned the city council for leave to replace their present hard pine poles with either cedar or chestnut, whenever and whereever desirable in their view.

Complaints about poor telephone service must go for naught in view of the recent order issued, that all presents sent in for the young ladies in the New York telephone exchanges shall be returned. Presents have been coming in such quantities that the management decided to put a stop to it. The inference is obvious and palpable. No mere sentimentality or a bidding for attention would prompt to such wholesale generosity. The girls have evidently won these favors by their good work, which, of course, reflects credit upon the exchanges.

Mr. J. C. Henry, a veteran electric railway man, whose pioneer work is well remembered, furnishes us this week from his Colorado seclusion some remarkably interesting data embodied in his estimate for operating electrically the Florence and Cripple Creek Railway. Mr. Henry, it is evident, believes in the ability of electric locomotives to deal with most of the difficulties; and note will be taken of the fact that he figures on the basis of overhead trolley methods.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—XII.

STORAGE BATTERIES IN EDISON STATIONS.—Continued.

BY JOSEPH APPLETON. (Copyright, 1897.)

THE second battery plant is located at the company's First Station and is the largest of the four, it consisting of 144 cells of the Tudor type and having a capacity of 6,600 amperes for one and one-quarter hours, 3,432 amperes for three hours, 1,388 amperes for ten hours.

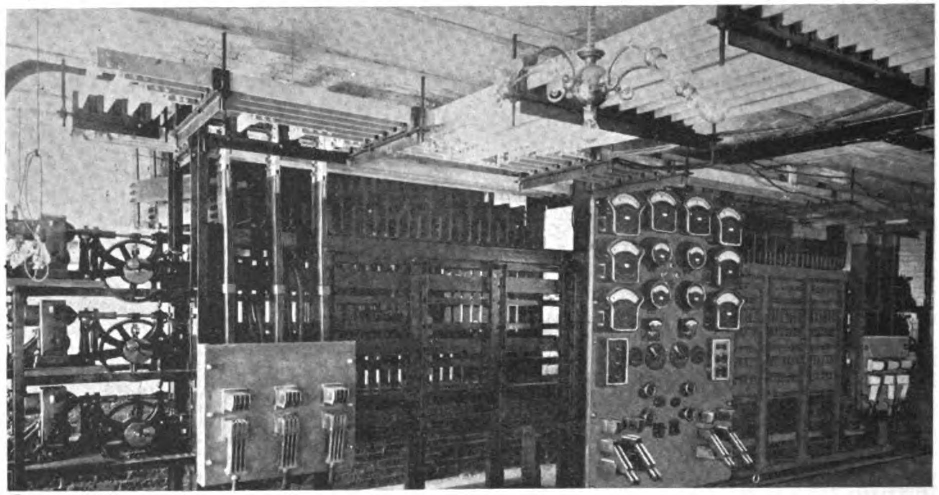


FIG 41.—STORAGE BATTERY SWITCHBOARD, FIRST DISTRICT STATION, EDISON ELECTRIC ILLUMINATING CO., BOSTON.

This plant is illustrated in Figs. 41 and 42, which show, respectively, the battery, switchboard and boosters user for charging. In this station there are three sets of busses, the switchboard being arranged accordingly.

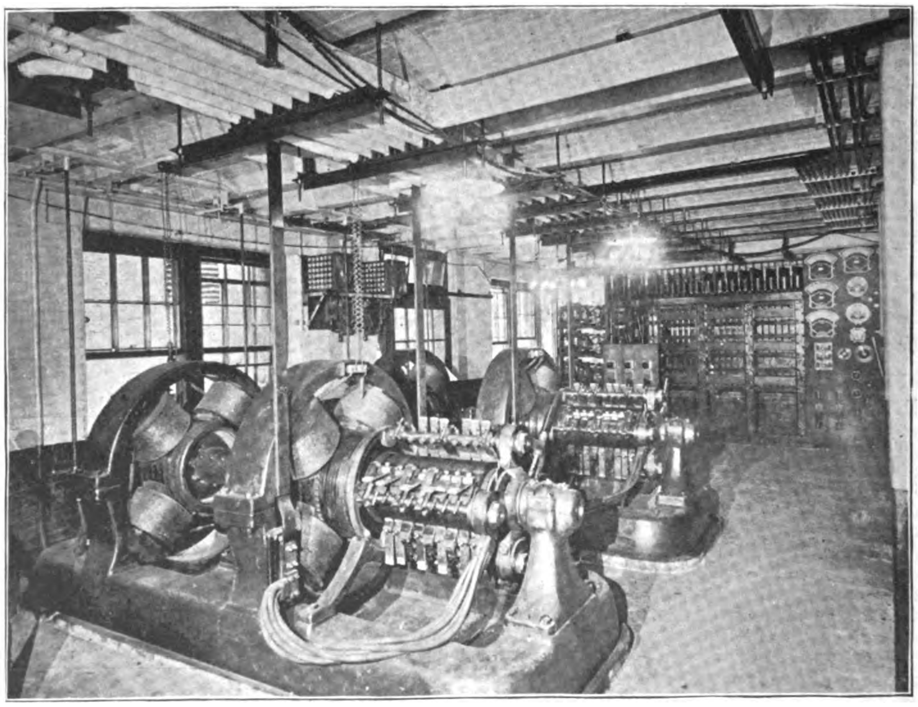


FIG. 42.—BOOSTERS AT FIRST DISTRICT STATION, BOSTON EDISON CO.

At the time this plant was installed it was the largest individual storage battery which had ever been erected, the cells being of much greater size than those in any European installation.

The installation of these two plants was the turning point in the history of storage batteries in this country, proving that the conditions of American central station practice did not differ sufficiently from the European methods to render the use of storage batteries less advisable and advantageous, as was frequently supposed, this being one reason given for the backwardness of American engineers in adopting them.

The third storage battery plant installed by the Boston Edison Company marked a fresh departure in direct current distribution in America, viz., the use of sub-stations consisting entirely of batteries, no generating machinery being employed. The problem arose of supplying a fashionable residential district, two miles from the nearest generating station, where it was impossible to erect a steam plant, apart from the question of poor economy which such a plant would give. The company had been compelled to refuse the supply of light and power in this district for several years on account of the fluctuation due to the great distance from the generating plant.

It was considered too great a distance to run new feeders of sufficient capacity to give good service and after careful consideration a storage battery sub-station was decided upon as giving the following advantages: New customers could be taken at the extreme end of their system, thereby extending the area over which they could supply current. Current could be taken from their most economical generating station on the water front, for charging the battery, at a time when the load was light, thereby increasing the economy of that station.

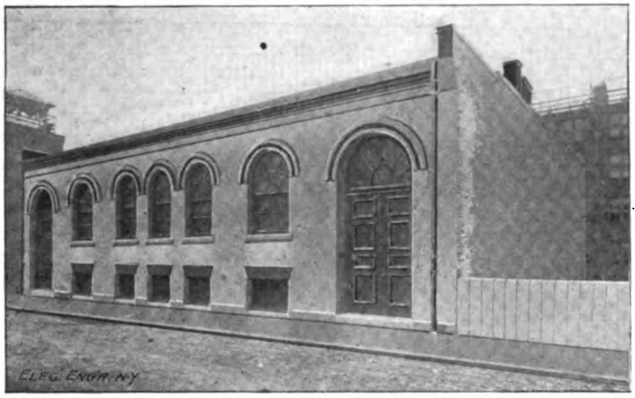


FIG. 43.—STORAGE BATTERY, SUB-STATION BOSTON EDISON CO.

The battery consists of 140 cells having a total capacity of 3,000 amperes for one hour, 1,500 amperes for three hours, 800 amperes for seven and one-half hours.

Figs. 43, 44, 45, 46 and 47 illustrate this plant, showing respectively the building, the interior of battery room, the switchboard arrangements and a still for providing distilled water for use in the battery.

The fourth battery now being installed by this company will be an auxiliary to their Second Station, which has a complete generating plant. The capacity of this battery is 4,000 amperes for one hour, 2,000 amperes for three hours, 800 amperes for ten hours.

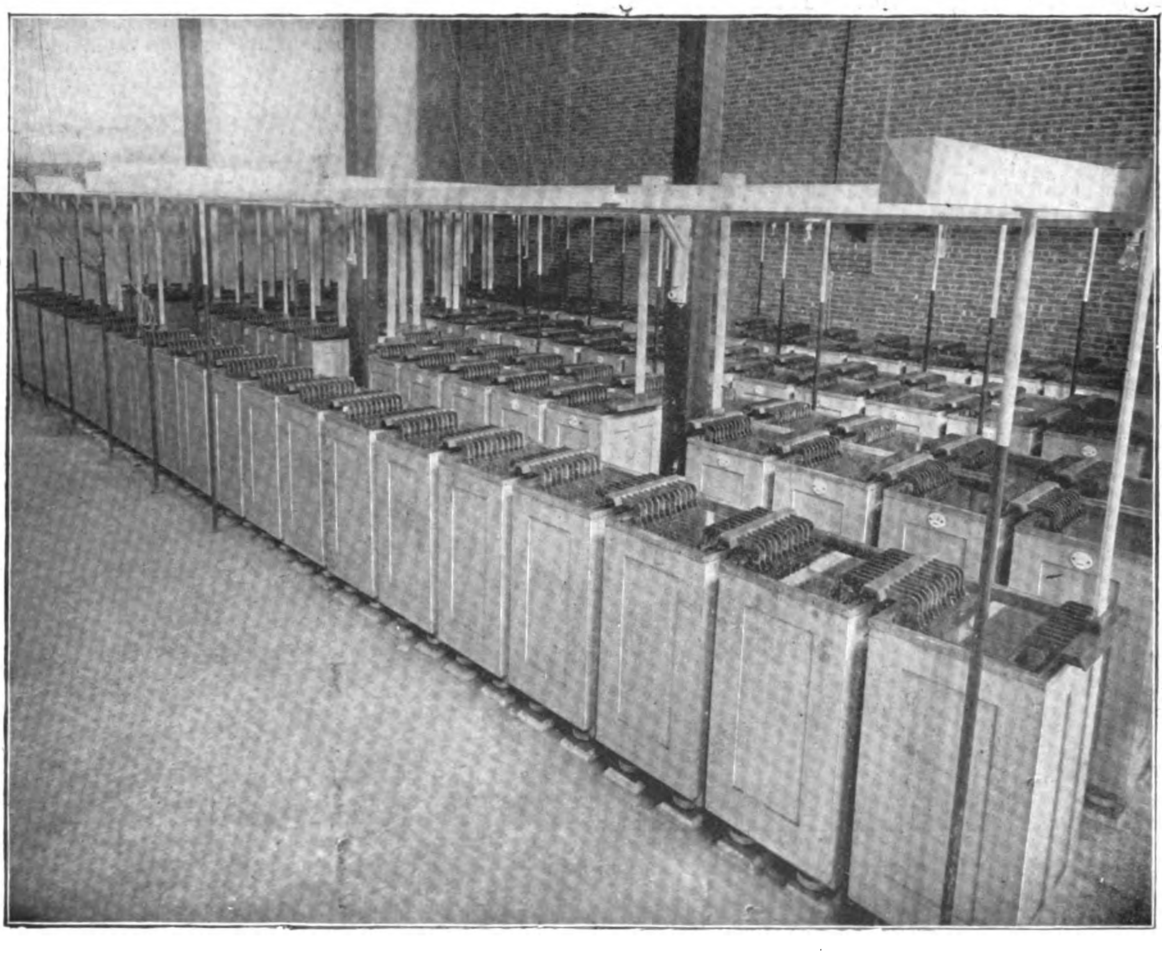


FIG. 44.—INTERIOR OF BATTERY SUB-STATION, BOSTON EDISON ELECTRIC ILLUMINATING CO.

The above mentioned stations are located as follows: The First, Second, and Third Stations are situated at three points which form approximately an equilateral triangle, the distance between Third and First being 3,800 feet, and between Third and Second 4,200 feet, the Fourth, or sub-station, being 7,000 feet from the First, or nearly 11,000 feet from the Third.

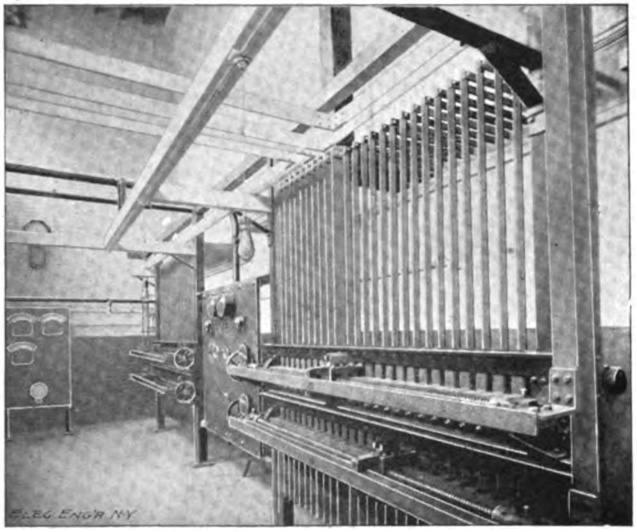


FIG. 45.—END CELL REGULATING SWITCHES, BATTERY SUB-STATION, BOSTON EDISON CO.

The First and Second stations are each connected with the Third by direct cables or tie lines of 3,000,000 circular mils capacity, on each side of the three-wire system, while between the First and Fourth it is so arranged that one of the feeders can be used as a tie line when desired.

This arrangement gives great flexibility to the system and enables the load to be divided up among the various generating centres in the most economical way.

Fig. 48 shows the total load on the system for a winter day, also the way in which it is distributed over the different stations. Curve A shows the total load on system. Curve B shows the load carried by the third district station. Curve C shows the load carried by the first district station. Curve D shows the load carried by the second district station, which at present has no storage battery, but where the new battery is being installed. Curve E shows the load carried by the fourth district or battery sub-station. The shaded portions show the load carried by the storage batteries, and the dotted portion the amount of charge given them at night.

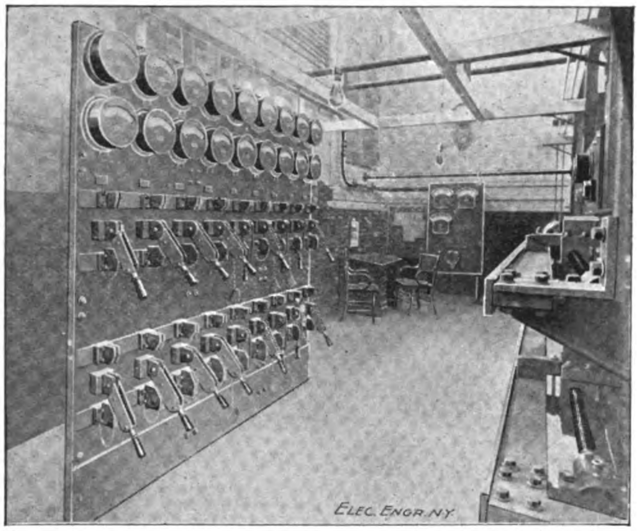


Fig. 46.—Main Switchboard, Battery, Sub-Station, Boston Edison Co.

This diagram does not illustrate fully the work done by the batteries, nor give an adequate idea of the important part they play in the system. For example: At the time of maximum load the batteries discharge at about 6,000 amperes while there is an available capacity in them of 13,000 amperes; this is due to the fact that while the third station battery is pretty well discharged during the peak, the first station battery is purposely not discharged, but is reserved in order to take the load in the event of the tie line giving out between the First and Third Station. It is used at a smaller rate of discharge on the residence lighting during the evening so that by midnight when the load is off the First station, the battery is about discharged. At the Fourth or sub-station, the load, being chiefly residence lighting, the maximum discharge does not occur till after the time of maximum load on the system.

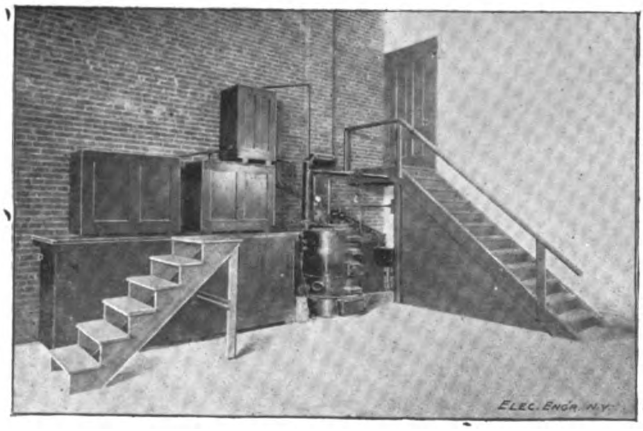


Fig. 47.—Water Still at Battery Sub-Station, Boston Edison Co.

By means of batteries arranged in this way, it is possible to generate the greater part of the output at the most economical station. For example: Ninety per cent. of the total output is generated at the Third station where the most efficient plant is installed.

The batteries are used continually during the day to equalize the load on the generators; when any units are becoming slightly overloaded the battery discharges in parallel with them and does away with the necessity of starting up a fresh unit, which would have to run at a light and uneconomical load. Again, if the load falls off so that any unit is not working at sufficient capacity to render it economical, it is used for charging the battery until the conditions are such that it can be taken off the system altogether or run at approximately full load.

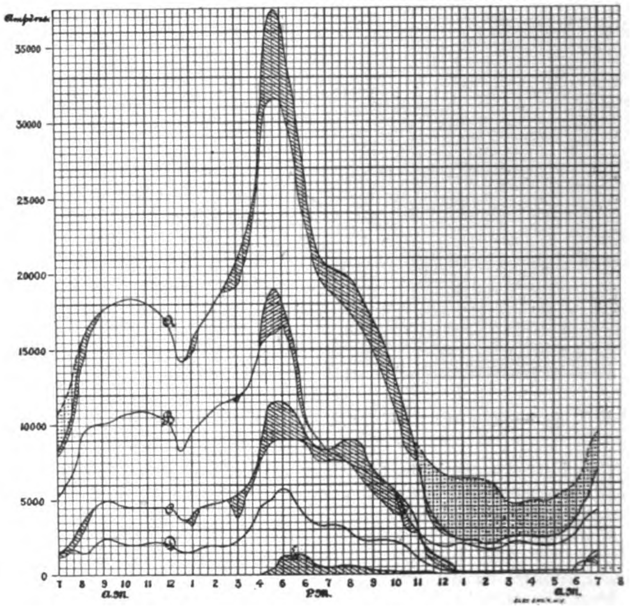
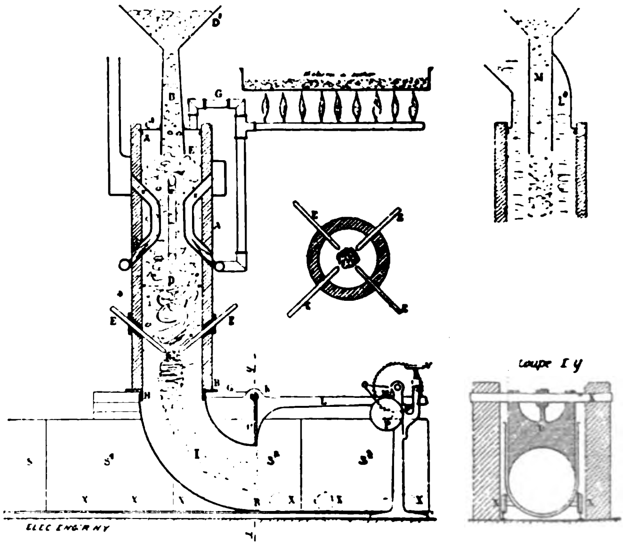


Fig. 48.—Curves Showing Load on Boston Edison Stations.

THE LELIEVRE ELECTRIC FURNACE.

THE great desideratum in an electric furnace is to obtain a continuous action, and also to obtain the best utilization of the heat produced by the arc. A furnace in which these these two conditions have been kept particularly in mind is that designed by Mr. E. Lelièvre, of Tours, France. As shown in the accompanying engraving, it consists of a cylinder A, of fire brick, or other resisting material, having a diameter D proportional to the output desired. About 50 centimeters above the base B are placed several electrodes E, either in even or uneven numbers and forming among themselves equal angles, the electrodes being either in the same plane or inclined towards each other. The multiple electrodes have the advantage of insuring perfect regularity of action by spreading the heat uniformly, and of allowing of their replacement without interrupting the action of the furnace.



The Lelievre Electric Furnace.

The bottom of the cylinder rests on a base plate G, having a cylindrical opening equal to that of the diameter of the furnace. Below the plate and corresponding to the opening there is a short cylinder H. The plate is carried by two parallel walls from which the elbow I descends at right angles, which elbow is carried on an axis centered at K, so that it can be moved absolutely concentric. The movement of the elbow is effected by the lever L, and the cam M by means of the gear and pinion at O. The number of oscillations are regulated once for all by the speed of the pulley, and the extent of the movement is regulated by the screw V, which limits the swing.

The end of the elbow R, is, so to say, embedded in a trough S, the lower part of which is a half cylinder, and the interior diameter of which is greater by several millimetres than the exterior of the elbow. The extremity of this elbow carries a casting U, forming with the opening of the elbow a surface similar to the transverse section of the trough. The sides of the latter are vertical and the trough consists of numerous sections, S, S^1, S^2, S^3, movable on a track.

The upper part of the furnace is closed by cover C^1. The middle of the cover has a hole through which passes a tube B^1, which is the charging tube, and extends below the cover about 25 centimeters. The upper end connects with a hopper D^1. The free space between the cover and the mass to be fused constitutes the gas chamber E^1.

The gas liberated is carried by a tube G^1 through to the condensing or liquefying apparatus, or to products with which they go to combine chemically. Since the escaping gases are generated in proportion to the amount of matter which goes into combination in the furnace, this gas when passed through a meter can thus be made to indicate the action of the furnace. Thus in the manufacture of carbide of calcium, for example, the carbonic oxide disengaged can be readily burnt, and the heat utilized to dry the carbon and the lime in the interior of the chamber, which is for that purpose traversed by the tubes K^1.

The top of the furnace may also carry a charging tube L^1, having a diameter equal to that of the furnace, and this same tube may carry at its center another tube M^1, reaching down 50 centimeters into the first. By this arrangement the material to be fused can be introduced into the center and the inert matter, such as carbon, placed in the tube. These two materials will then arrive without mixing into contact with the electrode, and the material to be fused will enter into fusion within the tube of the inert matter, which will thus always protect the sides of the furnace.

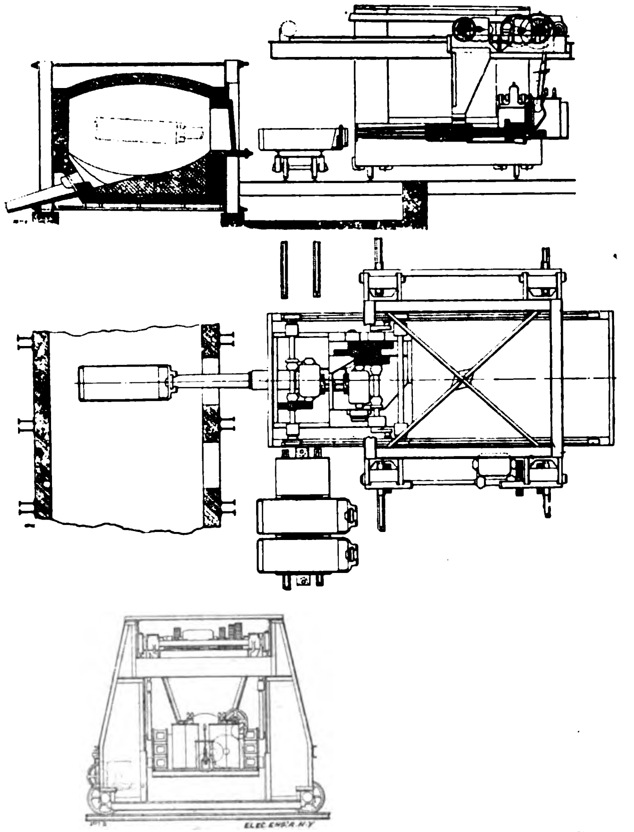
The action of the furnace is as follows: Before turning on the current the furnace is completely filled. At this period a part of the trough S is lined, and the elbow is full. The current is turned on and operation commences. Owing to the oscillating movement of the elbow the charge descends slowly, and is deposited automatically into the trough, which advances with every oscillation of the elbow. The full parts of the trough are emptied and replaced by others to be filled. The operation continuing, the material which enters into fusion, descends little by little in the elbow, traversing always the center of the material unfused and arrives finally in a pasty state, always surrounded by material, into the trough, from whence workmen extract it, after it is completely cooled. On the other hand, above the arc the gases produced by combustion have to take a long course through the midst of the charging material, and impart to it their heat.

WELLMAN ELECTRIC OPEN HEARTH CHARGING MACHINE.

In a paper read before the Institution of Mechanical Engineers, Mr. Jeremiah Head describes the Wellman electric open hearth charging machines which are employed at the Otis Steel Company's Works, at Cleveland, O. The machine illustrated represents the latest type of the Wellman machine, several of earlier types being still in operation at the works. Fig. 1 shows a cross-section of a furnace, the charging bogie with a charging box upon it, and the charging machine itself. Figs. 2 and 3 show the same in plan and back elevation. Downwards from the charger truck projects a strong bracket, ending in double-eye bearings, which carry a trunnion sleeve. Into this sleeve is threaded and secured with a back collar the charging bar. On the after end of the latter is carried the operator's platform, the tail end of which is connected by two rods with the pins of two cranks, keyed symmetrically to a shaft running across the charger truck frame at its rear end.

A motor carried on the truck is connected by gear with this shaft. By switching on the current the operator can rotate the crankshaft in either direction, and so move the charging bar up or down like a heavy gun in its trunnion bearings. As the motion is of the "all-round" type, no harm can come from overrunning. On the charger truck is also mounted a motor and gear for moving it and the charging bar, and all connected therewith towards or from the furnace by operating on the front axle and wheels.

The motors for producing the requisite movements are each 25 horse power, except that on the operator's platform for twisting the charging bar, which is only 3½ horse power. But as the maximum effort is seldom required in any of the movements, and as they are successive and not concurrent, 25 horse power may be considered the maximum used by them all at any one time. The power continuously used does not in all probability exceed an average of 10 horse power whilst the machine is at work. The current, which is brought by a single pair of conductors running overhead along the charging platform, is conveyed to the operator's platform by sliding contacts, to be there distributed to the various motors. The new high-framed machine has a great advantage over the old low-framed ones, in that it admits of the necessarily bare conductors and contacts being kept high up and well out of the way of the traffic in the floor. The power at the central station may and should be generated by economical engines under favorable conditions. Little pressure is lost in transit, and no current is taken by the machine except when at work, and then only in proportion to the work actually done. The motors are of a simple type, encased in iron, like those so common in America for use under electric street cars. The current is a continuous one, and the voltage used is 220 to 250.



Figs. 1, 2 and 3.—The Wellman Electric Open-Hearth Charging Machine.

The charging boxes are 6 feet long by 2 feet broad and 1¾ feet deep, which gives a capacity of 21 cubic feet. This is sufficient to contain a ton of ore or scrap and more than a ton of pig iron. Except when heavy castings and cobbles are to be dealt with, a ton is a convenient average load for a charging box, and 3 or 4 tons for a charging bogie, according to whether it is made to carry three or four boxes. If the boxes are properly loaded, the machine will pick up and empty one every minute, which is equivalent to dealing with an entire charge of 48 tons in 48 minutes. Allowing 12 minutes for contingencies, a charge would occupy one hour instead of 3½ hours, which is an ordinary time required for charging a 40-ton furnace, exclusive, say, of one hour for fettling. This would be required in either case. Thus a saving of 2½ hours per charge is effected by the machine. The time gained per week by using machine against hand labor may be expected to be at least 2½ hours x 9 heats = 22½ hours, which is more than sufficient for an extra heat or an increase in the total output of one-ninth, or 11 per cent.

Charging machines are also in operation in the Homestead Works, of the Carnegie Company; Illinois Steel Works, South Chicago, and the Cambria Iron Works, Johnstown, Pa.

THE DIRECT CURRENT TRANSFORMER.[1]

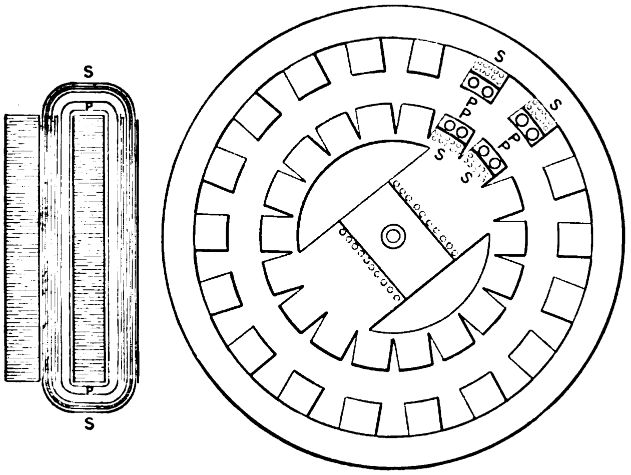
By C. THORDARSON.

THE direct continuous current is the ideal method for transmitting electrical energy, and it has advantages over the alternating current in almost all cases, and embraces a broader field, as for instance, the operation of the telephone and telegraph systems which cannot at present be operated in any other way.

The objections to the direct current transformer are not so much questions of efficiency (for this can be made as high as the alternating) as it is the first cost and running expenses. Now the first cost of the machine is a factor that cannot be greatly diminished. An apparatus having bearings, commutator and brushes will necessarily cost more than one having only two coils encased in a stationary magnetic field.

As regards the running expenses which constitute the wear and attendance, a direct current transformer of over 75-kilowatt capacity can be designed so as to require very little attendance, and experience has shown that an alternating transformer of the same output does require some attendance. Here therefore the difference between the two is not very great. When we come to the transformation in very small units the running expense of the direct current transformer has frequently been so high that it could not compete with the alternating current.

Let us first consider the friction on the bearings which if the armature is well balanced, is chiefly from its weight and sometimes from lateral pressure. The lateral pressure on the bearing can be entirely prevented by having the armature core of the same width as the field magnet poles, and the free space between the bearings and commutator the same as the length of the air space from armature core to field cores. But these proportions are only approximately true, and will vary some with slotted and surface wound armatures. When so designed the magnetic field will hold the armature absolutely free from all lateral thrust under all variation of load.



Elec. Eng'r. N.Y.

FIG. 1.—THE THORDARSON CONTINUOUS CURRENT TRANSFORMER.

The bearing friction caused from armature and commutator weight can be greatly diminished by mounting the armature eccentric or above the center in its running space. In this way the pull of the magnetic field will in smaller machines almost entirely counterbalance the weight of the armature and commutator. These are peculiar advantages of the rotary transformer, which when properly applied in the design can be produced in any dynamo and motor of the same output, there being no pressure on bearings from ropes or belting as the power is only transmitted between coils that are mounted on the same armature core.

To diminish bearing friction caused by armature weight it is profitable to use the bi-polar type on small units and to avoid friction from lateral thrust; all types having the field poles by the side of the armature as the Brush machines are objectionable.

Over a year ago I designed a 200-watt direct current transformer embodying most of these principles. It has run as long as 90 hours continuously without any attendance whatever.

In working out various designs of direct transformers the idea of rotating brushes and keeping all the other parts stationary will naturally suggest itself. Considerable experimenting has been done in this direction, especially by the Westinghouse and General Electric Companies, but very little of this information has found its way into print. A year and a half ago I designed and constructed a machine on this plan, Fig. 1, taking an ordinary laminated ring slotted on the external edge, and into each slot was wound one primary and one secondary coil, and over this ring was slid another laminated ring of the same width and sectional area, thereby encasing each pair of coils in a closed magnetic field; the leads were connected to a stationary commutator. Inside of the ring was mounted on a vertical shaft a field magnet of sufficient strength to produce rotation, and on this shaft were secured the arms carrying brushes and collector rings. The results might have been predicted. Each pair of coils acted as if it were an independent static transformer.

This is like taking so many static transformers, placing them anywhere at random on the floor and connecting them to commutators; they will give the same results. We have in both cases induction and an immense amount of sparking, and the sparking is so violent that it is difficult to run the apparatus even through an experiment. The advantages of slotted armatures are well known and spreading of the core teeth greatly diminishes the magnetic reluctance of the air space. If the coils are deeply sunk in the core and the slots closed over them the self-induction caused by the closed magnetic field surrounding each coil will become troublesome.

Even if there were no sparking this type of machine would be immensely more complicated than one having armature and commutator rotating.

Direct current transformers are at present chiefly used for operating telegraph and telephone circuits. For telegraph circuits the machines are required to give varying e. m. f. For that reason the primary and secondary circuits must be in two independent magnet fields, for no satisfactory variation of e. m. f. on the secondary can be made in any other way. The simple direct current transformer having primary and secondary circuits in the same magnetic field will vary its speed to maintain constant e. m. f. on the secondary.

THE DIRECT CONVERSION OF HEAT INTO ELECTRICITY.[1]

BY HARRY BARRINGER COX.

THE lecturer introduced his subject by stating that he was led to take up the study of thermo-electric generation by seeing an article in a newspaper to the effect that there were three great inventions to come: (1) The direct conversion of heat into electricity; (2) light without heat, and (3) a successful flying machine. He concluded that the greatest of these problems was the direct conversion of heat into electricity, and immediately took up the work with the courage and confidence of youth, little dreaming of the years of hard work before him.

Mr. Cox then described his first crude attempts at constructing a thermopile, which were unsuccessful. After many experiments Mr. Cox came to the conclusion that the success of an apparatus of this kind did not depend solely on its efficiency, but also on its cost and durability, cost of attendance, etc. As a result Mr. Cox paid very little attention to thermo-electric couples from the standpoint of their electromotive force. His chief attention was paid to this: that thermo-electric couples were deficient, not so much in their electromotive force, but in their mechanical construction. When he came to undertake the removal of the drawbacks to the thermo-generators of the past Mr. Cox was quite alarmed to find so many difficulties in one problem, conceding it to be a simple problem. He found, first, if one joined two metals together, that there was a great liability to oxidation of the joint. The oxidation would, of course, affect the output of the machine by cutting down the current to practically nothing in the course of time. Then there was the serious difficulty of the disintegration of the element, its breaking apart or disruption: thus one might have an element which would be all right and apparently strong to-day, but would, owing to defective structure, rupture or break apart without warning. No practical machine could be made with any such couple as that. Conceding that both these difficulties could be corrected there was still another very serious difficulty in the couple, and that was the fact that they were so fragile that, taking a couple of three-quarters of an inch in thickness, one could take it in one's fingers and crush it almost to powder; it was totally impracticable from a commercial standpoint. Mr. Cox then explained that his couples are made of two parts antimony and one of zinc, which is Seebeck's old metal, which he used back in 1821. The cross-connection piece is made of copper. These couples are now made by machinery. There is no soldering or brazing or joining, except a machine joint. The castings are made in a special room, the room being heated up to a considerable temperature. All the work is done under as high a heat as it is possible for the men to stand. The parts are dropped into the machine mold, and the couples are made quicker than it would be possible to count; fifteen are cast at one time. They will in a very short time, be running a machine which will make a casting which goes from the bottom clear to its top, with absolutely no joint in the entire device.

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[1] A paper read before the Chicago Electrical Association, May 7, 1897. Abstract.

[1] Abstract of a lecture delivered before the New York Electrical Society, May 20, 1897. With discussion.

In making this casting, it is not a joining of the cross strip with the lug, but it is a shading of one into the other. There is really no line of demarkation, no line where there is a joint; as there is no line of demarkation, it is impossible even to imagine where there might be a rupture or oxidation.

In thermo-electric couples it has been stated that the closer we could get to the surface, where the heat is applied, the higher the electromotive force. Mr. Cox does not find this so. Instead of putting the junction at the surface, he lets it in a distance, which very materially tends towards lowering the internal resistance of the lug; he finds no decrease in the electrical output from the standpoint of e. m. f.

After the thermo-electric castings are made they are subjected to a Wheatstone bridge test to get the internal resistance when cold. Strange to say, these thermo-electric couples as built give a current at all times absolutely independent of the fact whether heat is applied or not; there is a difference of potential indicated at all times. By approaching the hand to one side or the other, the needle of the testing galvanometer is brought to zero, the heat of the hand being sufficient to establish equilibrium. After the castings are made and tested they are formed upon a spindle and the connection of the castings brazed together. Using five castings, with a total of seventy-five junctions, made in five different operations, requires only ten minutes. The completed couples are then labeled as having an internal resistance of so much. After they are built up, the interior is cemented with vitrified cement. When it is all cemented, the plates which have held the built-up device are retained, and it is put in an oven and baked and vitrified. It is then tested again; and all this time it has the tag on it which it started with, which indicates the internal resistance when first built up, and the internal resistance during the various processes of its manufacture. The outside of the machine is then cemented and baked as well as the top and bottom. If it passes the bridge measurement its jacket of metal is cemented on and firmly joined to it, becoming an integral part of the cement and of the machine itself.

This cylinder so formed is then encased in a water-jacket and tested under 15 pounds water pressure for leakage. After the water pressure test has been completed, the machine is submitted to heat, slowly applied, in order to thoroughly vitrify the inside, and then a final resistance test is made of the machine, which must correspond with the original test. Each generator is tested for one week. Taking the machine, as it was running on the table before him, Mr. Cox said there was about 2½ cubic feet of gas used in the machine for the work which it was then doing (running a small fan), that costs at the ordinary rate of New York gas, which is extremely high, three-tenths of a cent to operate the fan motor per hour. In the heating of the generator a deflector is employed which gradually increases in size. The hottest part of the flame being at the bottom, it is the smallest in the deflector bar, and is furthest away from the sides of the device, and the higher up the flame goes the larger it gets, and the greater the heat is confined. The device works very efficiently. Mr. Cox explained that there was no danger of the deflector bar of iron wearing out by being run constantly at red heat, as the carbon burned out of the iron is redeposited on it from the Bunsen flame, the action being similar to that of the Bower-Barff process for making iron non-rusting. Mr. Cox then showed that the generator could operate a six-inch gong, a medical coil, a telegraph instrument and a fan, which were on the lecture table, all at one time.

As to the future Mr. Cox believed that we had reached the limit of thermo-electric efficiency; the question was now purely a mechanical one. He had constructed machines built exactly on the lines of the one shown, only larger, which ran five 16-candle-power lamps of full photometric value, for one cent per hour. His ultimate idea was to produce an efficient mechanical working device with a very high amperage output and low voltage. He did not attempt to attain extremely high voltage. He did not believe it would pay.

The water in the machine, according to Mr. Cox, has very little to do with its working. He does not find that the cooler the backs and the hotter the fronts, the greater the output. He had never found any such condition as the one just stated, that the hotter you make the hot junction, and the cooler you make the cool junction, the greater the electrical efficiency. He found that if one gets the cool junction too cool the efficiency of the hot junction is reduced, and one must be careful not to get the device too cool. A temperature on the outside between 60 and 185, only reduces the electromotive force a few tenths of a volt in a five-volt machine, and that is not due to the thermo-electric effect, but to the increased internal resistance which of necessity the excess of heat produces. He had tried it with freezing water, and confirmed his statement.

In reply to questions by various members Mr. Cox stated that the machines were built for 2.5, 4.5 and 10 volts. The 4.5 volt machine gave 4 amperes, and it contained 75 couples, in 5 rows of 15 each. On the higher voltage machines, the current output is less proportionally than with the low voltage machines. The generators could not be run economically above a certain temperature owing to the increase in internal resistance.

MR. G. S. DUNN suggested that a very simple way to measure the output would be to short-circuit the machine through the ammeter. Then we know when it is giving half the number of amperes it is giving the maximum number of watts at half the voltage on open circuit.

PROF. F. B. CROCKER: I think Mr. Cox is right in saying that there was no necessary disintegration in the thermo-electric pile. I have heard the statement made on high authority that there was an inherent deterioration; in fact, that the pile acted by that very deterioration; in other words, that its life was limited by its activity, and the more work it did the shorter its life. I do not think this is either theoretically or practically necessary. I do think, however, as Mr. Cox has said, that it requires a very perfect and perhaps peculiar mechanical construction to avoid the natural disintegration which is likely to occur when we join dissimilar metals. That sharp line of demarkation, to which he refers, as is well known, tends to produce a weak point and the elements are very likely to crack at that line of demarkation; but by some particular construction, one or two of which he has indicated (and there are several others), we can avoid that, not only partially, but entirely. I am familiar with thermo-electric couples in use a year without any serious depreciation in value of their output; and in fact we have a battery in our museum in Columbia College which we have had for several years, not used constantly, but more or less, and as far as I know it is as good to-day as it was several years ago. That difficulty I think can be, and practically is, overcome. In regard to the oxidation, I think that can be overcome by protecting the elements in some such way as Mr. Cox speaks of. In the case of the elements I speak of, each element is protected by a shoe, on which the heat strikes and that protects the elements from oxidation.

As to the output, as Mr. Dunn has said, the amperes on short circuit give twice the amperes registered when the external resistance equals the internal. At the same time we get only half the volts in the external circuit that we get on open circuit; and therefore if we multiply one-half the amperes given on short circuit by one-half the volts on open circuit, we get the actual watt output, which is the maximum to be obtained from any source of that kind, thermo-electric or otherwise. I have tested some electric batteries repeatedly, and that has come out correctly. You also get half the voltage when you have the external equal the internal; half the total voltage is available from the external circuit. It is a well-known fact, and is, of course, true in this case.

Concerning the hot and cold juncture or junction, differing in temperature, I have observed the same fact as stated by Mr. Cox that if you cool or reduce the temperature of the cool junction, and make it still cooler, you do not get a much increased electromotive force. Mr. Cox interpreted that to mean that a greater difference of temperature does not give a greater electromotive force. In that conclusion, from that observed fact, I do not agree, because I think it is a fundamental law that the electromotive force is proportional to the difference of temperature. It is used in physics as an absolute method for the determination of temperature and when it is used at low temperatures it is even more reliable than a thermometer. The law is that the electromotive force is in proportion to the difference of temperature. It is true of this battery as in every combination of thermo-electrics. I explain that phenomenon, which is undoubtedly observed, in this way: If you cool the junction having the lower temperature, the other one follows it down, and you simply have practically the same difference of temperature as before. You say why? Does not the higher temperature remain at that higher temperature? No; simply because it has a limited heating surface and can only maintain a certain difference of temperature between the ends, and if one end is cooler, the other will only be the same number of degrees above it in temperature, and if the cool one goes down, the higher temperature then follows and maintains the same difference between the two ends, or substantially so. (Applause.)

It always struck me that it does not pay to cool by water or otherwise the cool junction. I tried it and found if we drop cold water on the cool junction, or even put ice on it, there was no great increase in the electromotive force. Therefore, I argued it was not worth while to complicate the device by attempting to cool the lower temperature junction. It has been suggested by Mr. Bradley, who is present, that the thermo-electric battery is just like a boiler; that it has a capacity of output proportioned to its heating surface. In a boiler we have so many square feet of heating surface and there is so much possibility of producing energy. If more attention was paid to the fact, we might increase the heating surface of the battery, and get a greater difference in temperature, which I feel positive will give a greater electromotive force.

In regard to the small number of couples, Mr. Cox is right in preferring a smaller number, and therefore less complication, provided he does not need a higher electromotive force. If it is necessary to have a higher electromotive force, he suggests that it can be obtained by transformation. Unfortunately, the only way of transforming direct current now open to us, is by means of the motor dynamo, a fairly good device, but having an efficiency of not much more than 85 per cent., and that is somewhat of a disadvantage. Perhaps it would be better to have a fewer number of larger couples, and sacrifice efficiency in order to get simplicity with a few couples. If I wanted a hundred volts I would rather get it by a sufficient number of couples than by a small number of couples and a motor-dynamo.

MR. JONES: What is the difference in the internal resistance with 75 degrees? Is it possible to put several of the machines in series like a battery, and will they act in the same way as the cells of a battery?

In reply to Mr. F. W. Jones, Mr. Cox said that the generator could be treated exactly as though they were primary batteries; they could be put in series or multiple to any extent. Regarding the difference in resistance between the machine hot and cold, he finds it to be about three-tenths of an ohm to one ohm; if it has an internal resistance of one ohm cold it is about 1.3 ohm hot, representing a difference of 75 degs. in temperature. The generators could be short circuited.

MR. DUNN, at the request of the president and Mr. Cox, tested the machine to get the watt output. He first connected the volt-meter across the terminals on the left-hand pole on open circuit, which showed a voltage of 2.6. He short-circuited to the ammeter, and got a current of 3.9 amperes. Taking half of each of these values and multiplying them, he got an output of 2.53 watts.

MR. COX: This machine which Mr. Dunn says is only giving 2.53 watts is running that fan motor. (Applause.)

D. M. I. PUPIN: I would like to say a word in support of Mr. Cox's views. I do not think the test which Mr. Dunn made is quite unobjectionable. I think where a battery can work with the expenditure equal to the supply, the theory is right about the watts; but suppose the battery gives current at a much larger rate, and does its work at a much larger rate, than the supply of energy; then, of course, the voltage would drop. A battery is not the same thing, when it gives this large current, as it is when it gives the small current. It is quite possible, if a thermo-electric battery is short-circuited, and gives a large current, that the gas jet is not capable of supplying the heat at the rate at which the electrical energy demands it, and the actual voltage of the thing drops, and then the battery would not work under the same conditions as it would work if the heat supply was large enough to keep the actual induced difference of potential constant. It is a fact similar to the polarization cell; and when I see this motor work at 2.5 watts, as stated, I do not believe that it can do it.

MR. C. O. MAILLOUX: I do not think the Peltier effects should be neglected. As there is a self-induction in dynamos, so there is a counter phenomenon in thermo-electric currents, whereby the passage of the current changes the temperature. When the current is increased beyond the normal rate for which the instrument is designed, there would be a strong phenomenon which would act in a manner analogous to the self-induction and act as a counter electromotive force. I think it is an effect which should not be neglected, and which would make the actual current smaller than might be thought.

A PRESIDENTIAL CAR is what the Railroad Car Journal proposes to have built by public liberality for the personal and official use of the successive Presidents of the United States. There is an advisory committee of 25 expert car builders and superintendents of motive power, and offers of material, appliances, etc., should be sent to them at 132 Nassau street, New York City.

TELEPHONY AND TELEGRAPHY

CONVENTION OF INDEPENDENT TELEPHONE COMPANIES AT CHICAGO.

A CONVENTION of the Independent Telephone Companies of the United States was held in Chicago on Thursday, May 27 and two following days. The first session commenced at 10 o'clock on the morning of the 27th at 250 South Clinton street. The principal matter of importance which came up at this meeting was the election of a committee of ten and a chairman to appoint an executive committee of two from each State.

At the afternoon session, which took place in parlor N, Palmer House, after Mr. J. E. Keelyn, who was elected chairman of the convention, called the meeting to order, the Committee of Ten proceeded to appoint the executive committee of two from each State to formulate and devise plans for the purpose of organizing a national association in the interests of the independent telephone companies and to draw up a constitution and by-laws of the association.

The following executive committees were appointed: Chairman, T. A. Marshall, Keithsburg, Ill.; secretary, J. H. Vesey, Cairo, Ill.; J. E. Keelyn, Chicago, Ill.; W. H. Gilbert, East Saginaw, Mich.; D. McVichey, Ishpeming, Mich.; J. Slade, Oscaloosa, Ia.; Judge Stevens, Boone, Ia.; W. L. Miller, La Crosse, Wis.; W. A. Harper, Madison, Wis.; H. E. Ralston, Maryville, Mo.; E. C. Baker, Cameron, Mo.; W. B. Seaton, Ashland, Ky.; H. C. Cole, Owensboro, Ky.; H. E. Matthews, Huntington, West Va.; J. M. Payne, Charleston, West Va.; W. P. Roberts, Lynchburg, Va.; S. A. Duvall, Richmond, Va.; Clarence Hodson, Baltimore, Md.; C. E. Frink, Westminster, Md.; W. H. Rankin, Elizabeth, N. J.; H. C. Dow, Cobleskill, N. Y.; W. H. Laird, Wyona, Minn.; L. C. Ketcham, Palestine, Tex.; L. C. Baker, Beaumont, Tex.; R. B. Lebby, Charleston, S. C.; J. H. Twitchell, Spartansburg, S. C.; I. Newton Smith, Tarboro, N. C.; J. Brown, Montpelier, Vt.; G. H. Almond, Montpelier, Vt.; J. A. Evans, Rome, N. Y.; J. Stewart, Natchez, Miss.; J. Crane, Yazoo, Miss.; Hon. J. N. Thomas, Chillicothe, O.; J. H. Critchfield, Mount Vernon, O.; H. C. Young, Columbia, Pa.; C. R. Savidge, Sunbury, Pa.; Dr. J. A. Lumbkin, Mattoon, Ill.; J. L. Stone, Rushville, Ind.; G. W. Beer, Fort Wayne, Ind.; J. Burke, Carbondale, Ill.; C. Truitt, Columbia, Mo.; J. Leak, Cairo, Ill. At the termination of the first day's proceedings the meeting adjourned until 9 A. M. Friday morning at the Palmer House.

The telephone men opposed to the Bell interests, met again in session at the Palmer House, on Friday and adjourned, after deciding on a national convention in Detroit on June 22. The coming convention's purpose is to unite the anti-Bell exchanges, and the gathering was recommended by the executive committee. Manufacturers and dealers in telephone supplies were requested to meet also at the same time and place.

J. E. Keelyn, president of the Western Telephone Construction Company, who had been chairman at the Palmer House session, asked to be relieved, and J. L. Thomas of Chillicothe, O., was chosen therefore to preside. W. J. Veasey of Fort Wayne was made secretary.

A resolution commending Justice Harlan of the United States Supreme Court for his dissenting opinion on the Berliner litigation was introduced by L. Z. Holbrook of Chicago, but withdrawn, delegates saying it would be unwise to express an opinion of the action of any of the Supreme Court judges, in view of future litigation.

The executive committee, representing various States of the Union, met after the convention adjourned and appointed the following sub-committees:

By-Laws—C. R. Savidge, Sunbury, Pa.; H. D. Critchfield, Vernon; O.; Dr. I. A. Lumbkin, Mattoon, Ill.

Resolutions—J. L. Stone, Richmond, Ind.; Hugh Dougherty, Indianapolis, Ind.; A. T. Averill, Cedar Rapids, Ia.

Thomas A. Marshall of Keithsburg, Ill., chairman of the executive committee, was appointed to consult the railroads as to rates for the Detroit convention.

THE POSTAL TELEGRAPH COMPANY reports that this summer it will have an office in every city and town of importance in Texas. A great deal of extension work has also been done in New York State.

INDEPENDENT TELEPHONE MEETINGS IN INDIANA AND PENNSYLVANIA.

A special dispatch from Pittsburg says: The first annual meeting of the Interstate Local Telephone Association will be held at the Monongahela House June 3. Fifty-five distinct, independent telephone companies in western Pennsylvania, eastern Ohio and West Virginia are expected to have representatives at the meeting. Invitations have also been sent to the telephone companies at Sunbury, Shamokin and Mount Carmel to send representatives to the meeting. The people interested in the meeting expect to discuss the recent United States Supreme Court decision in regard to the Bell patent. They are prepared to defend themselves in any legal emergency and are negotiating for the services of a well known telephone lawyer to become their counsel. There are prospects of an immense combination of small telephone concerns of the United States this summer in opposition to the Bell company. A convention of companies will be called for some central point within the next few months, when the possibilities of extending the long distance system will be considered. The independent companies in this State do 75 per cent. as much business as the Bell company, it is understood, and in the small towns, where they have their principal business, have much more. In Greensburg they do about three times as much; in New Castle about five times as much, and in Carnegie they have nearly all the service. Independent telephone companies of this city and vicinity are having nothing to do with the convention in Chicago this week.

A dispatch from Fort Wayne, Ind., says: Representatives of the independent telephone companies from Ohio, Pennsylvania, Tennessee, Virginia, Michigan, Missouri, Illinois, Indiana, Arkansas, Iowa, Minnesota, South Carolina, Wisconsin and Texas are holding a meeting here to devise a means to formulate a toll system in opposition to the Bell Telephone Company. This meeting was addressed by Judge Robert S. Taylor, on the Berliner patent situation. It will be remembered that Judge Taylor took part in the prosecution of the Government suit against the American Bell Telephone Company.

ALLEGED WHOLESALE TELEPHONE SUITS AGAINST SUBSCRIBERS.

Reports have been current as to the intention of the American Bell Telephone Company to bring suits on a larger scale that has ever before been known in the annals of litigation. Such stories lack confirmation, but a high official in the local Bell Telephone Company at Pittsburg is quoted by the newspapers there as follows: "Our company has been a heavy loser by the competition of these concerns infringing on patents for which we have been paying a royalty. We expect to get some return for our loss. While I am not familiar with the course the American Bell Telephone Company will pursue, still I have heard it intimated by the officials that something is going to drop, and drop hard.

"Suits will be entered against everyone infringing on the patents, if I understand it, although time enough has not elapsed since the Supreme Court decision was rendered in our favor to prepare any plan of action. It has been intimated to me that the American Bell Telephone Company will change its plan of action. Heretofore it has been the policy of the company to enter suits only against the concerns making the telephones and those disposing of them for service. I have heard that a different policy will be adopted, and the individual user of the telephone will be made to answer for the infringement on the patent as well as those profiting by the transaction.

"I believe this is good law. If the subscribers did not subscribe for the apparatus that is duly patented and sustained by the courts, the concerns entering the business could not exist, and that would settle all opposition. The subscriber is directly responsible for aiding and abetting the infringement and should be held equally responsible."

INDEPENDENT TELEPHONE MOVEMENT IN BOSTON.

Five hundred circulars were sent out on May 25 from Boston to as many independent exchanges and manufacturers, calling for a meeting to be held at an early date in Boston, to form a combination to fight the Bell Telephone Company. As soon as a sufficient number of replies have been received a meeting will be called and some form of organization adopted. In the opinion of the projectors, the effect of this combination will be far-reaching and means that the independent companies have determined to band themselves together, pool their interests, and have the matter settled once for all. The call is the result of numerous requests by many independent exchanges in the East, and was sent out by Whitman & Couch, of Boston. The circular states that the call is made for a meeting to decide what means can be taken for mutual protection against the Bell company in case of suit, and also some means of consolidation whereby all the exchanges in the East may have a bond of fellowship and good will, and, in the near future, extend their lines for long-distance work and connect with the Western exchanges.

Mr. Whitman, of Whitman & Couch, said that the meeting to be held in Boston would work in harmony with the Western movement. It is practically a branch meeting for those who cannot afford the time and money for a trip to Chicago. The combination will be among the independent exchanges and the larger manufacturers who build and have an interest in these exchanges. With a firm combination the independent exchanges will have no fear of the Bell company in the courts, in fact, they will welcome a legal fight; and, if the Bell company does not take the initiative in the matter, the new combination will force it and fight the matter to the end. It is proposed that each organization in the combination shall contribute a proportionate sum of money in cash to the general fund, which shall be deposited in the hands of a board of trustees or directors. The great fight will come over the Berliner patent, and those interested in the movement believe that they could not lose if the matter were fought to the end.

ASSESSING TELEPHONE PROPERTY IN KANSAS.

An agitation has been aroused by the sudden multiplication of the assessment on the property of the Missouri and Kansas Telephone Company, at Topeka, Kan. The company has its headquarters in Kansas City, but the president, John R. Mulvane, lives at Topeka, and says he will fight the case to the Supreme Court. Heretofore the company has been turning in its statement of property at $4,000. This year there was a new assessor and the company raised its statement of property to $5,000. This did not suit the assessor, and he made it $35,000. He claims the plant cost over $100,000.

BELL TELEPHONE OUTPUT.

The American Bell Telephone Company's statement of instrument output for the month ended May 20 and the year to date shows:

May—	1897.	1896.		
Gross output	20,598	20,001	Inc.	597
Returned	452	7,537	Inc.	915
Net output	12,146	12,464	Dec.	318
Dec. 21 to May 20—				
Gross output	94,333	96,519	Dec.	2,186
Returned	36,608	35,999	Inc.	609
Net output	57,725	60,520	Dec.	2,795
Total telephones in hands of licensees of the American Bell Company under rental				830,014
Against total one year ago				735,496
Comparative increase				94,518

LEGAL NOTES

VAN DEPOELE PATENTS ON TROLLEY SWITCHES AND TRAVELING CONTACTS SUSTAINED ON APPEAL.

Appeals from the Circuit Court of the United States for the Northern District of Ohio. Submitted Feb. 27, 1897. Decided May 17, 1897.—Before Taft and Lurton, Circuit Judges, and Clark, District Judge.

THESE were appeals in two patent cases between the same parties that present questions of such a similar character that they were argued together and were disposed of in one opinion. The appeals were from orders of preliminary injunction made before a hearing upon the merits. The first case was a suit by the Thomson-Houston Electric Company to enjoin the alleged infringement by the Ohio Brass Company of U. S. Patent No. 424,695 for suspended switches for electric railways, issued to Charles J. Van Depoele, April 1, 1890, and assigned by mesne assignment to the complainant. A preliminary injunction was issued against the making and selling by the defendant of overhead conductor switches for electric railways for use in the combinations covered by the 3d, 4th and 11th claims of the patent. The second case was a suit by the same complainant against the same defendant for an alleged infringement of U. S. Patent No. 495,443, issued to Charles J. Van Depoele for suspended switches and traveling contacts for electric railways and assigned by mesne assignments to the complainant. A preliminary injunction before the hearing on the merits was granted, enjoining the defendant from the manufacture or sale of trolleys or trolley bases intended to be used in the 6th, 7th, 8th, 12th or 16th claims of said patent.

It appeared in the first case that in a suit before Judge Coxe in the Northern District of New York, the validity of patent No. 424,695 was in issue and the validity of the claims involved were sustained. (69 Fed. Rep., 357). The cause was carried to the Circuit Court of Appeals for the second circuit and the order of injunction so far as the claims here involved were concerned was affirmed, though the complainant was required to enter a disclaimer as to certain other claims in the patent, to-wit: The 2d, 9th and 10th, which disclaimer was duly made and filed in the Patent Office. (71 Fed. Rep., 396.)

In the second case it appeared that the validity of patent No. 495,443 had been at an issue in a cause heard upon its merits and passed to final decree before Judge Townsend in the District of Connecticut and that the claims of the patent here involved were sustained.

There were two principal objections made in this court to the injunctions below. The first was that there was not any proof of actual infringement or of an intention to infringe the combinations covered by the claims set forth in the orders of injunction appealed from. The second objection was that the patents, Nos. 424,695 and 495,443 were both void, the latter because the former a patent of earlier issue, was for the same invention; and the former, because patent No. 397,451, a still earlier patent, issued to the same patentee, covered and was also for the same invention.

The Court of Appeals delivered a voluminous decision overruling both objections and sustaining the preliminary injunction.

TROLLEYS ENTITLED TO MORE PRIVILEGES THAN OTHER VEHICLES.—A PENNSYLVANIA DECISION.

IN deciding in favor of the Electric Traction Company, of Philadelphia, an action for personal injuries sustained by a child, the Pennsylvania Supreme Court reversed the decision of the lower court and said:

"We are without any definite information as to the speed of this car. The witnesses are of opinion that it was greater than usual, but was not so great but the motorman was able to stop it within about its length. We are not prepared to lay down any rule in regard to the rate of speed at which an electric car may be run between crossings, nor to say that the mere fact that the defendant's car was moving faster than usual at the time the plaintiff ran in front of it would be, in the language of the charge, 'sufficient to justify the jury in finding the defendant guilty of negligence.' All that can be safely said upon this subject is that the car must be kept well in hand, and that the speed must not be so great as to make this impossible, or to endanger the safety of the public using the streets with responsible care.

"But these passenger railways are created to facilitate the movements of the general public and to furnish rapid transit for citizens from their homes to the business centre of the city. They are practically indispensable in all great cities. The same rules as to speed that may be applied to ordinary vehicles propelled by horses are not applicable to street cars. They move upon a track from which they cannot turn, which is plainly visible and which is prepared with a view to the rapid movement of cars upon it. The cars can be seen and heard for considerable distances, and are required to warn persons who may be upon their tracks of their approach. The purpose of their owners and the demand of the public are that the greatest rate of speed consistent with the safety of other persons using the street or highway shall be maintained, and we are unable to say that any rate of speed that does not transcend these limits is negligence, or should be submitted to the jury as 'sufficient to justify' a verdict against the railway company.

"As to the failure to ring the bell at Fitzwater street, it is enough to say that the evidence shows that the cars stopped there only when there were passengers to get on or off at that crossing and that it was not a regular stopping place. On the day of this accident there was one to get on or off this car at that street, and there was nothing to require it to do more than slacken its speed as it crossed the street. There was no one upon the street to be warned and no occasion for striking the gong or bell. It went on with an unobstructed track before it into the next square, when suddenly this child dashed into the street just before it. The motorman saw the movement and at once applied the brake with such force as to attract attention from people who were indoors for some distance along the street and with such effect as to stop the car almost instantly. There was nothing in all this to require the striking of the gong or to suggest its necessity to the motorman. The fact that this was not done under the circumstances disclosed by the evidence in this case was not the cause of this accident nor could his failure to do so amount to negligence.

"Upon a careful examination of this record we are unable to find any evidence of negligence on the part of the defendant sufficient to justify the submission of the question to the jury. The injury was not inflicted at a crossing where the passage of footmen should be looked for. The child was upon the sidewalk until it ran suddenly on the track and was struck on the instant of reaching it. The immediate cause of the injury was, therefore, her own thoughtless act, for which the defendant is in no way responsible, and no act of negligence on the part of the motorman being shown, there can be no recovery. The assignments of error are sustained upon the facts of this case and the judgment is reversed."

VALIDITY OF LONG LIGHTING CONTRACT IN MINNESOTA.

Long-time contracts by cities for hydrants and street lights are held to be legal, in the decision by Judges Baxter and Searl, in the cases between the City of Little Falls and the local electric and water company. Several years ago, the village and city entered into contracts for water for fire protection and arc lights for street lighting for thirty years, and last year, the city attempted to set aside the contracts. The amount involved for yearly payments for both water and light is over $5,500. The judges decided that the general powers of the villages and cities give the council authority to provide fire protection and street lights in some practical manner, and that, if they decide to make long-time contracts, they have the power to do so. There was no special provision in the village or city charter providing for such contracts, and the municipality, therefore had the power to make the contracts, and once made with a company and properly accepted and carried out, the city could not annul them without being liable for damages the company might sustain. The president and principal stockholder of the company is John A. Berkey, of St. Paul, who has this and other large investments in Little Falls.

PROTEST OF WASHINGTON CITIZENS AGAINST AIR CAR.

A petition signed by residents of Brookland, D. C., has been filed with the commissioners remonstrating against the adoption of the air motor. The petitioners say they "protest against the present unsatisfactory service of the Eckington and Soldiers' Home Railway Company and the attempt to foist upon the patrons of the road an air motor that fails to give even half satisfaction. "The car," they say, "is dusty, uncomfortably warm for summer and foul smelling. It cannot make a round trip, running only from the power house to the treasury department. Consequently passengers going to Brookland are landed at the power house, where they are compelled to await the arrival of the electric car, into which they are transferred."

The petition suggests that "if an electric car accompanied each air motor as a hill horse a round trip might be made, but even that would not do away with the other disagreeable features," and that "the patrons of the road should continue protesting against being subjected to such unsatisfactory experiments when there are systems the success of which has been demonstrated and which, while entailing a greater first cost, would in the end be of profit to the company." The petition is signed by W. F. Robbins, M. L. Marean, P. M.; Grace Thomas, J. E. Eastlack and nineteen others.

THE UNION PACIFIC AND WESTERN UNION MUST SEVER THEIR BUSINESS CONNECTIONS.

After a struggle lasting two years, it has been decided that the Union Pacific Railroad Company and the Western Union Telegraph Company must separate their business connections by September 1 next. This was the order issued by Judge Munger in the United States Court at Omaha on May 24.

Counsel asked that a note be added providing for a referee to take an inventory of the property and decide to which company it belonged. They also sought to secure an amendment giving the right to present reasons why the time should be extended if new conditions arose. Judge Munger ruled this out, saying that if there were any reasons why the time should be extended they should be made known to the court before September 1, and would be passed upon.

After the case had been disposed of Judge Kelly of the Union Pacific was asked what his company would do. He said it was difficult to say. It could not appeal from this decision although it might find some way to further delay the action of the decree.

Judge Munger suggested that the question of adjusting the property right of the two corporations would be brought before Judge Cornish, special master in chancery in the Union Pacific case.

MULTIPLE SWITCHBOARD LITIGATION.—WESTERN ELECTRIC CO. vs. CAPITOL TELEPHONE AND TELEGRAPH CO., ET AL.

On June 7 the suit of the Western Electric Company, against the Capitol Telephone and Telegraph Company, of California, comes up at San Francisco before the United States Circuit Court on the argument for the granting of a preliminary injunction.

This is the first suit brought by the Western Electric Company on its multiple switchboard patents. The particular patent, which the company claims is infringed by the defendant, is that issued to Leroy B. Furman, entitled Multiple Switchboard Board, No. 252,576.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 25, 1897.

Alarms and Signals:—

ELECTRIC SIGNAL DISTRIBUTOR. P. H. Fisk, North Branch, Minn., 583,039. Filed October 28, 1895.

Details of construction.

SYSTEM OF PNEUMATIC DOORS AND GRATINGS. E. S. Corbett, Allegheny, Pa., 583,405. Filed October 29, 1891.

The movement of the door diminishes the pneumatic pressure which closes a contact of an electric circuit to sound an alarm.

ELECTRIC SIGNALING APPARATUS. A. D. Wheeler, Hyde Park, Mass., 583,423. Filed February 2, 1897.

Fire alarm system.

Batteries, Primary:—

GALVANIC ELEMENT. P. Schmidt, Berlin, Germany, 533,128. Filed May 29, 1896.

Comprises a carbon cylinder in the annular space between two zinc cylinders, the inside of the carbons containing a generating fluid, and the annular space between the carbons and the outside zinc cylinder being filled with a generating paste.

PRIMARY BATTERY. H. M. Sutton and W. L. Steele, Dallas, Tex., 583,132. Filed March 17, 1896.

Details of construction.

Batteries, Secondary:

METHOD OF AND APPARATUS FOR CHARGING STORAGE BATTERIES. C. C. Branwell, Hyde Park, Mass., 583,323. Filed August 22, 1895.

Consists in having the number of cells in the charging circuit in direct proportion to the strength of the current.

Conductors, Conduits and Insulators:—

WIRE COUPLING AND BINDING POST. J. A. Wright, Wilkinsburg, Pa., 583,242. Filed January 11, 1897.

Consists of a body, a threaded shank having a cross slot and a wire hole at right angles thereto and a screw cap provided with a central longitudinal wire hole at the end.

Dynamos and Motors:—

EMERGENCY ELECTRIC GENERATING APPARATUS. C. E. Emery, Brooklyn, N. Y., 583,173. Filed August 22, 1895.

Employs a constant potential dynamo and a prime mover for operating it and a series dynamo in parallel therewith operated by a racing prime mover.

ELECTRIC MOTOR OR DYNAMO ELECTRIC MACHINE. R. Lundell, Brooklyn, N. Y., 583,264. Filed December 15, 1896.

Comprises a field magnet consisting of two cylindrical enclosing magnetic shells having inwardly projecting wedge shaped pole-pieces and supports cast integral therewith, in combination with a single five-sided field magnet coil adapted to conform to the interior structure of the cylindrical parts when secured together.

Electro-Metallurgy —

AMALGAMATOR. F. B. Austin, Tempe, Arizona Territory, 583,354. Filed September 12, 1896.

A mercury pan formed of insulating material and provided with vertical grooves in the inner faces of its sides, and metal plates fitting the grooves of the pan and extending nearly to its bottom, the plates being provided with curved lugs.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. F. A. La Roche, New York, 583,060. Filed December 22, 1896.

Of the enclosed type.

INCANDESCENT LAMP. A. Swan, New York, 583,204. Filed December 8, 1896.

Embodies a cup-shaped base having a central conical opening narrowest at the face of the base, and a metallic shell externally grooved and located in the conical opening and held by cement filled into the conical opening surrounding the shell.

ELECTRIC LAMP HANGER. W. S. Weston, Chicago, Ill., 583,316. Filed August 8, 1896.

Details of construction.

Measurement:—

MAXIMUM AND MINIMUM RECORDING ELECTRIC METER. A. Wright, Brighton, Eng., 583,160. Filed June 12, 1896.

Consists in withdrawing from a body of liquid, portions by the action of the current characteristic and commensurate with the extreme limit thereof.

Miscellaneous:—

ELECTRIC HEEL PLATE. J. W. Gibbs, New York, 53,043. Filed January 10, 1897.

Comprises a plate element, an opposing plate element, and a non-electric generating plate to cover the rounding edge of the upper element, the latter serving also as means of supporting the person and as connecting means for the elements.

SYSTEM OF GENERATING AND USING HYDROGEN GAS AND ELECTRICITY. L. H. Wattles, Providence, R. I., 583,104. Filed December 7, 1895.

Consists in a generator in which hydrogen gas and electricity are both generated simultaneously, combining therein gas collecting apparatus having ducts for conducting the gas to mechanism intended for its use.

ELECTRIC RACE-HORSE CAROUSAL. J. W. Daniels, Paterson, N. J., 583,109. Filed October 28, 1896.

Comprises a horse mounted upon the truck with a circuit breaking mechanism or switch mounted in the mouth of the horse and adapted to be operated by means of the reins.

APPARATUS FOR AND METHOD OF STERILIZING LIQUIDS. H. G. Stiebel, Jr., St. Louis, Mo., 583,131. Filed October 2, 1896.

Consists in producing a series of disruptive electric discharges thereby generating ozone, and passing the liquid through the atmosphere of ozone thus formed and between the electrodes, but out of contact with them.

AUTOMATIC FIRE IGNITER FOR FIRE ENGINES. G. J. Brown, Chelsea, Mass., 583,208. Filed March 8, 1897.

Comprises an electric burner containing magnets, means actuated by the movement of the engine to close the circuits of the magnets and to break the circuits after the magnets have been energized.

ELECTRIC WARP STOP-MOTION FOR LOOMS. R. J. Mommers, Manchester, Conn., 583,213. Filed August 31, 1896.

Details of construction.

ELECTRIC WARP STOP-MOTION FOR LOOMS. R. J. Mommers, Manchester, Conn., 583,214. Filed August 31, 1896.

Similar to above.

ELECTRIC FURNACE AND METHOD OF OPERATING SAME. A. H. Cowles, Cleveland, Ohio, 583,249. Filed July 6, 1895.

Consists in passing an electric current and generating within the mass of the material electrical heat, and in periodically passing gas therethrough in opposite directions.

ELECTRIC FURNACE. A. H. Cowles, Cleveland, Ohio, 583,250. Filed July 6, 1895.

Similar to above.

CATHODE FOR ELECTROLYSIS. E. A. G. (called Charles) Street, Paris, France, 583,255. Filed June 13, 1896.

A thin sheet, preferably of metal, wound upon itself, for the electrolysis of bodies which produce solid deposits on the negative electrodes.

ELECTRIC GAS LIGHTING ATTACHMENT. W. H. Fargo, San Francisco, Cal., 583,303. Filed August 6, 1896.

Details of construction.

ENGINE STOP MECHANISM. J. H. Cary, Springfield, Mass., 583,326. Filed May 9, 1896.

Devices for actuating electro-mechanical apparatus located at considerable distance from the point where it is desirable to operate the same by means of electro-magnetic apparatus placed in a closed circuit.

PROCESS OF ELECTROLYSIS. E. A. Le Suer, Ottawa, Canada, 583,330. Filed April 5, 1892.

Process of decomposing the chlorids of sodium and potassium by electrolysis. Adds hydrochloric acid continually to the anode compartment.

ELECTRIC DRILL. C. E. Davis, Chicago, Ill., 583,407. Filed April 27, 1896.

Adapted for use in coal mining.

MACHINE FOR FASTENING HANGERS IN ELECTRIC WIRE CABLES. W. H. Johnston, St. Louis, Mo., and S. B. Fowler, Chicago, Ill., 583,411. Filed July 18, 1896.

Details of construction.

Railways and Appliances:—

UNDERGROUND ELECTROMAGNETIC RAILWAY SYSTEM. J. Hoffman, Schenectady, N. Y., 583,178. Filed May 13, 1896.

Details of construction.

ELECTRIC MOTOR. J. Conner, J. R. McMillan and A. J. Fuller, Philadelphia, Pa., 583,210. Filed September 26, 1896.

Truck for electric motors.

SERIES MULTIPLE CONTROLLER. T. Von Zweigbergk, Cleveland, O., 583,273. Filed January 21, 1897.

Adapted for trolley cars. Details of construction.

STREET OR STATION INDICATOR. A. C. Goetz, Cleveland, O., 583,304. Filed August 21, 1896.

Operated by current from the conductor.

OPERATING MECHANISM FOR CAR BELLS. J. T. Haskins, Malden, Mass., 583,305. Filed July 21, 1896.

A bell with two hammers operated by electricity.

BOND FOR ELECTRIC RAILWAY. J. McLaughlin, Chicago, Ill., 583,309. Filed October 19, 1896.

A connecting conductor between the heads or terminals, which is constructed of sections hinged together so as to yield in the movements of the rails.

CURRENT COLLECTING DEVICE FOR ELECTRIC RAILWAYS. W. M. Brown, Johnstown, Pa., 583,324. Filed July 18, 1896.

A magnet carried by the vehicle, a flexible member depending below each magnet pole, and a spring between, and bearing against the pole and flexible member.

Telegraphs:—

SYSTEM OF TELEGRAPHY. C. G. Burke, Brooklyn, N. Y., 583,026. Filed September 4, 1896.

A system of machine telegraphy employing the Morse code.

TELEGRAPHY. O. R. Roberson, Glen Ridge, N. J., 583,418. Filed August 24, 1896.
System of duplex telegraphy.

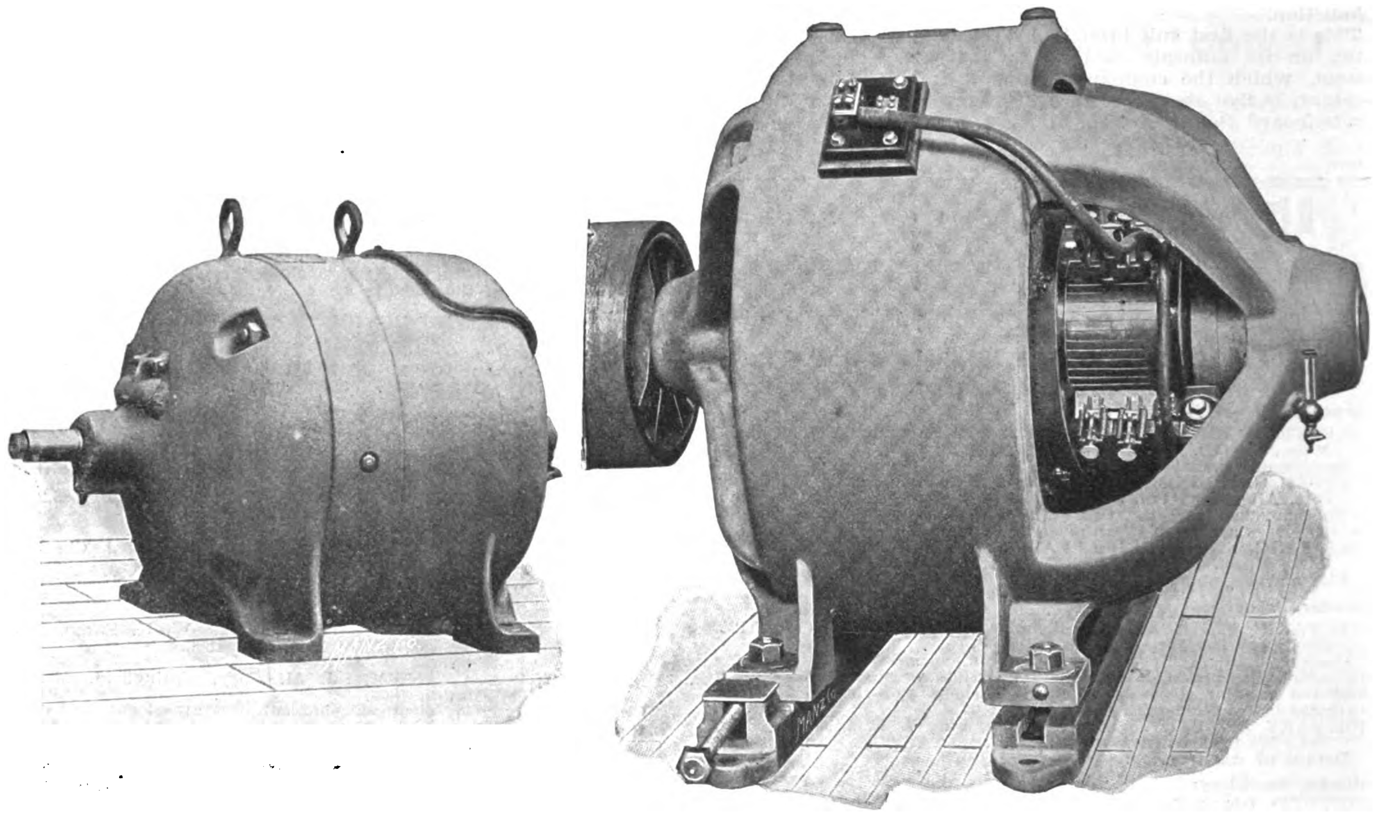
Telephones:—

TELEPHONE RECEIVER SUPPORT. L. Duque and F. M. Cosgrove, San Francisco, Cal., 583,142. Filed September 15, 1896.
A device adapted to support a telephone receiver in a natural position for a person of any height while using the telephone, so that the hands will be perfectly free for writing, etc.

NEWS AND NOTES.

THE ELWELL-PARKER MOTORS.

THE accompanying engraving, Fig. 1, shows the new enclosed railroad type intermittent service motors for cranes, hoisting machinery, isolated tools and similar kinds of service, built in sizes ranging from 2 to 60 horse-power, by the Elwell-Parker Electric Company of America, Cleveland, O. These motors are for use where there is much dirt, dust, or moisture or where for other reasons the completely enclosed type is either necessary or desirable.



FIGS. 1 AND 2.—ELWELL-PARKER ENCLOSED AND SEMI-ENCLOSED MOTORS.

Fig. 2 illustrates the semi-enclosed Elwell-Parker machine, for use in locations that do not require complete protection against dust or moisture. This type admits of somewhat heavier duty as the ventilation is better than that of the entirely enclosed machine.

The above motors embody all the latest features of modern heavy and irregular duty machines, such as self-aligning, self-oiling, removable interchangeable bearings, with ample size and rigidity of parts that are to be subjected to heavy and unusual strains.

All these machines are equipped with special carbon brushes, and are made reversible, or not, as required, and are wound series, shunt or compound, according to character of service to be performed. The armatures are ventilated and built of unusual strength. As can be readily seen these machines can be arranged to bolt to floor, ceiling beams, vertical posts, or side wall beams.

Both these types, but more especially the semi-enclosed one, are also built for continuous service for driving line shafting, isolated tools, pumps, fans, etc., and are arranged for speeds suitable for either direct, belt, or gear connection to shafts they are to drive. The efficiency of these motors is very high, and the commutators are sparkless on practically all loads.

A large number of these motors, both enclosed and semi-enclosed types, are now in use operating electric traveling cranes and ore handling machinery, and for driving line shafting, isolated shop tools, as punches, hydraulic presses, drilling machines, emery grinders, band saws, planers, etc.

The Elwell-Parker Company, of Cleveland, O., have built a number of semi-enclosed motors for operating special ore handling machinery, designed and built by the Brown Hoisting & Conveying Machine Company, of Cleveland, who have exported and erected a considerable number of these plants in Germany and Austria.

BIDS WANTED FOR RAILWAY MATERIAL.

The Riverview Electric Street Railway Company of Beaver Falls, Pa., are in the market for construction and material. Plans and specifications for the work and material can be seen at the office of H. T. Barker, the company's engineer, Beaver Falls, Pa. Bids for above work and material will close Friday, June 4, 1897, at 5 o'clock p. m. Address all bids, sealed and marked "Proposals for Street Railway," and should be sent to H. T. Barker, Beaver Falls, Pa., or J. M. Hughes, Beaver Falls, Pa.

THE STOCK MARKET

DULL BUT HOPEFUL.

Spring trade has not yet proved to be all that was expected of it, but the country is certainly not going backward the way it was two or three years ago. Merchants had been hoping for a marked gain, but the indications are that in most lines only an average demand exists, without much buoyancy. In stocks, there is also dullness, but prices are higher, and the steadily improving crop prospects encourage further advances.

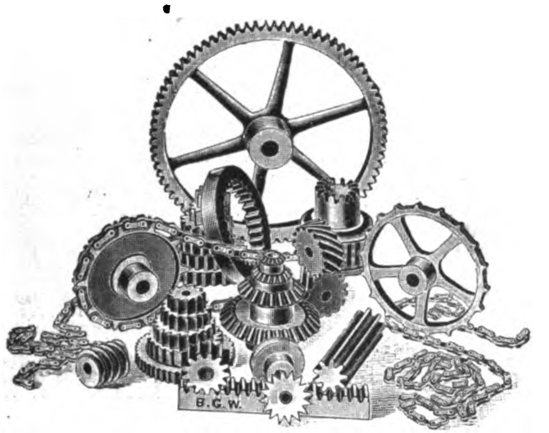
Western Union is still gaining and closed the week at around 80. General Electric was quoted at 30⅞ to 31. American Bell, in Boston, has gone off slightly to 228½, the reports of active opposition in various quarters dulling the recent demand.

COPPER. Copper is unchanged in price, and recent car-load lots of Lake were quoted at 11½ cents, Western brands at 11¼.

TRADE NOTES & NOVELTIES

THE BOSTON GEAR WORKS.

THE tendency of modern mechanics is to connect moving parts of the same machine, or machines among themselves, as rigidly and directly as possible, and hence the gear wheel is coming more and more into general use as a transmitter of motion. In many situations, of course, in which a definite and fixed ratio of speed between two moving parts must be preserved the gear is indispensable and hence the mechanic will find it useful to have some handy guide to aid him in the selection of the gear best suited for the work. We know of none better for this purpose than the catalogue of the Boston Gear Works, entitled "Gear Wheels and Cutting." This valuable booklet is not merely a categorical list of the various types of gears made by the concern, but it shows how to draw and lay out teeth for any kind of special work and how to order gears. There is scarcely a gear made that the Boston Gear Works does not carry in stock; among them we find lists of various sizes of brass and iron spur gears finished and unfinished, motor and bevel gears, standard brass ratchets and pawls, crown gears, brass racks, internal, spiral and escape wheels, elliptic gears, worm gears—in short, every conceivable type and form of metal gear for transmitting motion. Not the least interesting section is that devoted to intermittent gears, of which the works make a large variety and to which a special catalogue is devoted. Besides the gears the works also manufacture chain wheels and chains of all kinds.



SOME OF THE BOSTON GEAR WORKS PRODUCT.

The office of the Boston Gear Works, Frank Burgess, proprietor, is at 31 Hartford street, Boston, Mass., and every one building electrical apparatus, be it an electric elevator or an arc lamp, will do well to have the gear catalogues above referred to at his elbow.

BULLOCK MOTORS FOR PRESSES.

The Bullock Electric Manufacturing Company are remarkably active in the field of direct connected motor applications to printing presses, particularly of the large newspaper type, and they announce among numerous applications the following new equipments: N. Y. Herald, N. Y. Sun, N. Y. Journal (5th equipment); San Francisco Examiner, Chicago Journal, and Toronto Globe. In these equipments the motors are attached directly to the presses, and by means of the special speed regulator and starting devices the press cylinders may be inched along for making ready or run at 1-20 speed for feeding through the sheets; intermediate speeds are also given. The Bullock Electric Manufacturing Company accomplish this by using a standard motor, and the customary sources of supply, such as central stations or ordinary power circuits, the entire control coming within the movement of a single lever. The system employed is such that the enormous torque of the motor is provided for without making correspondingly heavy demand on the line.

In writing the B. E. M. Co. congratulating them on the success of their equipment, Mr. T. T. Williams, business manager of the San Francisco Chronicle, speaks as follows: I consider your motor with the slow motion attachment the only really efficient and economical method of moving a printing press. The old style of belting, while the best known up to the production of your invention, caused a loss of power at least 25 per cent. through the shaft and counter pulley; the belt was liable to slip, and it required such a long stretch of belt from the shaft to the press pulley that it was extremely difficult in many instances to set up presses in the room that could be conveniently alloted to them.

ADVERTISERS' HINTS

ARMORITE INTERIOR CONDUIT COMPANY, of Detroit, Mich., have moved to Pittsburg, Pa., where, to use their own words, they have "the most up-to-date conduit making plant in the United States."

J. B. COLT & COMPANY, 117 Nassau street, New York, furnish a complete apparatus for the manipulation of light with prism, reflectors, lenses, etc., producing scenic and illustrative effects, including the animated pictures.

THE BELKNAP MOTOR COMPANY, Portland, Me., publish this week some very excellent testimonials relative to the merits of the Chapman voltage regulator.

THE GENERAL ELECTRIC COMPANY are advertising the Wirt short-gap lightning arresters for alternating current circuits. These arresters are used on the Niagara-Buffalo transmission lines.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, Ohio, claim there are more of their Victor turbine wheels operating dynamos than there are of any other make.

THE STANDARD AIR-BRAKE COMPANY have something to say about a progressive electric road, which publishes a time table and uses the "Standard" air-brakes.

NEW YORK NOTES.

MR. CHAS. BLIZARD, the manager of the New York office of the Electric Storage Battery Company, has moved to very handsome and commodious quarters in the new Commercial Cable building, 22 and 24 Broad street.

MR. FRANK G. FULLER, well known for years as a successful wire salesman, has associated himself with Mr. W. R. Brixey, and will hereafter devote himself to the sale of kerite wires and cables, with headquarters at 203 Broadway, New York.

VILES ELECTRIC PLANT.—One of the features of long distance power plants now appears to be F. M. Locke's porcelain insulators. In the Viles plant, illustrated in our last issue, they are used, being of the Locke triple petticoat type. The Riverside transmission in California, recently described, also employs Mr. Locke's admirable insulators.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY, of Philadelphia, announce that they have opened an office, in charge of Mr. H. B. Kirkland, in the "Beard Building," 120 Liberty street, New York City. No stock of any kind will be carried in this office, but the extensive line of I-T-E circuit breakers and C-S switches will be on exhibition. Mr. Kirkland will be pleased to extend to his friends and the electrical trade generally the facilities of this office, and a continuance of patronage is requested. V. C. Gilpin will be associated with Mr. Kirkland.

MR. HEBER WELLS reports business in pattern letters and figures for castings as improving. This is especially the case in the brass sorts. He carries a full stock of all kinds on the corner of Ann and William streets.

McINTOSH, SEYMOUR & CO. have opened an office for the sale of their products in New York City and contiguous territory in the Havemeyer Building, Room 1211, No. 26 Cortlandt street, the Pierce & Miller Engineering Co. having ceased to handle their engines.

FULTON, N. Y.—The Victoria Paper Mills Company are making extensive additions and alterations to their plant. One of these additions will make what they term their new mill building No. 3. The walls of this addition are to be of substantial brick construction. The floors are to be carried by steel girders supported by the side walls and interior steel columns, and the roof which is to be gravel on plank will be carried by steel trusses. This will make a neat building, thoroughly fireproof, and well adapted to their needs. The contract for furnishing and erecting the steel work has been

awarded to the Berlin Iron Bridge Company, of East Berlin, Conn.

THE COOPER GENERAL MACHINE & ELECTRIC COMPANY, of New York City, has been formed, with a capital stock of $10,000, by R. Cooper, of Jersey City; C. W. Congdon, of Brooklyn, and J. H. Williams, of the same city.

THE ELECTRIC BLEACHING COMPANY.—The sheriff of New York County has received an execution against the Electric Bleaching Company for $1,520 in favor of Albert E. Woolf. The company was incorporated in March, 1892, with a capital stock of $2,000,000. T. J. Montgomery was president.

WESTERN NOTES

H. M. UNDERWOOD & COMPANY, 1114 Marquette Building, Chicago, are representing the Belknap Motor Company in that section and report that they have had a large number of inquiries regarding their voltage regulator. They have also been appointed exclusive agents for the United States for the Cloos junction box, a full description of which appeared in The Electrical Engineer of February 17. Their lamp guard is meeting with so much success that they are working overtime to supply orders and on the whole consider the business outlook for the coming season more than encouraging.

THE FAN SEASON may now be said to be fairly opened and a large business should be done during June and July. The Electric Appliance Company are in the field with a large and complete fan catalogue, showing their full line of alternating and direct current desk, wall and ceiling fans. This catalogue will be valuable to every purchaser of electric fans of any kind.

THE CENTRAL ELECTRIC COMPANY states that the fan motor business is opening up with unusual activity. The line of Lundell fan motor apparatus handled by them has been quite considerably increased this year, and with the addition of the Wagner ceiling fan motor, and the Emerson induction fan motor, they claim to have the most complete line of ventilating apparatus. Their 1897 fan motor catalogue is an unusually fine representation of the printer's art, and it will be sent to any one interested on application.

ARMORITE.—The plant formerly operated by the Pittsburg Tube Company at Pittsburg is being fitted up for occupancy by the Armorite Interior Conduit Company. Insulated pipe lined with wood for electrical conduit purposes will be manufactured.

THE EAST SIDE ELECTRIC COMPANY, Detroit, Mich., owing to an increase in their business, have ordered from the Ball Engine Company, Erie, Pa., a 100-horse-power engine. The owners of the Claus Spreckels Building, a new structure nineteen stories high, at the corner of Third and Market streets, San Francisco, have recently awarded a contract for three 150-horse-power vertical cross-compound engines, each of which is arranged for direct connection to a 100-kilowatt General Electric direct connected machine. The engines will be built by the Ball Engine Company. This will be one of the banner plants of the city.

THE WALKER COMPANY, of Cleveland, O., have just made a large shipment of 120 motors to Germany for railway work. The order was placed through Charles Le Blanc, their European representative.

DORNER & DUTTON COMPANY of Cleveland has been organized to make and deal in electrical and street railway supplies. The capital stock is $50,000. The incorporators are J. H. Van Dorn, E. J. Leighton, H. H. Hodell, W. A. Dutton and H. A. Dorner. The specialties of the company are well known.

MR. H. L. CHILDRESS, manager for the Postal Telegraph Company in Cleveland, O., has been promoted to the superintendency of the second district of the Postal Southern Division, including Alabama, Georgia, Mississippi, Louisiana, Florida and a part of Tennessee. His headquarters will be at Birmingham, Ala. He is less than thirty years of age.

H. B. CAMP & CO., Aultman, O., have received the contract for the underground conduits of the Delaware and Atlantic Telephone Company, Wilmington, Del., and will begin work on them at once.

CHICAGO LIGHTING FIXTURE COMPANY to do electric work, has been formed by H. G. Willard, J. McClellan Means, F. F. Kinney and G. G. Glaescher, with a capital stock of $25,000.

WESTERN ELECTRIC COMPANY have recently placed upon the market a soldering paste to be used in place of soldering salts. It is packed in half pound, and one pound cans.

ASTORIA, ORE.—A new electrical supply company has formed with a capital stock of $3,000 all subscribed.

NEW ENGLAND NOTES

STANDARD THERMOMETER AND ELECTRIC COMPANY, Peabody, Mass., are meeting with good success with their new Midget arc lamp for low and high tension direct current circuits. Among the concerns to which they have recently furnished their enclosed arc lamps may be mentioned the Solvay Process Company, Detroit, Mich.; Shoot-the-Shutes plant at the Nashville Exposition; New England Engineering Company, etc.

PHILADELPHIA NOTES

MR. J. F. STEVENS, Keystone Electric Instrument Company, Philadelphia, will have an exhibit in Parlor E, Cataract House, Niagara Falls, at the coming N. E. L. A. convention, and will there display a full line of their instruments, with a background of cigars and punch.

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WITH COLORED SUPPLEMENT.

Electrical Engineer.

A WEEKLY REVIEW OF THEORETICAL AND APPLIED ELECTRICITY.

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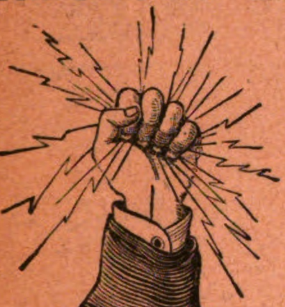

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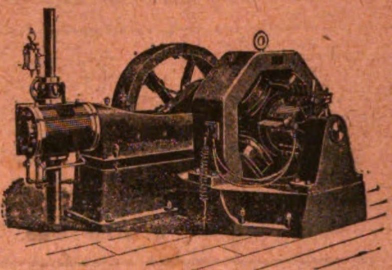

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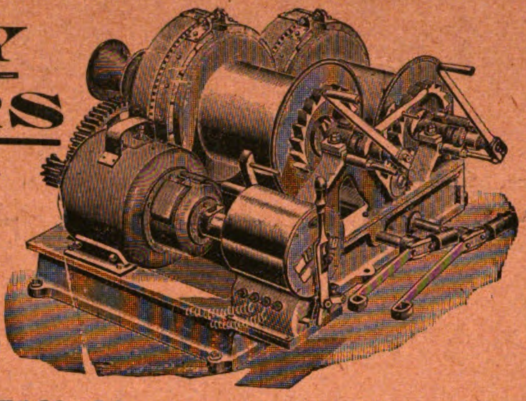

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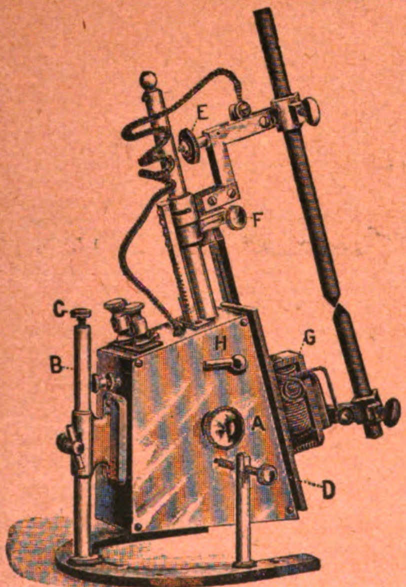

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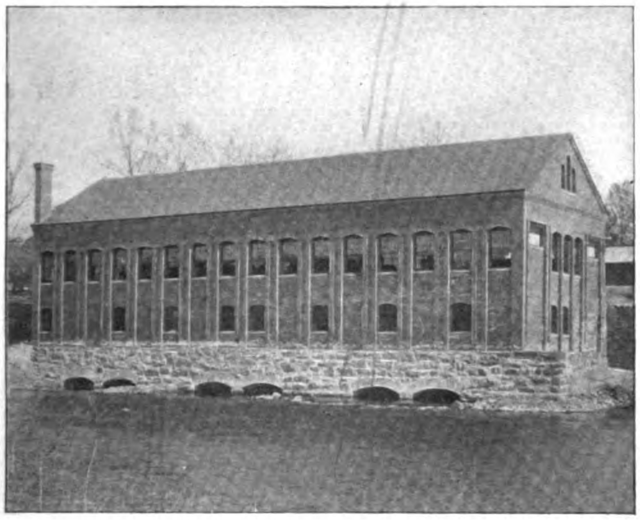
The Electrical Engineer.

Vol. XXIII. JUNE 9, 1897. No. 475.

ELECTRIC LIGHTING

THE INDIAN ORCHARD WATER POWER TRANSMISSION PLANT OF THE UNITED ELECTRIC LIGHT CO., SPRINGFIELD, MASS.

SPRINGFIELD, MASS., has always been known as one of the most enterprising cities among the many which that State can boast of, and hence it came that as far back as 1881 a wideawake firm in Springfield undertook to light its premises by means of a 10-light arc machine; its neighbors soon desired to share in the benefits of the improved method of illumination and, encouraged by the results, a company, known as the Springfield Electric Light Co., was organized, to do commercial lighting. This company was later merged into the United Electric Light Co., which, since 1887 has been steadily increasing its plant situated on the bank of the Connecticut River in the heart of the city.



Indian Orchard Station, United Electric Light Co., Springfield, Mass.

It is not our intention to follow the growth and rise of the company and to describe the plant which has until recently furnished current to Springfield; but rather to give an account of the water power station which has brought about the shutting down of the company's steam plant and practically transferred its generating plant beyond the city limits. Suffice it to say that the old steam station which has not yet been dismantled contains four engines aggregating 2,000 horse power and electrical apparatus with a capacity for 23,000 incandescent lights, 1,000 arc lights, and 200 kilowatts in 500-volt motors.

Situated about six and one-half miles from the city of Springfield, is Indian Orchard, on the Chicopee River, where for many years past the river's power has been utilized for the operation of a few small mills. The availability of this power for electrical transmission to Springfield was recognized some time ago, but it was not until last year that definite steps were taken to carry out the plans which the management had long since contemplated.

THE CHOICE OF A TRANSMISSION SYSTEM.

When it was definitely decided to transmit power from Indian Orchard the most important question which came up for solution was the choice of a system of transmission. After due consideration the 2-phase system at 133 periods per second was adopted, and has been installed. As many stations probably present conditions of working similar to those existing in Springfield, it seems worth while to indicate briefly just what the management of the company considered the dominating factors that led them to the selection of the system referred to.

In the first place, they point out that the 2-phase system distributed over four wires offers two single-phase circuits entirely independent of each other, which can be run and regulated independently in case of accident to one of the circuits. Again, lighting may be done from one of the phases while a single-phase motor may be run on the other without affecting the regulation of the lights.

To these features was added the fact that the company's business is principally a lighting and not a power business and that the flexibility of the 2-phase system is a great advantage, while outside of the mere fact of a small saving in copper, the 3-phase offered no advantage over the 2-phase.

As regards the frequency of 133 periods per second, adopted, it must be borne in mind that the old station is supplied throughout with high frequency apparatus and many of the transformers and meters are designed for that frequency; it was therefore not considered advisable to break up the uniformity of the system by introducing a lower frequency for the new work. It was also shown that in the present state of the art no advantages were offered by a lower frequency with the exception of some slight bettering of regulation, but at the expense of considerable power to maintain for twenty-four hours a day a larger leakage current in the transformers. With the company's present equipment it was shown that this leakage current would amount to 75 horse power, valued at about $4,000 a year, or in a few years covering the entire original cost of the electrical plant.

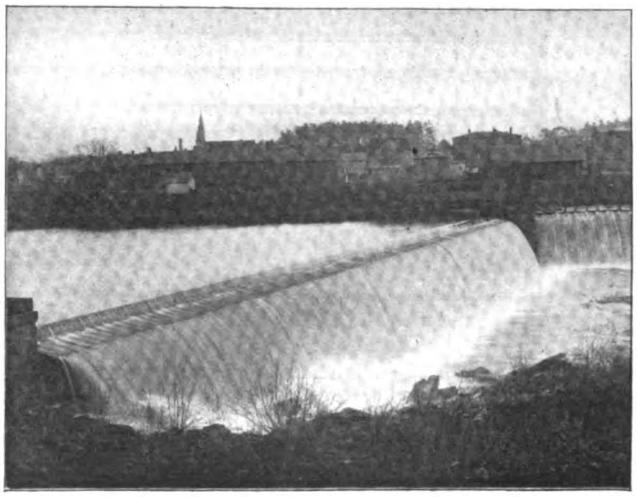
No difficulty has been found in the regulation and synchronous working, so that for this reason, as well as for those given above, the choice of the system has thus far been found to have been a wise one. Besides, if later it is deemed advisable to change to a lower periodicity, enough money, it is thought, will have been saved to make the change.

THE POWER BUILDING.

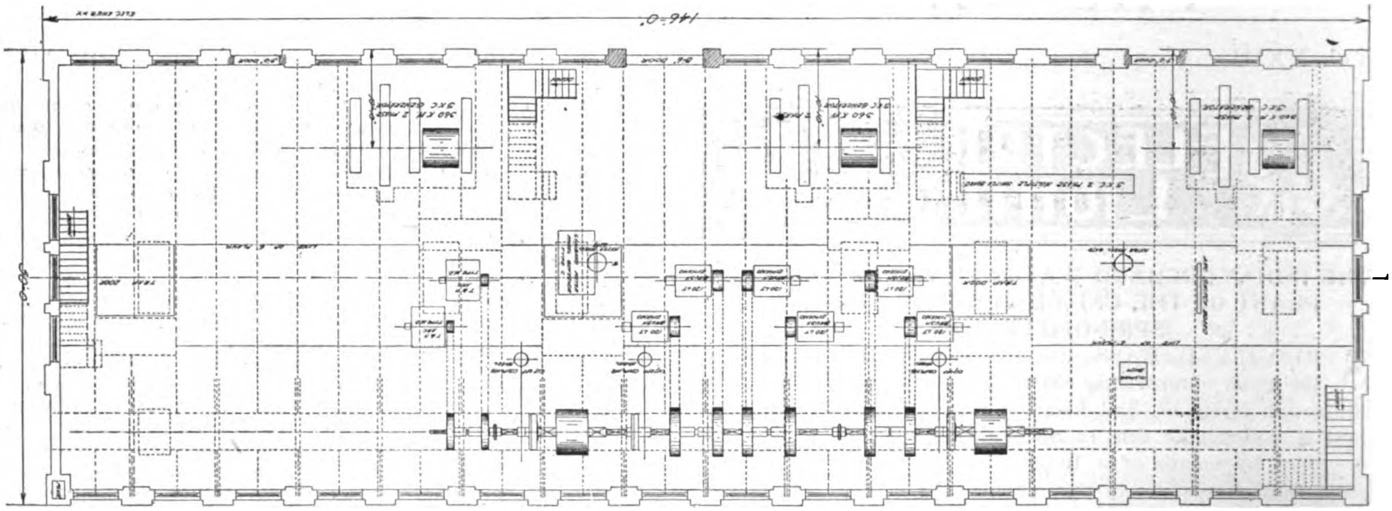
The new power building at Indian Orchard, which takes the place of a temporary installation, is shown in the engraving on this page, which gives a view of it as seen from the river.

The building, which is of brick, with massive masonry abutments, is 150 feet long and 50 feet wide. It is two stories high, the lower being occupied by the water wheels and the upper by the electrical machinery, the construction being fireproof throughout. The foundations of the building are of brown sandstone, taken from a quarry across the river directly opposite the station. The iron roof is planked with three-inch Southern pine and slated.

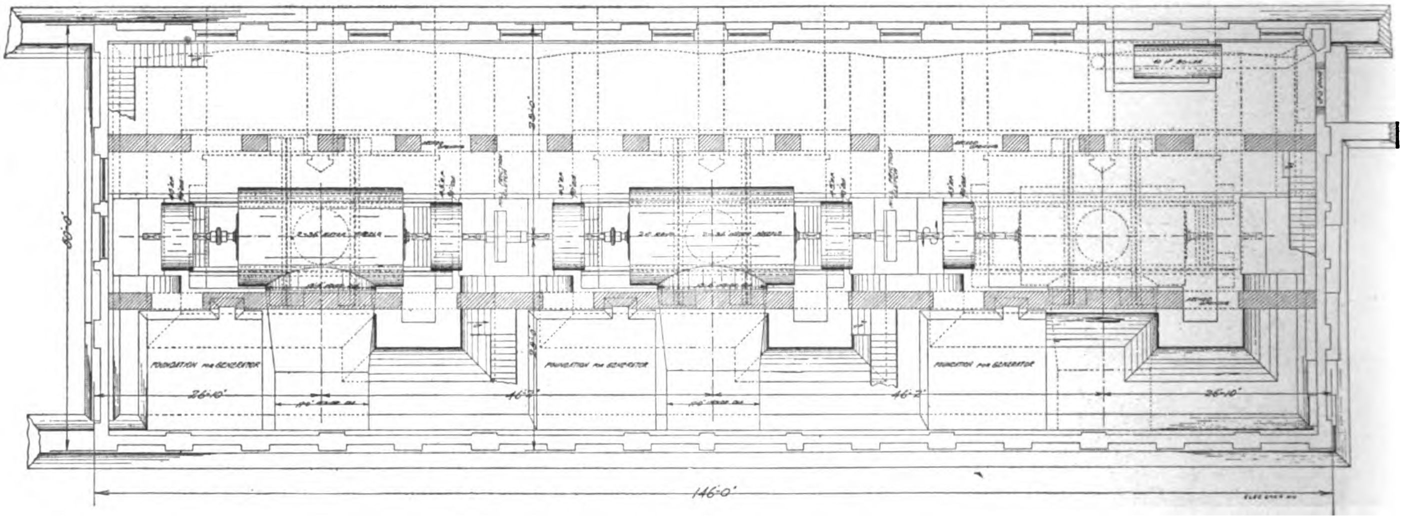
The floor is built of iron I-beams, with brick arches between them, and capped with six inches of concrete and a flooring of maple. It will be noticed that the line of countershafting is supported on a pair of steel I-beams, which run the entire length of the building. All this construction is illustrated in the cross sectional view on page 610. The traveling crane which travels the whole length of the machine room floor has a span of 45 feet, and a capacity of ten tons.



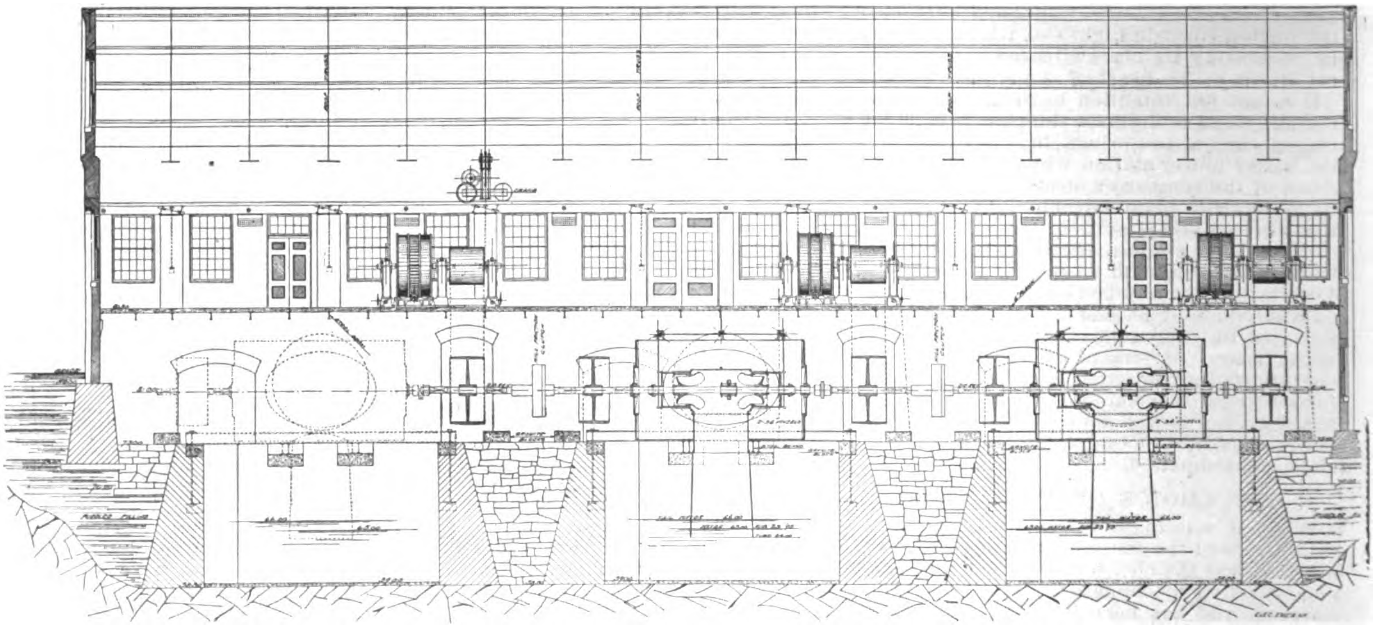
Falls of the Chicopee River, Indian Orchard, Mass.



Indian Orchard Water Power Station.—Plan of Dynamo Floor.



Indian Orchard Water Power Station.—Plan of Turbine Floor.

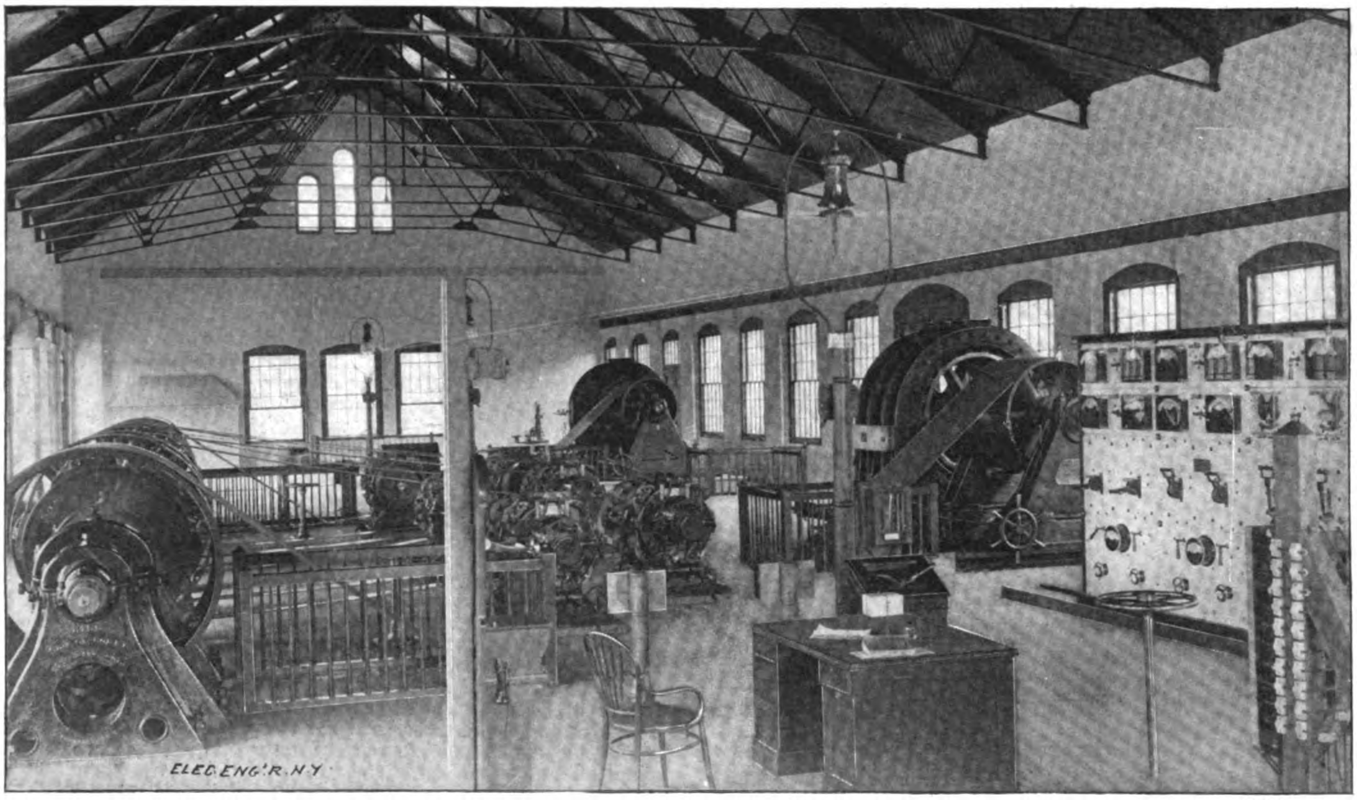


Indian Orchard Water Power Station.—Longitudinal Section Through Turbines.

THE POWER EQUIPMENT.

The stone dam 400 feet long and 26 feet high thrown across the Chicopee River has a gate house at its south end. From this gate house a canal 1,400 feet long runs in a westerly direction and at the end of the canal are the penstocks which run at right angles for a distance of 196 feet to the station on the bank of the river, so that no tail race is required. These penstocks are 11 feet in diameter and built of 7-16-inch steel, riveted and set up on saddles of brick work, 16 inches thick. Provision has been made for three head gates and penstocks, but thus far only two have been installed. The penstock cases are 11½ feet in diameter, and they, together with all iron work about the station, were furnished by P. F. Hawkins, of Springfield, Mass.

The power equipment of the station consists, at present, of two pairs of thirty-six-inch McCormick horizontal turbines, built by Jolly Bros., of Holyoke, Mass. Each member of these pairs has a capacity of 480 horse power, or 960 horse power per pair, making a total wheel capacity of 1,920 horse power. Each pair of wheels is enclosed in a case 12 feet in diameter, and runs at 210 revolutions per minute. As shown in the longitudinal sectional view on page 608, provision has been made for the installment of a third pair of turbines, when the work of the station shall demand it. These turbines can be coupled among themselves by Hill friction clutches, making one unit of power when desired. Along the wheel shaft are four pulleys, 90 inches in diameter and 45 inches face.



Dynamo Floor, Indian Orchard Water Power Station of the United Electric Light Co., Springfield, Mass.

As indicated in the sectional views, the wheels are set 15 feet above the tail water, and the draft tubes are made flaring and incline towards the river, a single draft tube being employed for each pair of wheels, which are of the central discharge type. Each wheel has two outlets, the wall between them being protected by a wedge.

The regulation of the turbines is effected by means of a Lombard water wheel governor, one of which is in use so arranged as to regulate both wheels. This governor is run in connection with a speed recorder, which gives a continuous record of the operation of the turbines. The governor is mounted on the dynamo floor and is driven by belt from the turbine shaft direct.

THE ELECTRICAL EQUIPMENT.

The plan view on page 608 shows the layout of the dynamo floor and the sectional view on page 610 shows the arrangement of the belting. As will be seen, the turbine shafts are connected by two main belts to a line of countershafting, which will eventually run the full length of one side of the building. This line of countershafting was constructed by C. F. McMurray & Co., of Troy, N. Y., and is provided with Hill clutches, which enables any machine to be run independently of the other. The bearings of this countershafting have small centrifugal pumps, the buckets of which take up oil and raise it above the level of the shaft to a reservoir, which keeps up a continuous flow of oil.

The alternating electrical equipment consists of three 360-kilowatt S. K. C. 2-phase alternators, built by the Stanley Electric Manufacturing Company, of Pittsfield, Mass. These machines run at 365 r. p. m. The voltage on each phase is between five and six thousand volts. One generator carries the day load; the two others operate 2-phase current, and are thrown in for the heavy night load. The circuits of all these machines are so arranged at the switchboard that all the machines may be run in parallel, so as to deliver their current to either of two sets of overhead circuits. We may note in passing that the No. 1 machine in this station is the first one of this size built by the Stanley Electric Manufacturing Company, now some three years ago.

The arc machines at present installed in the station are eight in number, comprising six Brush 120-lighters of the latest type, and two Thomson-Houston 75-lighters. These are arranged along the center of the floor, as shown in the plan, and belt direct to the countershaft, and can be handled independently by means of friction clutches. The arc switchboard, designed for ten circuits and ten dynamos, is mounted near the southern end of the room, and is built of marble by the General Electric Company.

THE SWITCHBOARD.

The switchboard consists of three panels, one for each generator, provided with ammeters and voltmeters on each phase of each machine. For each phase there is provided a double pole switch, designed to throw the generator on to the bus bars in parallel with any other generator. Each panel is provided with synchronizing lamps, by which the switch attendant is guided in the operation of the switches. Each panel also has a field rheostat, and a rheostat for the field of the exciting machine, and a current indicator to show the current in the field of the generator. The exciters are belted directly to the shaft of the 2-phase machines, and deliver 60 amperes at 60 volts. The field coils of the generators themselves take about 50 volts at 30 to 40 amperes.

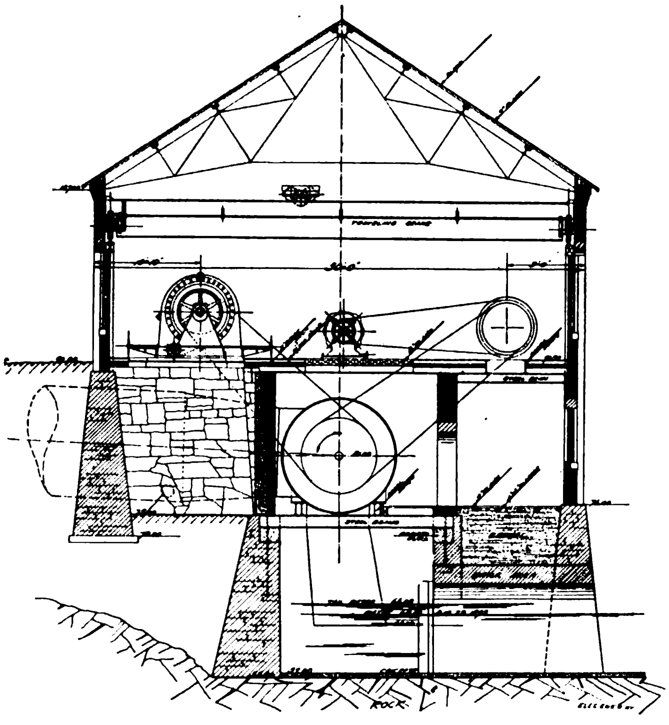
The switchboard also has two circuit panels, each panel provided for two single-phase transmission circuits, making for each panel one set of four wires for a 2-phase transmission. Each single phase circuit is provided with a current indicator and ground detector, and each side of the line is protected by an automatic circuit break switch, having eight breaks, which in case of a short circuit opens the circuit automatically. There are no fuses whatever employed on the board, reliance being had entirely on the circuit breakers. The switchboard and all its equipments was built by the Stanley Electric Manufacturing Company.

THE TRANSMISSION LINES.

From the switchboard the lines pass through marble slabs in the end wall of the building, the holes being bushed with porcelain tubes. At the point of exit the lines are provided with Wurts non-arcing lightning arresters.

The arc lines consist of seven circuits (14 wires) of No. 4 weather proof wire. These are carried on large deep-grooved glass insulators, the grooves being at the top of the insulators. Although glass has been employed in this instance for insulators with 5,000 volts alternating, no trouble has been experienced with them in the way of breakdowns or leakage after an extended period of operation.

These circuits run into the outskirts of the city and connect to the six existing arc circuits, which are used for the city and private lights. The seventh pair of wires run to the old station, and connect to the arc switchboard there, furnishing current to the day arcs. Each of these circuits carries 100 lamps and they are so arranged that in case water at the Indian Orchard station should run low the circuits can be readily connected to and fed from the old steam station.



Indian Orchard Power Station, Transverse Section.

The alternating circuits are run on the same poles with the arc circuits. They consist of two sets of four wires each, the wires being run in quadrature, so as to avoid inductive effects. These wires run to a point about one and one-half miles from the city, where they are connected to the underground conduits, which run through the city to the old station. The underground circuits consist of four duplex cables of No. 0 wire lead covered, made by the Safety Insulated Wire Company, of New York. The underground conduits are of cement lined pipe, made by the Connecticut Pipe Manufacturing Company, of New Haven, Conn.

HANDLING THE CURRENT AT THE SPRINGFIELD STATION.

At the city station in Springfield one set of the four alternating wires connects with a 2-phase S. K. C. alternator of 300 kilowatt capacity, run as a 2-phase synchronous motor. This motor drives a countershaft from which are run a 200-kilowatt 500-volt power generator, and six 75-light Thomson-Houston arc machines, designed to run the commercial circuits. The city arcs are all run directly from the Indian Orchard station.

The other set of four alternating wires are connected to two banks of three transformers, each bank consisting of two 60-kilowatt transformers, designed to transform from 5,000 down to 1,200 volts. These transformers are provided with regulating heads for cutting in or out sections of the secondary coil, for raising or lowering the secondary electromotive force. The transformers deliver their current to the switchboard at the old station in the same manner as the alternating generators did before the power was transmitted from Indian Orchard.

PLANS FOR THE FUTURE.

Although the present installation has already shown admirable results in economy of operation, the management has by no means stopped in its consideration of further possible improvements. Indeed, plans for the future are already contemplated. These include a storage battery sub-station to provide for taking the peak of the load represented by the current required for the motor circuits between the hours of three and six p. m. This is desirable for the reason that one generator at the Indian Orchard station is not of sufficient capacity to operate at the same time the power circuits and the arc lights in the early evening before the motor load goes off. The storage battery would be connected across the 500-volt motor circuit.

Besides, such a battery would always act as a temporary standby in case of the failure of current from the Indian Orchard station. It would also act as a starter for the synchronous motor, by furnishing current to the 500-volt generator run as a motor, which could be used to bring the synchronous motor up to speed.

The plan of the Indian Orchard water power station was conceived and worked out in detail by Mr. Henry S. Anderson, the able general manager of the company, Mr. F. W. Fowler, superintendent, acting as superintendent of construction. Mr. Elisha Morgan, president of the Morgan Envelope Company, of Springfield, is the president of the company, and Mr. W. A. Lincoln, of the Springfield Safe Deposit and Trust Company, is the treasurer. Great credit is due the general manager and engineers of the company for the excellent manner in which the new work has been carried out and to the officers for the liberal policy adopted by them in placing the necessary funds at the disposal of the engineers.

A LIVE WIRE "ACCIDENT" AT SYRACUSE, N. Y.

A special dispatch from Syracuse, of May 24, says: A number of lads this morning had great sport with a live electric wire at the corner of Charles and Milton avenues. The wire had been employed as a guy to support an electric light pole, but had come down and crossed a live wire in falling. The boys attached it to a piece of barbed wire from a neighbor's fence and laid the latter across the cycle path, from which wheelmen would attempt to remove it in passing and receive a shock. Another trick was to throw it over a trolley wire, making a short circuit and stopping the cars.

Martin Dinehart, a 10-year-old lad, who was playing barefooted about the corner, grasped the wire, and becoming venturesome, ran his hand swiftly across a point where the insulation had worn off. He was standing with bare feet on the tracks of a disused trolley line at the time. The boy died in about eight minutes. He had received about 2,500 volts.

MUNICIPAL PLANT CONTRACT FOR DES MOINES, IA.

McClaskey & Holcomb of Springfield, Ill., offered to furnish 500 arc electric lights to the city of Des Moines, Ia., for six and a half years at the cost of $55,000 per year, and at the end of that time to sell the plant to the city for $1. The annual payment asked for is less than the city now pays other companies for its lights, and in an election held on May 18 the proposition was accepted by a vote of nearly three to one. The city will soon vote on a proposition for municipal water works to cost $1,000,000.

KANSAS STATE IRRIGATION PLANTS A FAILURE.

A correspondent of the New York "Evening Post" writing from Kansas says: "The State is selling at auction the expensive irrigation plants that were put in last year. Some of them cost a thousand dollars each, but they are being disposed of for a song. One plant with forty acres of ground sold the other day for $158. In the work of the Irrigation Board there was seen the foolishness of putting matters of this kind into politics. The board spent $30,000 and had nothing tangible to show for it except the report, which proved that irrigation was a failure in the western portion of the State, just as everybody knew it must be." The private owners will in all probability make money out of these plants.

GLOBE BREAKING AT ROCKFORD, ILL.

The habit of globe-breaking has become so prevalent in the City of Rockford, Ill., that to protect the plant the following ordinance has just been passed: An ordinance to prevent breaking or interfering with electric light lamps, lines, poles or other apparatus.

Be It Ordained by the City Council of the City of Rockford, Ill.

Section 1. That it shall be unlawful for any person or persons to throw or cast any stone, ball or other missile or projectile at any arc lamp or glass globe thereon of the electric lighting plant of the City of Rockford, or to in any manner or by any means injure, damage, break, interfere with or destroy any glass globes, arc lamp, wire, line, pole lock fastening or other apparatus entering into the construction of or used in connection with the city electric lighting plant in the City of Rockford. Any person violating any or either of the provisions of this ordinance shall be subject to a penalty of not less than $2 nor more than $10, for each and every offense.

ARC LIGHTING FROM STREET CENTERS IN SAN FRANCISCO.

L. M. King, superintendent of the Merchants' Association, San Francisco, has recently completed an extensive report and plan for a general system of lighting this city by electricity, the additional cost of which, he claims, would not be more than $5,000 per annum. The leading principle of this system is that of suspending an arc light in the center of each crossing of all the business streets of this city and dispensing with the adjacent gas lamps, which will thereby become unnecessary. In addition to the regular business streets it is also proposed to place electric lights at each crossing on Golden Gate avenue, from Market to Devisadero, and on Folsom as far out as Nineteenth street. In this way the main thoroughfare to the Park will be well lighted and made attractive to persons driving and particularly to those riding bicycles at night. As Folsom street, from Nineteenth to Twenty-sixth, is already well lighted, this new arrangement would give Mission residents equal advantages with the rest of the city.

The cost of this system of lighting would not, in Mr. King's opinion, be more than $5,000 greater than the present gas illumination. He figures that in the district north of Market and in the Western Addition one electric light wiuld displace four gas lamps. According to the present contract these gas lamps cost 48 cents a night, and the electric light would cost 55 cents per night. The total number of electric lights required for this schedule is 281, and the number of gas lamps that would be displaced is 1,042. This would make the cost of 281 electric lights, at 55 cents each, $154.55 per night, and there would be a saving of 1,042 gas lamps, at 12 cents each, amounting to $125.04 per night, which makes the total increase of cost only $29.51 per night. These figures, however, Mr. King says can be materially reduced, and the actual additional cost would not be more than $5,000.

BRUSH PLANTS AROUND NIAGARA.

The Brush Electric Company have a large amount of electric lighting apparatus in the vicinity of Niagara Falls, which will undoubtedly be of interest to visitors to the convention.

The Brush Electric Light and Power Company of Niagara Falls was one of the first electric light companies organized in the country. They secured water power from the company that owned the canal. The property of the old Niagara Falls Brush Company was purchased a few years since by the Buffalo and Niagara Falls Electric Light and Power Company. A new station was erected very near the large power house of the Niagara Falls Power Company, from whom they secured current to run the motors which operate their dynamos. In this new electric light station may be found four 100-light 2,000-candle-power Brush arc dynamos belt driven from motors.

The Brush Electric Light Company, of Rochester, N. Y., has one of the largest arc lighting stations in the country. These Rochester and Niagara Falls companies were among the first companies in the world to operate electric lighting machinery by water power.

The Buffalo General Electric Company have a total capacity in their large arc station of about 3,000 lights. This station is located on Elk street. About one-half of these lights are run from 65-light Brush arc dynamos. The remainder of them are run from the new large Brush arc dynamos of 125 lights capacity. There are eleven of these large Brush arc dynamos.

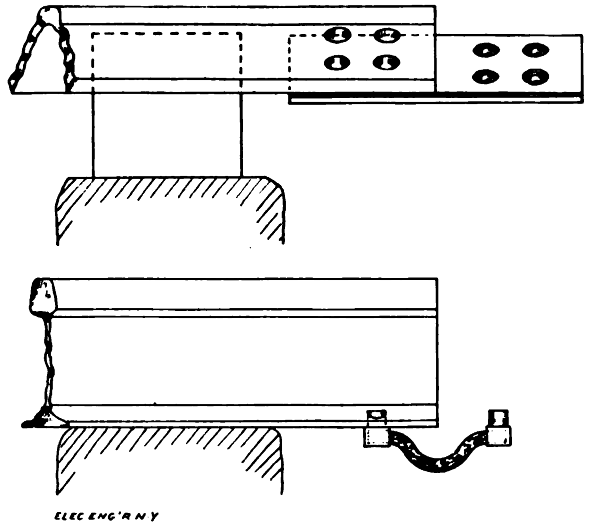
At Lockport, N. Y., there is a large amount of Brush apparatus run by water power.

ELECTRIC TRANSPORTATION

INSULATION AND BONDING OF THE THIRD-RAIL ELECTRIC CONDUCTOR.

BY H. K. LANDIS.

IN extending the electric traction system on the N. Y., N. H. & H. R. Railroad, their branch road at Nantasket Junction near Boston, the trolley construction would have necessitated a double line of poles or the spreading of the parallel tracks already in place. To avoid either of these methods it was suggested to bring the conductor down to the track and support it on the ties. Experts disagreed as to the advisability of this construction and predicted abnormal losses of current and other consequent evils. Notwithstanding the great diversity of opinion, the chief electrician of the road tried the system, which not only possesses many advantages in operation, but was installed at less than half the expense of the trolley construction already put in on the adjacent seven miles of track. Three and one-half miles were first built in the spring of 1896 and one year of operation proved so satisfactory that it was determined to put the system to a final test, to demonstrate its ability to compete with street railway traffic.



FIGS. 2 AND 3.—METHOD OF BONDING THIRD RAIL AND SERVICE RAIL, N. Y., N. H. & H. R. R.

Two tracks, one between Berlin and New Britain and the other between Hartford and New Britain, Conn., were therefore equipped with a third rail conductor, the first inspection trip being made on May 11, 1897, and the first regular service established on May 24, between New Britain and Berlin, a distance of three miles. A trolley line is under construction which will parallel this latter line, while the nine-mile division connecting with Hartford is already paralleled, and here will be decided the vital question whether the public are influenced to a very considerable extent by reduced fare and greater speed. For, on the Hartford division the experimental trips were found to occupy about twenty minutes at a fare of 10 cents, while the trolley system charged 15 cents and took fifty minutes to make the trip of nine miles. (See The Electrical Engineer of May 19, p. 535.)

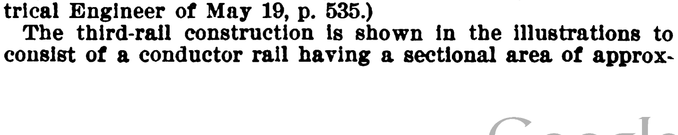


FIG. 1.—TRACK AND THIRD RAIL CONSTRUCTION, N. Y., N. H. & H. R. R.

The third-rail construction is shown in the illustrations to consist of a conductor rail having a sectional area of approximately nine inches and a weight of about 93 pounds to the yard. The service rails are the regular high carbon steel 100 pounds to the yard standard section of the New Haven road, which are 6 inches high above the ties. The top of the conductor rail is placed 1 inch higher. Throughout the track is the regular main line construction, is well graded and rides very smoothly. This is rendered necessary as the service is supposed to represent regular main line traffic, but with more frequent stops.

From the power house issue four cables, two of which connect with the conductor rail and each of the others with each of the two service rails. The latter are not insulated and are of ample conducting capacity, i. e., about equal to or slightly greater than the third rail. The conductor rail is separated from the ties by a pine block which was first creosoted, then boiled in tar, and christened the Bergtha block. The rail rests directly on this block and bonds are made between ties.

At grade crossings the conductor ends in two bare cables, each of which runs through a creosoted pine conduit 4 inches square with a bore of 2½ inches, the space between and around being filled with an insulating compound composed of petroleum residuum and asphalt mixed in such proportion as not to be pasty and yet be elastic; the whole is enclosed in creosoted inch pine board boxes from 7½ to 11½ inches square, and placed about 2 feet under the roadway. This device has given excellent results.

Under ordinary conditions the handling of a 600-volt current is attended with some risk, but in this case the conductors are so large that there seems no incentive for the current to leave them. Short circuiting is unknown in the year's experience with the third rail. By some unavoidable circumstance the Nantasket track was flooded by water for a distance of two miles and yet both the trolley line connected with the end of the third rail and the regular motor cars continued to run without being inconvenienced thereby. So much for a large conductor and low voltage.

A number of cases have occurred where workmen have received shocks from the rail but no effects ensued excepting a sharp muscular contraction. As to current deflection, there is none, and the leakage amounts to but the small amount of one per cent. One test, after a rainstorm and when the insulation on one of the cables had been broken by a spike, showed a leakage of 2.6 amperes; the cable was fused for a distance of one foot and through one-third its section. On another occasion under favorable circumstances on a dry summer evening a loss in current of 0.5 ampere was found.

The rubbing surface of the contact shoe is 12 x 5 inches; there are two of these shoes on the first car carrying the two motor trucks, and one on each trailer, connected by flexible cables. There is thus ample conducting capacity and this is probably one of the reasons why there is no sparking and so little leakage.

The standard rail bonds are of copper and are applied as illustrated. For the third rail, plain copper plates 3.75 x 12 x 1-16 inches are punched with oval holes to admit the bolts, and placed between a fish plate of the same size and the under side of the rail, then bolted in place. At crossings a brass socket plate having a contact surface of 22 square inches replaces the copper bond; it is bolted to the under side of the rail in the same manner. The cable is soldered into a socket in its end and bolt covered by the wooden approach up which the contact shoe slides to the rail end. Two of these sockets are attached to each conductor rail end and carry cables of 500,000 and sometimes 850,000 circular mils each. The capacity of the flat copper bonds is about 900,000 circular mils, and they have a sectional copper area of nearly one square inch with an additional area of two steel fish plates, each about 4 x 0.25 x 12 inches in size.

The service rail bonds are the usual copper strands the ends of which are placed in a socket and drop-forged into contact. On opening some of these contacts it was found that the connection was not as perfect as could be desired so that they will no longer be used in new work, but the bond illustrated in Fig. 3 will be used. It consists of 21 strips of copper of a total thickness of one-half inch and seven-eighths of an inch wide. The ends of these strips are placed in a casting mold and brass heads cast about them with the addition of a little solder; upon sawing through this joint the metal appears as if solid.

Contact is made with the rail through a drilled hole three-quarters of an inch in diameter into which the cylindrical split part of the bond fits; a white metal wedge is driven into this slot and the stem thus spread so as to fill the hole perfectly. This bond is flexible and when the two service rails are compared to the third rail it will be found that both possess about equal conductivity. The bonds first used had the copper strips replaced by twisted wire and the square head with stem by a flat head with circular hole for a bolt. The two first plates in the third rail joint were formerly connected, forming an angle bar joint, but this gave trouble and was abandoned.

The large cable is one inch in diameter, has 38 wires and an equivalent copper section of two-thirds of a square inch, or of one and one-third square inches at each crossing. The small cable having a diameter of 13-16 of an inch has an equivalent area for both cables of a little over three-quarters of a square inch of copper surface. The four service rail bonds carrying the return current have a total area of 1.75 square inch of copper. This is not the relative conductivity of the bonds, it must be understood, as that depends largely upon the area and character of the actual contact surfaces. The safe carrying capacity of a 500,000 circular mils cable is about 350 amperes, while the larger cable can conduct about 500 amperes.

It will therefore be readily seen that the resistances in such a circuit are very small and that when the perfection which is usually arrived at in continuous service is here attained practically all the energy sent out by the dynamo will be utilized in the car motor. The officials of the road are not yet ready to make public the exact figures referring to cost of operation, maintenance, and receipts, but say they are very well satisfied indeed with the results at Nantasket Beach.

CONDUIT RAILWAY SYSTEMS IN MEXICO.

A special dispatch from Bridgeport, Conn., of May 26, says: The American Electric Traction Company, which was recently formed in New York for the purpose of placing the third-rail scheme of Capt. J. M. Murphy into operation, has secured several contracts, which guarantee its success, among them one with President Diaz of Mexico, and J. B. Higgins of California. This contract was made for the patent right in Mexico and in return President Diaz agrees to compel by law all overhead systems to bury their wires and further agrees to have in practical operation, within a period of six months, a road out of the City of Mexico equipped with Murphy's system.

TROLLEY AND STEAM COMPETITION IN OHIO.

The Lake Shore & Michigan Southern has reduced passenger rates between Cleveland and Painesville and Cleveland and Elyria to about 1½ cents a mile, to compete with the electric roads. This low rate can be had only by buying 25 rides at once, however. A Cleveland paper says that the rate is a trifle lower than by the electric line; and the speed is considerably better.

THE STEAM AND TROLLEY SITUATION IN CONNECTICUT.

The defeat of the projected trolley parallel between Norwich and New London ends the contest for the session of steam and trolley in the Connecticut Legislature, and there are no more noteworthy questions relating to parallel trolleys to be disposed of. An analysis of the results, so far as concerns trolley roads, shows that under new charters or amendments of old ones about 151 miles of new trolley roads have been authorized. Of that number about fifty-seven miles represent trolley roads very unlikely to be built, or, if built at all, a long time hence. About eighty-three miles are parallels of steam roads, and of these about twenty miles—including, in one case, parts previously built—are now under construction. On two roads or extensions the State courts will probably have to pass under the "necessity and convenience" clause of the general street railroad law. Prospectively at the end of the present year from seventy-five to one hundred miles will have been added to the mileage—about 350—in operation in Connecticut on January 1, 1897. Of the projected trolley parallels, however, some twenty miles are very indirect parallels, and do not seriously menace steam-passenger traffic. On the whole, the steam interests have emerged from the legislative campaign pretty successfully. As a concession to public demands and from motives of policy they have been forced to yield two important parallels—the Hartford and New Britain and the Torrington and Winchester. But the former has been met by the third-rail route and the latter is a localized line. On the other hand, the steam interests have defeated trolley projects for serious parallels between Derby and New Haven, between Norwich and New London, and, probably, in the courts, between Streeton and Stratford. An important parallel trolley link between Southport and Westford yet remains to be passed upon by the courts.

TORONTO, CANADA, for the third time, has voted on the Sunday street car question, and this time the clergy and their allies in the livery business have been downed, the vote in favor of Sunday cars being 16,433 against 15,954. The preceding polls were against Sunday service by 2,000 votes first and next by only 900.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—XIII.

BY JOSEPH APPLETON. (Copyright, 1897.)

STORAGE BATTERIES IN EDISON STATIONS.—Continued.

IT is found by the Boston Edison Company that the batteries can be charged most conveniently and economically at night. By means of the tie lines all the load on the system can be carried from one station and this, together with the current used for charging the batteries, forms a total load which is sufficient to secure efficient operation.

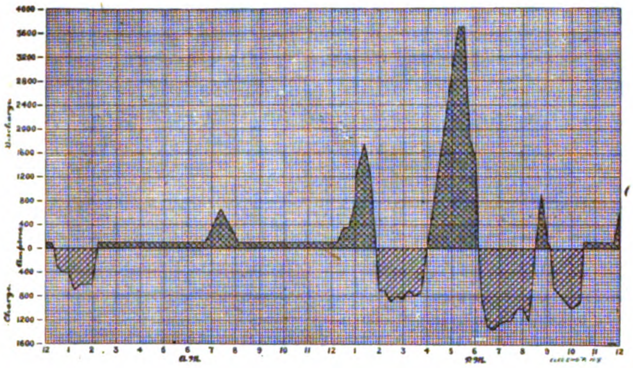


FIG. 49.

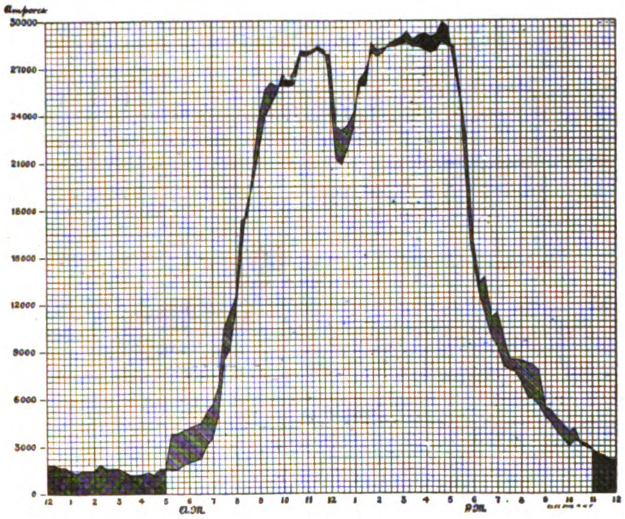


FIG. 50.—CURVE SHOWING LOAD AT DUANE ST. STATION OF NEW YORK EDISON CO., AND THE PORTION OF SAME CARRIED BY STORAGE BATTERIES.

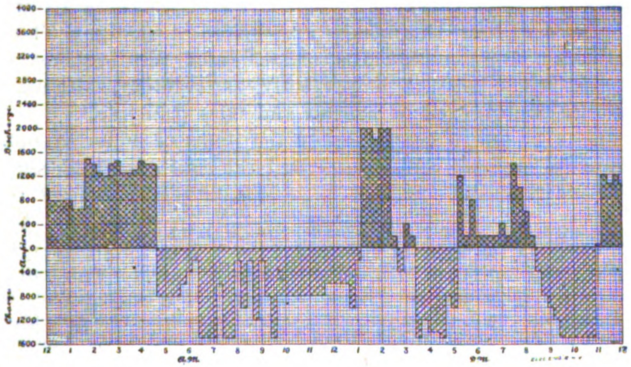


FIG. 51.

The New York Edison Illuminating Company have three storage battery plants in operation. The first installed is located at one of their uptown stations on Fifty-third street. It has a capacity of 1,000 amperes for three hours, or 2,000 amperes for one hour.

The second battery is in the Twelfth street station, which is located practically at the center of the area covered by their system. This plant consists of 150 cells, having a total capacity of 800 amperes for ten hours, or 2,000 amperes for three hours, or 4,000 amperes for one hour.

Both these batteries act as auxiliaries to the stations in which they are installed, but the third battery is located in a sub-station which forms the center of distribution for a portion of the downtown district, and is used both for this purpose and as an auxiliary to the large Duane street station.

This battery consists of 150 cells having a total capacity of 800 amperes for ten hours, or 2,000 amperes for three hours, or 4,000 amperes for one hour. It is located in the Bowling Green Building, about one mile from the Duane street station, and takes the place of an annex generating station, formerly situated in the Produce Exchange.

The battery is charged from the Duane street station at times of light load through tie lines which are arranged so that they can be used as feeders on the system during the hours of maximum load, feeding current into the system from both the Duane street station and Bowling Green battery; this

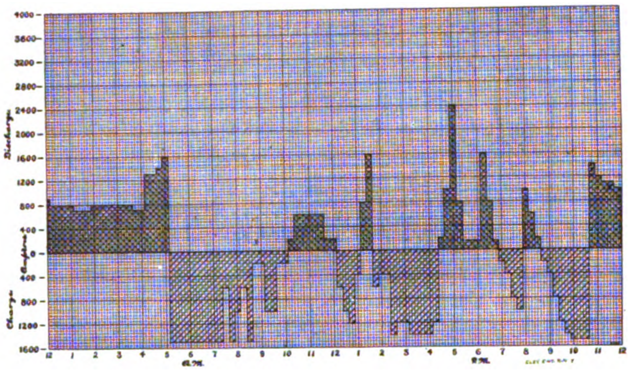


FIG. 52.

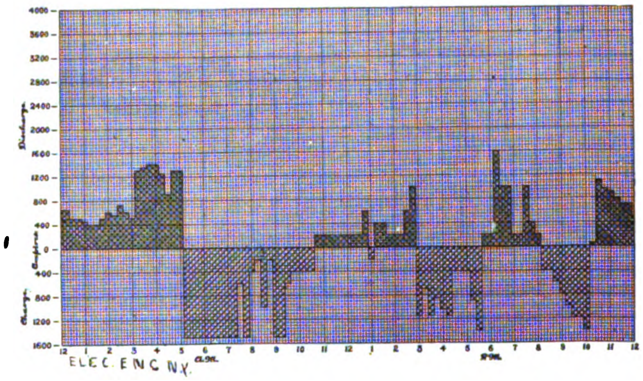


FIG. 53.

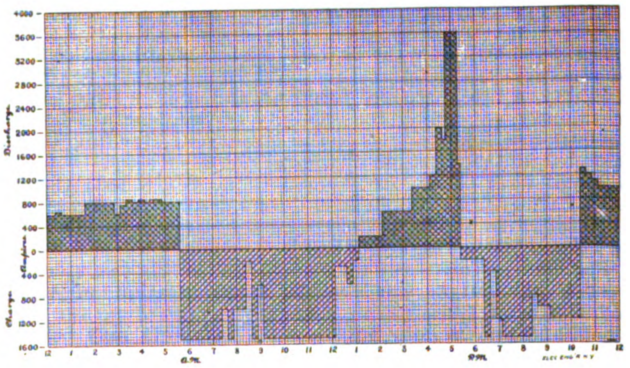


FIG. 54.

saves considerable in the copper required for the distribution of the current in this section.

Fig. 49 is a diagram of the work done by the Twelfth street battery during 24 hours. This battery being situated at the center of the system enables the various generating plants to be run at the most economical point, the surplus current from any one being used for charging the battery, and vice-versa the battery assisting any of the stations when required. It also carries the peak of the load for the immediate district, thus obviating the necessity of transmitting this large amount of current over the feeders from one of the other stations at a time when the loss would be the greatest and the value of the current at its maximum.

Fig. 50 illustrates the load curve of the large Duane street station, and shows how the Twelfth street and Bowling Green batteries enable the entire generating plant to be shut down during the night, as well as the assistance they give in equalizing the load on the generating units during the day time. The discharge is represented by the double shading and the charge by the single shading.

Figs. 51, 52, 53 and 54 show the working of the Bowling Green battery for four days and illustrates the flexibility which such an arrangement gives; the battery being constantly called upon to discharge and assist the generators or take up surplus current as the conditions demand, thus enabling the generating plant to be operated in the most efficient way.

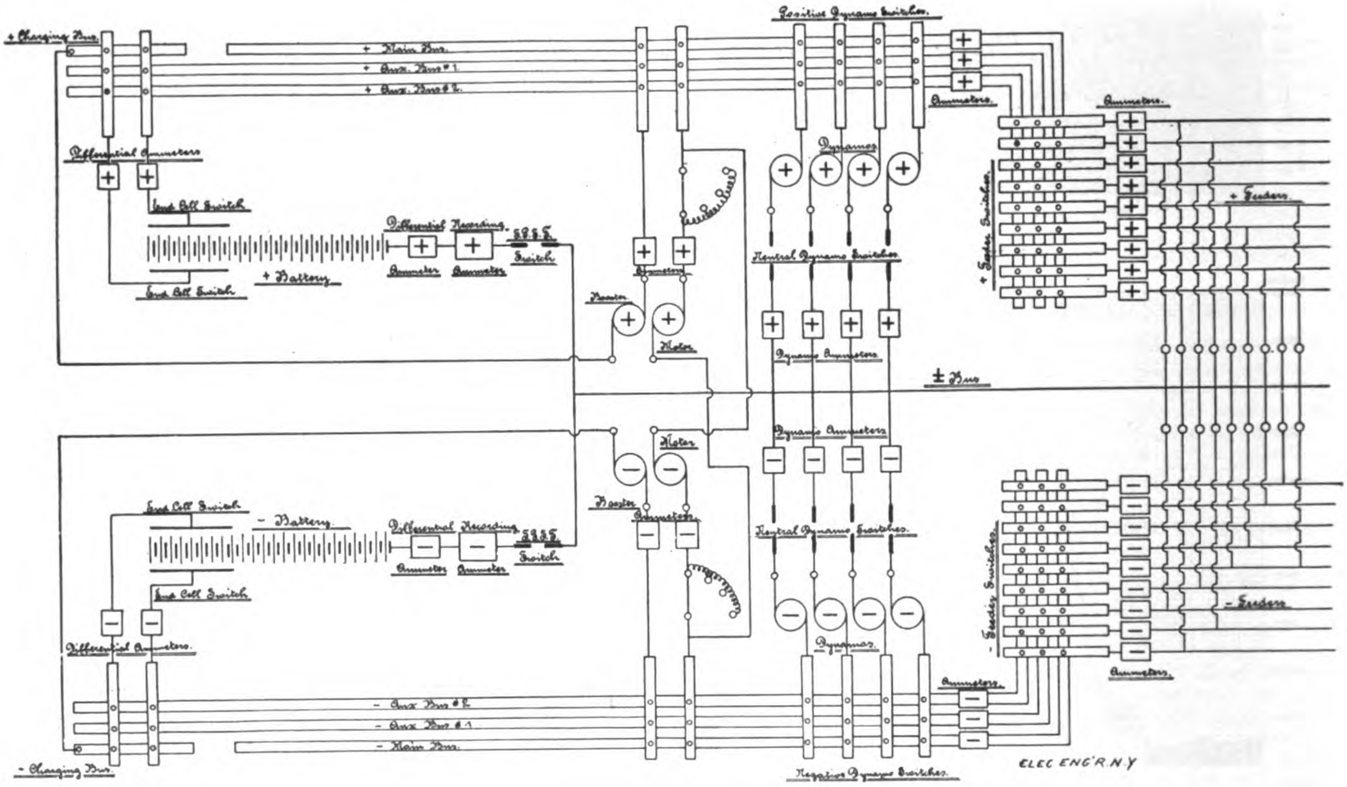


Fig. 55.—Diagram of Connections of Storage Battery in 12th St. Station, New York Edison Co.

Fig. 54 shows how the battery is of great assistance in times of emergency, such as a thunderstorm. About five o'clock on this day, a thunderstorm came up and the load increased tremendously, exceeding the capacity of the generating plant by several thousand amperes; the battery at Bowling Green responded and discharged at the rate of 3,600 amperes for about one-half hour while the excessive load continued. The value of a battery under these conditions cannot be overestimated; it frequently prevents the pressure dropping on the whole system if not a total shut down.

Fig. 55 illustrates the method of connecting the storage battery equipment at the Twelfth street station of the New York Edison Illuminating Company. The diagram explains itself and shows how flexible such a system may be made.

CATALOGUES AND QUOTATIONS WANTED.

The city of Okolona, Miss., is just completing a system of water works and electric lights, and Abbott, Glidewell & Company, hardware merchants, of that place, wish to get catalogues, quotations, etc., on apparatus of this class.

LETTERS TO THE EDITOR

GAS ENGINES FOR ELECTRIC LIGHTING.

THE editorial in The Electrical Engineer of May 26 on the experience had with gas engines in an English central station has been read with interest, and the writer has thought that a brief account of his own experience with those engines would be of value to the Engineer's readers.

We have had a 50 horse-power "Otto" gas engine in use in our electric plant for 7 years, and are installing a second 50 horse-power engine of the same make and intend installing a third in the near future, making 150 horse-power in all.

We have been using a 50 horse-power Westinghouse "Standard" along with the 50 horse-power Otto, the two being belted to a line shaft carrying a balance wheel weighing about 3,000 pounds. From this shaft are belted a 50-light Thomson-Houston arc machine and a 1,000-light Westinghouse alternator. The service is perfectly satisfactory, although the engine is governed on the hit and miss principle.

Leaving out of consideration the items of boiler attendance, repairs, etc., we have found that the coal gas at 30 cents per thousand is equal to coal at $2 per ton. In this connection I might mention that our engines are of the older type and use at least 20 per cent. more gas than more modern engines.

With us the cost of lubrication is a very small item, as we use about 3 pints of filtered oil (from dynamos), 1 pint cylinder oil and ½ pound of grease for an 8-hour run. This would make the cost of lubrication less than 0.1 cent per kilowatt hour. The ignition tubes cost 1¾ cents per day. The repairs amount to about $50 per year on the average, or about 1-10 of a cent per kilowatt hour.

I consider that any company operating both coal gas works and electric plant will be largely benefitted by using gas engines.

C. W. ANDREWS, B. S.,
Gen'l M n. Hamilton, O., Gas Light and Coke Co.

Standard Electric Light and Power Apparatus, 1897.

INTRODUCTION.

IT was in 1831 that Faraday discovered the great and simple principles of magneto-electric induction. That discovery was soon followed by the construction of machines for generating electric currents, and beginning as early as 1833 we find the magneto machines of Paxton, Clarke, Holmes, Van Malderen and a host of others rapidly following one another, each an improvement in some respects upon its predecessor. Then came Siemens and Wheatstone with the great discovery of the dynamo principle of self-excitation which did away at one stroke with the greatest obstacle that had stood in the way of constructing powerful electric generators. Gramme showed how the Pacinotti ring could be utilized as a generator armature as well as for that of a motor. The Siemens and Gramme may be said to be the prototypes of all dynamo machines at present constructed.

As regards electric motors, their history is almost coeval with that of the magneto and dynamo electric machine, but it was not until Gramme in 1873 demonstrated the reversibility of his dynamo that the electric motor really began to occupy a recognized position as a factor in power transmission, and it practically took ten years before that recognition was sufficiently grounded to enable the electric motor to obtain a commercial foothold.

The dynamo and motor made possible those applications which created new industries that are still the wonder and admiration of the world and whose influence has yet scarcely begun to be felt, great though it has been. The dynamo and motor made possible the arc and incandescent light, the electric railway, the electric heater, the purest, refined electrolytic copper, the electric furnace and all its products present and still to come, the great transmissions of power of which Niagara stands at the head—and a host of others too numerous to mention.

In view of the far-reaching importance which electrical apparatus has assumed it has been thought that a brief description of the principal types as now constructed by various American manufacturers would be of timely interest.

The apparatus described below, though fully representative, is by no means complete, it being impossible to gather within the limited space at command the work of hundreds of manufacturers. But such as it is it will not fail to show the trend of modern practice and may, it is hoped, prove instructive to the student, the user, and the manufacturer as well.

I.—DIRECT CURRENT DYNAMOS AND MOTORS.

THOUGH at one time quite a sharp line was drawn between the motor and the dynamo, that distinction has long ceased to exist, and hence we have grouped both under the same general heading. The abolition of this distinction was due largely to the improvement in the design of these machines and one hears nothing nowadays of the lead of the brushes, that never-ending topic of discussion of the early days of dynamo machinery. The carbon brush has also come into general use and has added much to the life and running stability of the machine. The commutator still exists, though it has lost many of its terrors, while hope is still held out to us by several workers for a commutatorless dynamo.

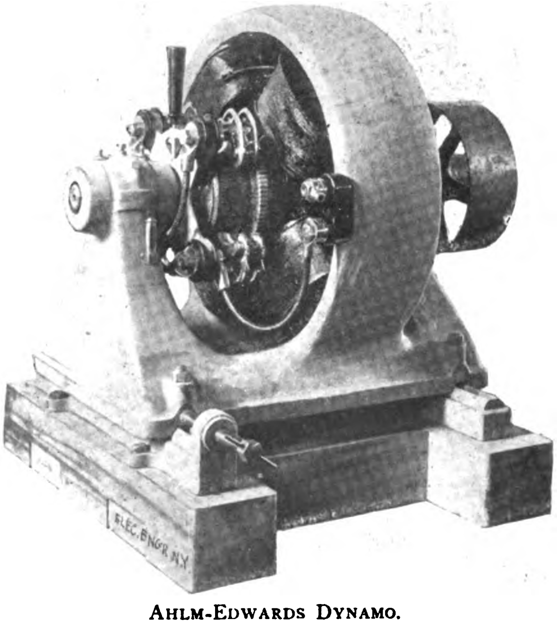
THE AHLM-EDWARDS ELEC. CO., CLEVELAND, OHIO.

The magnet yoke of these machines is one single casting for machines up to 20 kilowatts and divided horizontally for machines above 20 kilowatts, and provided with a base cast thereto. The magnet yoke is made of the best cast iron and is of the multipolar type with projecting poles. The bearings are of the ball, socket and self-oiling type, with babbited linings.

The magnet poles are laminated, of wrought iron, and cast solidly with the magnet yoke, making a welded and perfect joint with the same. The polar surface is increased by the use of pole shoes designed and shaped so as to maintain under all conditions a steady commutation point.

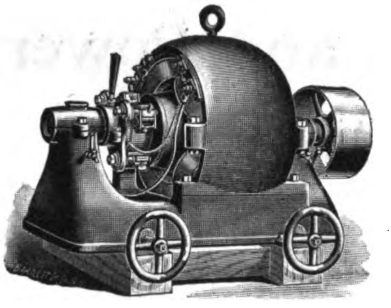
The magnet coils are wound on well insulated sheet iron spools with brass flanges, having the terminals of the winding brought out in a manner proper to avoid danger of breaking in handling.

The armature is of the toothed drum type and built up of thin double annealed sheet iron discs securely attached to the shaft by means of a cast iron spider. All armature coils are interchangeable.

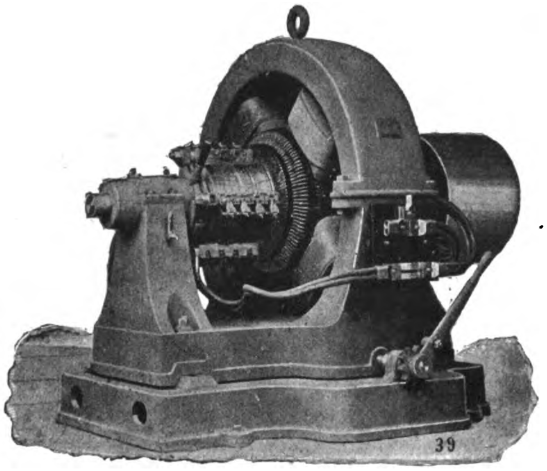


AHLM-EDWARDS DYNAMO.

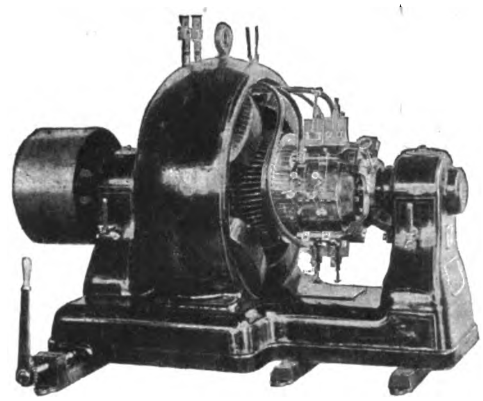
The commutator bars are of hard drawn, drop forged copper of 9-16 inch wearing depth and insulated from each other by .03 inch of the best India mica.



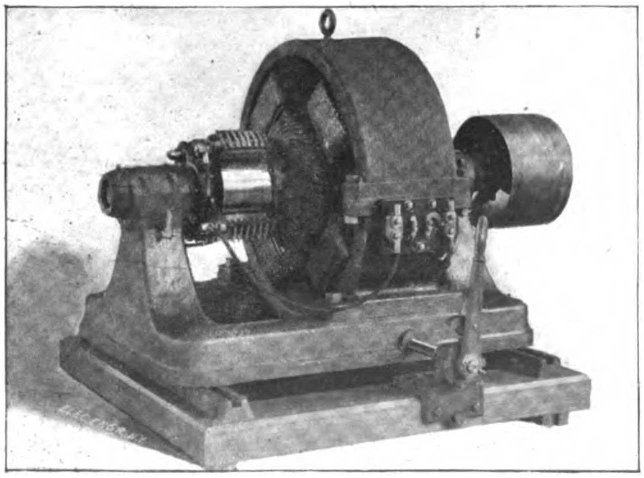
American Engine Co. Dynamo



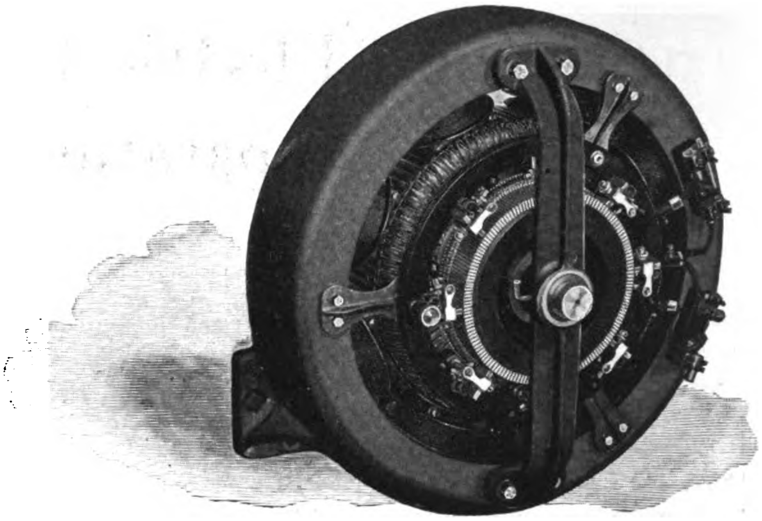
Bullock Electric Co. Dynamo.



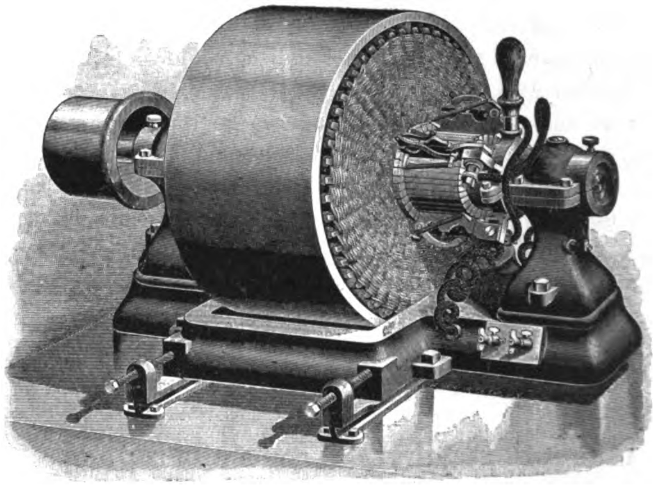
Card Electric Co. Dynamo.



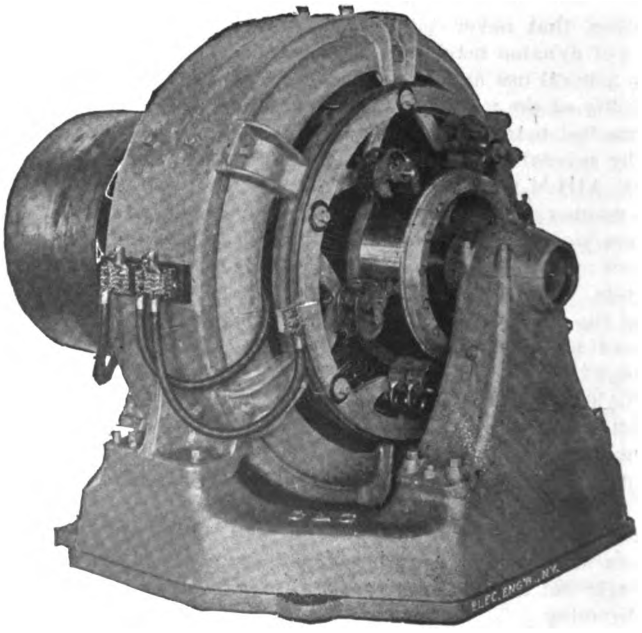
Elektron Dynamo.



Crocker-Wheeler Slow Speed Motor.



Diehl Motor.



C. & C. 6-Pole Dynamo.

THE AHLM-EDWARDS ELEC. CO., CLEVELAND, OHIO.

Slow Speed Dynamos and Motors—Any Voltage.

Kilowatts.	Horse Power.	R. P. M.	Pounds.
4.5	5	1,000	750
7	7.5	900	1,080
9	10	800	1,775
13.5	15	800	2,100
17	20	700	2,750
20	25	650	3,200
25	30	650	4,000
30	35	600	4,850
40	50	600	6,400

Moderate Speed Dynamos and Motors—Any Voltage.

Kilowatts.	Horse Power.	R. P. M.	Pounds.
7	7.5	1,500	750
9	10	1,300	1,080
13.5	15	1,200	1,775
17	20	1,000	2,100
25	30	1,000	2,750
30	35	950	3,200
35	42	900	4,000
42	50	850	4,850
55	70	850	6,400

AMERICAN ENGINE CO.—The accompanying engraving shows the standard type of generator and motor of this company. The following table gives the capacity, dimensions, etc., of the machines:

Size.	H. P.	Revs. per min.	Diam. Pulley.	Width Belt.	Floor Space.
1	3	1,500	5	3	33x33 in.
1½	5	1,200	6	4	36x38 in.
3	12	1,200	12	6	49x40 in.
5	25	750	16	6	60x50 in.
11	35	650	20	8	69x53 in.
15	50	550	24	10	76x57 in.
22	70	475	28	12	84x62 in.
33	100	425	36	14	93x65 in.

BULLOCK ELECTRIC MFG. CO. have brought out a complete line of 1897 generators and motors for direct current from 1 kilowatt to 150 kilowatts, both for belted and direct connected work. The shop tests require non-sparking with fixed brushes under an instantaneous variation of from 50 per cent. overload to no load, and vice versa.

The pole pieces of these machines are of laminated wrought iron, cast into the annular fields. In compounding, the series coils are independent and separated from the shunt coils, so that a circulation of air is permitted between them as well as through the pole pieces. The armatures are of the iron clad type, the laminae being of unusually thin charcoal iron. Wooden retaining wedges are used for the coils, which are of the continuous conductor type. Armatures are thoroughly ventilated, down to the smallest sizes. Radial carbon brushes are used almost exclusively, each brush having its own adjustment. In the case of the larger machines the brush holders are supported from the pole pieces.

In addition to their standard apparatus the Bullock Co. have produced a complete line of direct connected iron clad motors for all classes of work, beginning with 1 horse power at 100 revolutions per minute, and ranging upward.

C. & C. ELECTRIC CO.—The illustration represents this company's new six-pole generator. The armature coils are form-wound, the slots being separately insulated with fireproof insulation. The field coils are reinforced for protection, and are interchangeable. The air gap is sufficiently small to avoid the necessity of large magnetizing currents, and the flux densities determined with a special view to sparkless commutation. In this respect the results are very flattering. The 60-kilowatt machine was loaded up to 75 kilowatts and ran several hours at that load with practically no sparking, and without shifting the brushes. The net commercial efficiency of the C. & C. six-pole direct connected dynamo is 92 or 93 per cent. at full load, in the larger sizes, and careful tests show a falling off of only 3½ per cent. at one-half load. An efficiency curve taken from a 60-kilowatt C. & C. direct connected generator showed a net commercial efficiency of 80 per cent. at ¼ load. A full description of this machine appeared in The Electrical Engineer of May 26, 1897.

CARD ELECTRIC CO.—This company's machines have their field cores cast in one piece and all details have been worked out with great care. They are built in standard sizes up to 85 kilowatts as generators, and 125 horse power in motors, for 125, 250 and 550 volts.

CROCKER-WHEELER ELECTRIC CO.—The engraving represents this company's new type low speed motor for direct connection. The machine shown is the size 2-100, called so because at 100 revolutions per minute it gives 2 horse power. This method of rating is adopted because the motor is intended to be wound for any desired speed and will give power corresponding to the speed. The requirements of a very slow speed motor which shall be efficient, have been carefully considered, every point in favor of a slow speed motor having been taken advantage of, so that many features of the machine are novel. The size illustrated of this new line of machines, is about 30 inches in diameter over all and perfectly round, resembling a fly wheel and especially proportioned for direct bolting flat against the machinery to be driven, from which it will project about twelve inches over all.

It is an eight-pole machine with wrought iron cores, cast iron yoke and detachable pole pieces. The metal of the yoke is carried over the sides and forms a curtain or protection for the coils, at the same time giving great rigidity to the frame and adding to the appearance of the machine. It also forms a continuous "lug" by which the motor may be bolted at any point to different kinds of machinery. The armatures are of the toothed iron clad type supported on solid cast iron spiders and wound with separately formed coils.

Cables for connecting the various brush holders are made unnecessary, the brush holder stubs being directly attached to brass conducting rings which are entirely covered with insulation. These rings are bolted together and rock in rollers bearing on the extremities of three brass brackets, the bearing extremities of the brackets being bored to a true circle from shaft center. The free ends of the brush holder studs point outward, and being unobstructed, the brush holders may be slipped bodily off from them and the surfaces of contact of the brushes with the commutator may be readily seen.

The type chosen for this machine is such that the efficiency is the highest that can be obtained at the low speed. By special means of regulation, the speed of these machines can be varied, the changes being accomplished without resistances. These machines can be run at half speed with full torque and full efficiency. They are designed so as to stand a very high temporary overload.

A number of new features have been incorporated in the design and construction of the latest type of Crocker-Wheeler direct connected generators. The frame of the machine is of cast steel, to which the pole pieces, also of cast steel, are bolted. A ring type armature with a drum winding is used. This winding is firmly secured at each end by means of thoroughly insulated clamps, which prevent any displacement of the winding and protect it from damage.

The armature core is built up of soft laminated iron discs insulated with paper and the tooth is of the overhanging pattern. The winding is threaded through the slots in the armature, which makes it practically iron clad. The core is supported on the shaft by means of a split collar, and drawn up to a bearing with bolts. The commutator is of ample capacity and the connections to it are made with set screws held in position with cotter pins.

The rocker arm consists of two rings supported from the frame of the machine, making it self-contained. The rings are thoroughly insulated from each other and an allowance is made for the adjustment of the brushes. The brush holders are connected to one another by a series of insulated links which enable them to be lifted from the commutator by the movement of a small lever placed on the side of the rocker arm. Carbon brushes are used and are held by an adjustable brush holder of the most improved design.

The Crocker-Wheeler Company is now making these machines in ten sizes, viz.: 6, 9, 15, 30, 50, 75, 100, 150, 200 and 250 kilowatts capacity.

DIEHL MANUFACTURING CO.—The principle on which the Diehl motors and dynamos are constructed is that of the armature encircling and revolving around the field magnets. The slower speed thus gained is due to the large diameter of the armature, and is obtained without increase of weight, and gives a starting torque proportionately great; at the same time increasing the efficiency by a diminution of friction of the bearings and the brushes.

The armature, which is of the ring type, is securely housed within a brass casing, which not only protects it from mechanical injury, but also acts as a balance wheel for the machine, and further presents a large radiating surface which carries away the heat generated in the armature.

Perfect lubrication of the bearings is obtained by means of reservoirs in the standards, which are cast hollow. The amount of oil in the reservoir is indicated by the height of oil in the glass gauges on the sides of the standards. The bronze bearings in which the shaft rotates, are so formed that they rest in spherical seats of babbitt metal formed in the standards, and allow of a perfect alignment of the shaft.

The following table gives the data of the Diehl machines, which are wound for any direct current up to 500 volts:

TABLE OF DIEHL MOTORS AND DYNAMOS.

H. P.	Approx. Speed.	Pulley Diameter.	Pulley Face.	Weight.	Floor Space.
⅓	1,200	2½ in.	1¾ in.	45	10 x12
¼	1,000	3 "	2 "	75	11 x15½
½	1,000	4 "	2¼ "	110	12 x16
1	950	5 "	3¼ "	195	14 x18
2	900	6 "	3½ "	250	15 x21
3	900	7 "	3½ "	300	15 x21
5	800	8 "	5½ "	490	17½x26
7½	750	9 "	6½ "	650	21½x28
10	650	10 "	7½ "	750	22 x30
					24 x35
20	600	15 "	10½ "	1600	28 x39½

The speed of dynamos and motors wound for 500 volts, is 10 per cent. higher than the speed given above.

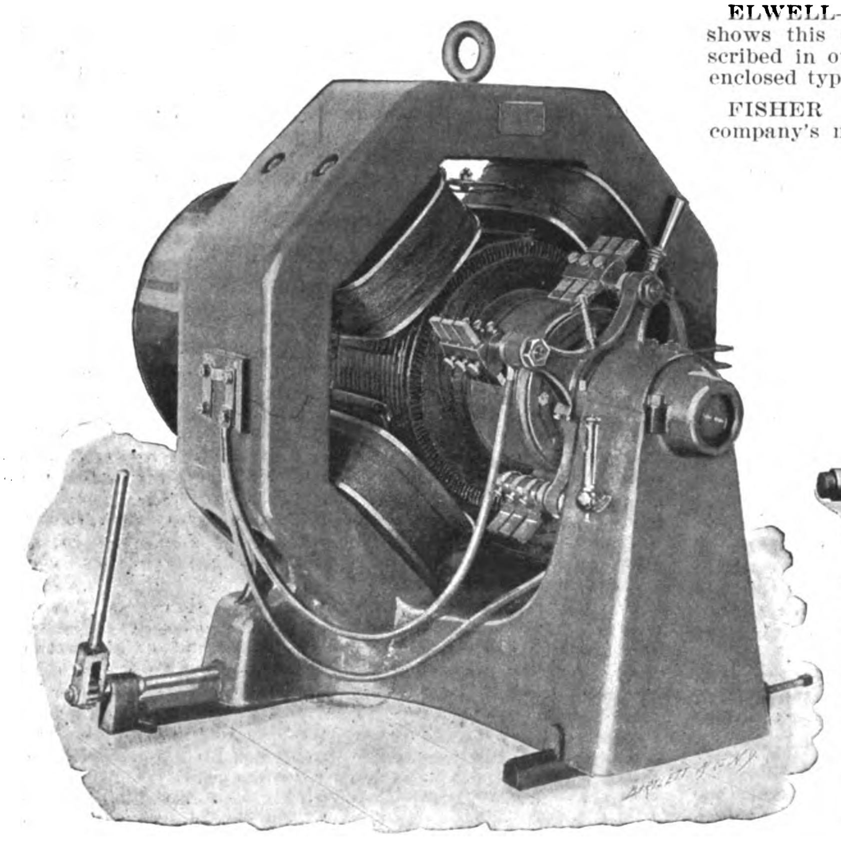
ELEKTRON MFG. CO.—This company's dynamo, illustrated herewith, is built in sizes from 18 kilowatts upwards, the machine illustrated being of 25 kilowatts.

The field magnet is a steel casting with the four inwardly projecting poles cast integral with the ring. The field coils are machine wound and are slipped on the pole pieces from which they are separated by a small air space, insuring cool running.

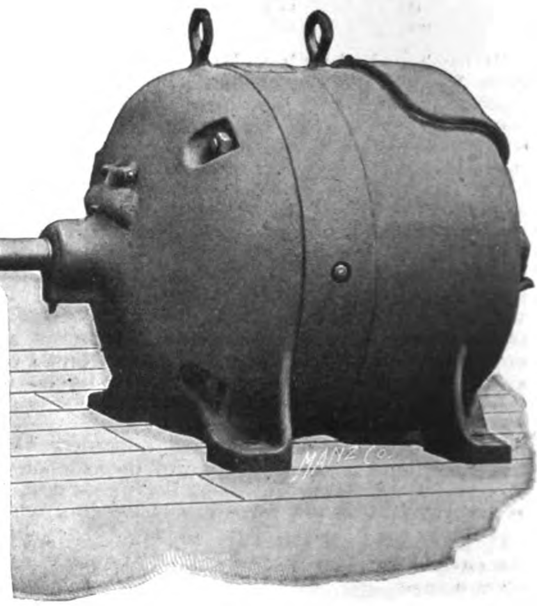
The armature is of the tooth ring form with wire all on the outside. The fields are wound by machinery on forms, being thoroughly insulated and taped before being slipped into the slots which are insulated independently. A two-path winding is generally used, admitting of the use of two brushes, but for heavy currents and low voltage four brushes may be used. The engraving shows the machine equipped with four self-adjusting radial carbon brushes. No provision is made for rotating the rocker arm, as the diameter of commutation does not change materially under changing loads.

The pedestals and bearings are very massive, and have bronze bearings, each of which is oiled by two loose rings dipping into an oil receptacle below. The depth of oil in this receptacle is indicated by the gauges shown.

Each machine is equipped with sliding base, belt tightener, screw ratchet lever, pulley and non-combustible field rheostat. The terminals are mounted on a handsome polished slate slab attached to the lower half of field ring.



EDDY DYNAMO.



ELWELL-PARKER ENCLOSED MOTOR.

EDDY ELECTRIC CO.—The Eddy Type "G" generators consist of a cast iron octagonal frame, to which are bolted four cast steel poles, with flanging tips. Each pole is excited by a field coil, wound on a metal spool, the shunt and series portions in separate compartments. Each layer of wire is insulated from the next by a sheet of tough paper, and the whole winding is thoroughly insulated from the spool by layers of paper, cardboard and mica. Cast with the lower portion of the field frame are extensions for supporting the pillow block bearings. The bearing shells are self-aligning and self-oiling, and well babbitted.

The armature consists of a laminated and ventilated core of sheet iron, mounted on a sleeve which is forced on and keyed to the shaft. The windings are made up of copper rods of rectangular section, embedded in insulated slots in the surface of the core, and spirally shaped copper ribbons connecting them on the ends of the armature.

The commutator is made up of segments of hard copper beveled on the ends and held in place by collars bolted together. The bolt nuts are secured by an efficient nut lock which simultaneously binds all the nuts. Either tangential or radial holders are supplied with these machines. In either form the brush is held against the commutator by a pressure regulated at the will of the attendant, and in such a way as to prevent rattling and jumping.

ELWELL-PARKER ELECTRIC CO.—The illustration shows this company's enclosed motor which was fully described in our last issue, together with the company's semi-enclosed type of machine.

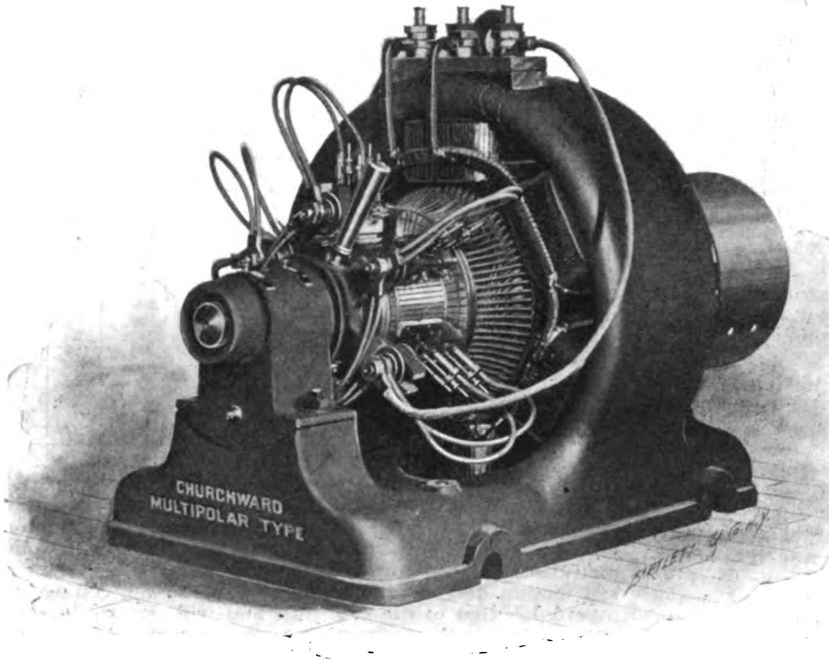
FISHER ELECTRICAL MANUFACTURING CO.—This company's machine has a magnetic frame of cast steel, the shunt and series coils being wound separately and secured to the pole pieces by suitable clamps.

The slotted type of armature is used in this machine. The coils are so designed and placed in the armature that they are interchangeable at every point. They are of equal length and ample conducting capacity.

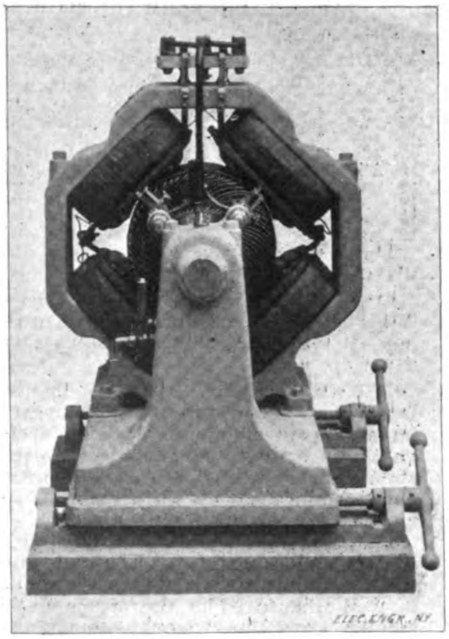
These machines are built in sizes from 1 to 60 kilowatts.

EXCELSIOR ELECTRIC CO.—This company's "Churchward" six-pole belt-driven generator has its frame cast in one piece, of a special metal, of high permeability. The armature shaft is short and its diameter large, and hung low to insure stability. The armature is designed so as to limit the rise in temperature to 40 degs. Cent. The magnetic proportions of armature and fields are such that sparking is prevented under all conditions of load. The bearings are self-oiling and aligning, and by taking out two bolts the machine can be taken apart in a few minutes.

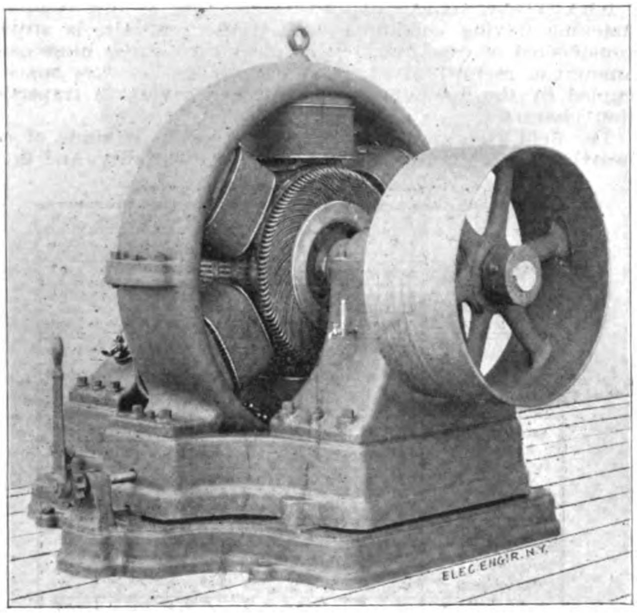
The following table gives data regarding the Churchward slow-speed belt-driven machines.



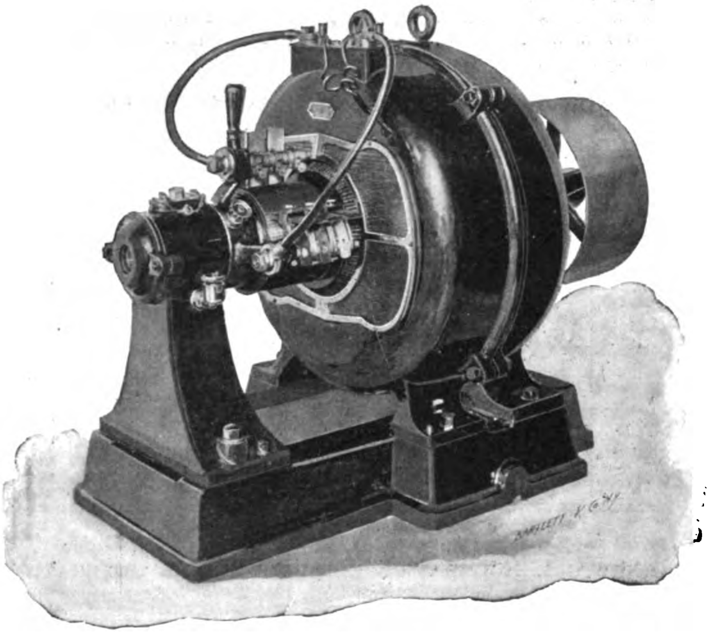
Excelsior "Slow-Speed" Dynamo.



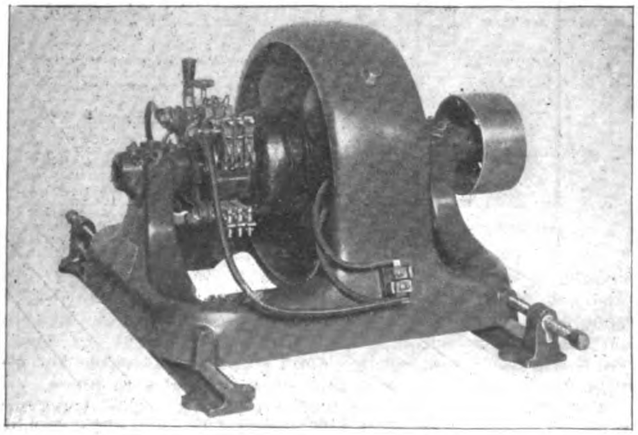
Fisher Electric Co. Dynamo.



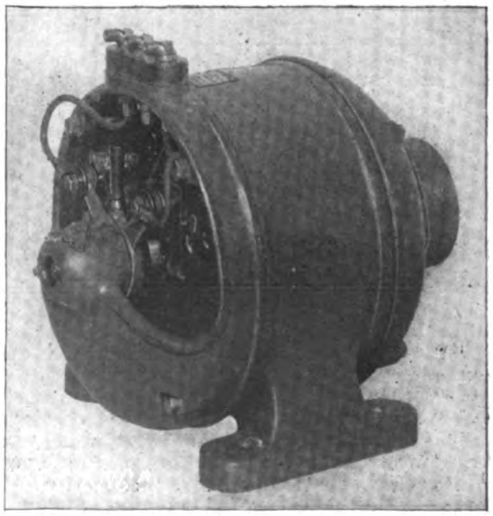
Fort Wayne Dynamo.



Lundell Dynamo.



General Electric Slow-Speed 4-Pole Dynamo.



General Electric Iron Clad Bipolar Dynamo.

TABLE OF CHURCHWARD SLOW SPEED GENERATORS.

Classification. No.	H. P.	K.W.	Speed.	Volts.	Amperes, Full Load.			Wgt., Lbs.	Floor Space.
3	3.	2.2	700	125,250,500	17.5	8.75	4.37	337	18¾x30
4	5.	3.75	700	125,250,000	30.	15.	7.5	511	23¾x30
5	7.5	5.62	700	125,250,500	45.	22.5	11.25	704	29 x33
6	10.	7.5	700	125,250,500	60.	30.	15.	979	30⅝x33
7	15.	11.25	700	125,250,500	90.	45.	22.5	1115	34¼x41
8	20.	15.	700	125,250,500	120.	60.	30.	1374	44 1/16x48
9	30.	22.5	700	125,250,500	180.	90.	45.	1851	48¾x48
10	45.	33.75	660	125,250,500	270.	135.	67.5	3471	62¼x54
11	60.	45.	660	125,250,500	360	180.	90.	5400	67⅛x54
12	85.	65.	600	125,250,500	520.	260.	130.	5400	67⅛x54

The Churchward generators are also constructed for direct driving.

FORT WAYNE ELECTRIC CORP.—This company's Wood direct current generator is shown in the accompanying engraving. It represents their 50-kilowatt 6-pole machine running at 275 r. p. m.

GENERAL ELECTRIC CO.—The slow and moderate speed belt-driven generators of the General Electric Co. embody the latest improvements in dynamo design, and possess all the valuable features of the older form of this same machine, such as cast steel pole pieces, ventilated armature core, machine wound coils on the armature, carbon brushes, tough and moisture proof insulation, etc.

The four-pole construction is used in the larger sizes down to and including the 6.5 kilowatt slow speed, and the 9 kilowatt moderate speed. The general appearance of the machine is well illustrated in the accompanying engraving. For the smaller sizes the two-pole construction is adopted as is indicated by the symbols I. B. (iron-clad, bipolar), by which these machines are designated. This machine is also illustrated, showing its compactness and general neat appearance.

Below we give a table of the company's new slow speed and moderate speed belt-driven generators.

NEW G. E. SLOW SPEED BELT-DRIVEN GENERATORS.
Voltage at full load, 125, 250 or 500.

Classification.				Amperes, full load.			Weight, Lbs.	Dimen. in Ins.		
Type.	Poles	Kilowatt	Speed.					Pulley, Diam.	Pulley, Face.	Floor Space.
IB.....	2	.75	1,200	6	3	1.5	209	5.25	2.5	15¾x22¾
"	2	1.75	1,200	14	7	3.5	66	5.25	2.5	15¾x22¾
"	2	2.5	1,100	20	10	5	560	5¾	3	20 x30¾
"	2	4.5	1,100	36	18	9	750	9¾	4	21¼x34⅞
MP.....	4	6.5	950	52	26	13	856 without rails 942 with rails	11	4.25	26x37⅞*
"	4	9	900	72	36	18	1,250	11½	6.5	29¼x42†
"	4	13.5	850	108	54	27	2,180	12¼	8.5	32x47†
"	4	17	750	136	68	34	2,500	13¾	8.5	36¾x54⅞
"	4	20	700	160	80	40	3,200	15	10.5	40¾x59†
" ...	4	30	675	240	120	60	3,800	20½	11.25	48x64†
"	4	40	605	320	160	80	5,400	22¾	15.5	50x72†
"	4	50	600	400	200	100	6 100	23	18.5	53x80⅝*
"	4	75	550	600	300	150	7,100	26½	24.5	56x92½*

* Actual. † Approximate.

NEW G. E. MODERATE SPEED BELT-DRIVEN GENERATORS.
Voltage at full load, 125, 250 or 500.

Classification.				Amperes, Full Load.			Weight, Lbs.	Dimensions in Inches.		
Type.	Poles.	Kilo-watt.	Speed.					Pulley, Diam.	Pulley, Face.	Floor Space.
IB.	2	1.5	1,900	12	6	3	209	6⅝	2½	15¾x20¾
"	2	2.5	1,900	20	10	5	266	6⅝	2½	15¾x22¾
"	2	4.5	1,800	36	18	9	560	6¾	3	20 x30¾
"	2	7.5	1,800	60	30	15	750	7	3½	21¼x23⅞
MP	4	9	1,450	72	36	18	856 without rails 942 with rails	9½	4¾	26 x38⅜*
"	4	12.5	1,350	100	50	25	1,250	10	6½	29¼x42†
"	4	17.5	1,175	140	70	35	2,100	11½	8¾	32 x47†
"	4	25	1,100	200	100	50	2,500	12½	9	36¾x55⅜†
"	4	30	1,050	240	120	60	3,200	13	11	40¾x59½†
"	4	45	975	360	180	90	3,800	16¾	13	43 x65¾†
"	4	55	925	440	220	110	5,400	17¾	16¾	50 x73¼†
"	4	65	875	520	260	130	6,100	18¾	19½	53 x85⅝*
"	4	85	750	680	340	170	7,100	22	24	56 x92*

* Actual. † Approximate.

INTERIOR CONDUIT AND INSULATION CO.—The Lundell motors and dynamos manufactured by this company are encased in a steel shell, so that field and armature windings are thoroughly protected. A single coil energizes the fields and the armature is iron clad, no wires being exposed on the surface. Both dynamos and motors of this company are designed for slow speed and direct connection. The illustration shows a four-pole type of machine. Below is a table of sizes and capacities.

TABLE OF LUNDELL MOTORS AND DYNAMOS.

Brake H.-P.	Watts.	Amperes at 115 Volts.	Voltage.	Approximate Speed.	Pulley. Diameter.	Pulley. Face.
1/16	......	......	4 Battery	1,900	1	V
1/12	......	......	115	1,900	1	V
⅛	......	......	8 Battery	1,800	1½	V
1/6	......	......	115	1,800	1½	V
¼	250	2.2	115,230,500	1,700	2¾	1½
½	500	4.3	115,230,500	1,500	3½	2
1	1,000	8.7	115,230,500	1,300	4½	2¾
2	1,920	16.7	115,230,500	1,150	6	3⅜
3	2,750	23.9	115,230,500	1,150	6	3⅜
4	3,675	32.	115,230,500	1,200	7	3¾
5*	4,525	39.4	115,230,500	1,100	8	4½
7½*	6,650	57.8	115,230,500	1,050	9	5
10*	8,750	76.1	115,230,500	1,000	11	6
15*	12,700	118.7	115,230,500	850	13	6½
20*	16,700	145.2	115,230,500	800	15	7
25*	20,650	179.5	115,230,500	750	17	8
35*	28,500	248.7	115,230,500	650	22	10

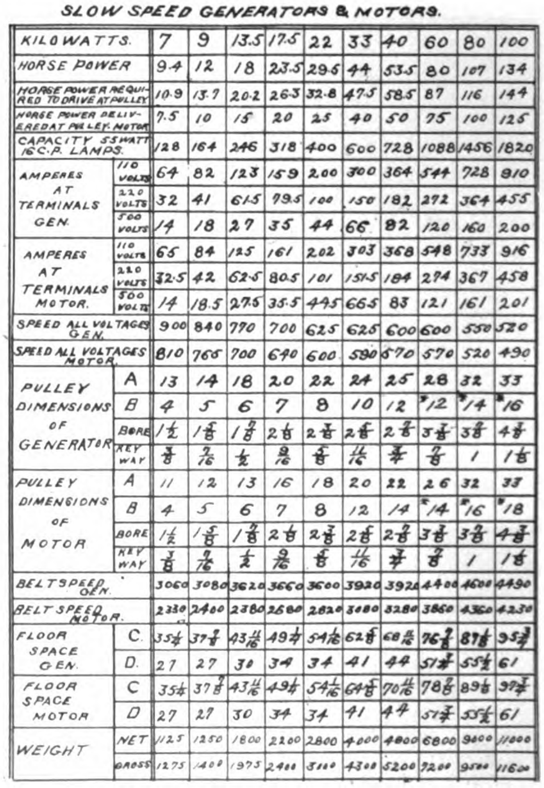
* 4-pole type; all smaller sizes, 2 pole type.

NORTHERN ELECTRICAL MANUFACTURING CO.—This company's specialty is direct connection of slow speed, direct current motors to all kinds of machinery. Their motors are built entirely of soft steel with machine made coil wound armatures and drop forged commutator bars. All their standard motors may be run inverted hung to the ceiling, or half inverted bolted to the side wall and will operate in this position as well as though resting upon the floor. Another feature of the machine is the self-locking sliding base, which, when belted connection is used, is a very handy arrangement. The illustration shows a 1 horse-power motor equipped with pinion for gear connection to press.

KEYSTONE ELECTRIC CO.—The base of this company's machine having combined with it the journals, is strongly constructed of cast iron, but so designed that no unnecessary amount of metal is used; thereby reducing the floor space occupied by the machine and effecting a saving in transportation charges.

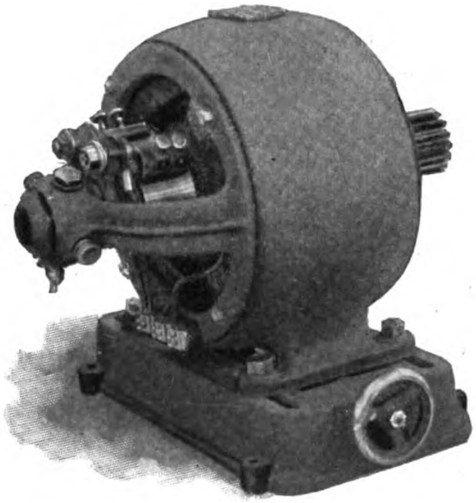
The field yoke or ring, cast in two parts, is made of open hearth steel of the highest magnetic permeability, and is consequently very light for the output of the machine. The poles, also of open hearth steel, are bolted to the yoke. The spools, on which the field coils are wound, are placed on the poles before the latter are bolted to the field yoke, thereby making the coils readily accessible by simply removing the cap screws that hold the poles in place.

The armature is of the well known iron clad type, wound with coils placed in slots and completely embedded below the surface of the core. The core, built up of well annealed sheet

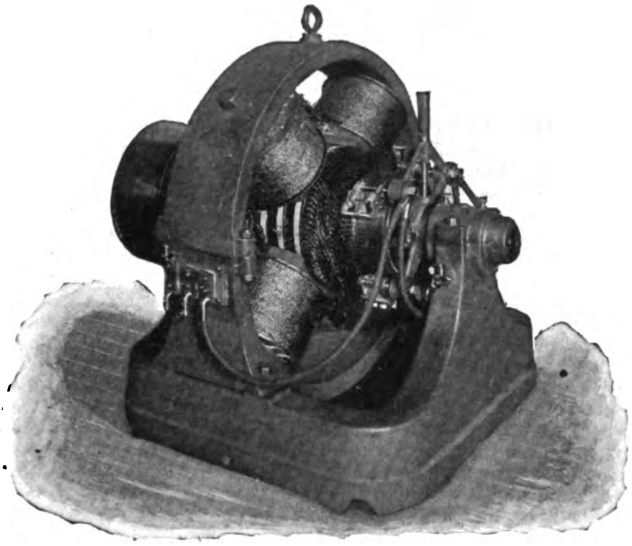


SLOW SPEED GENERATORS & MOTORS.

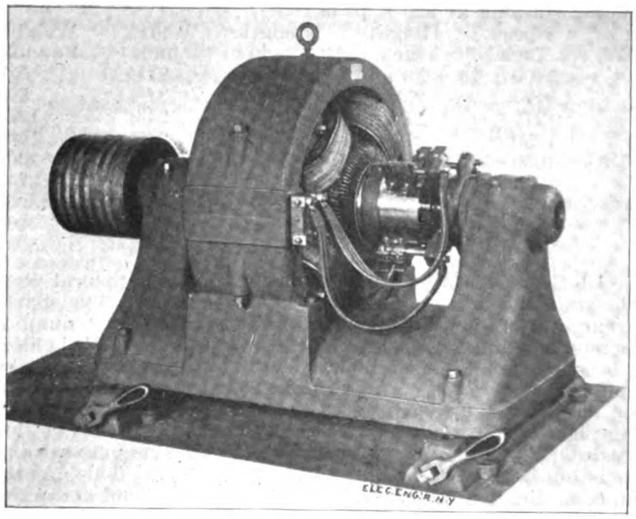
KILOWATTS.		7	9	13.5	17.5	22	33	40	60	80	100
HORSE POWER		9.4	12	18	23.5	29.6	44	53.5	80	107	134
HORSE POWER REQUIRED TO DRIVE AT PULLEY		10.9	13.7	20.2	26.3	32.8	47.5	58.5	87	116	144
HORSE POWER DELIVERED AT PULLEY. MOTOR		7.5	10	15	20	25	40	50	75	100	125
CAPACITY 55 WATT 16 C.P. LAMPS.		128	164	246	318	400	600	728	1088	1456	1820
AMPERES AT TERMINALS GEN.	110 VOLTS	64	82	123	159	200	300	364	544	728	910
	220 VOLTS	32	41	61.5	79.5	100	150	182	272	364	455
	500 VOLTS	14	18	27	35	44	66	82	120	160	200
AMPERES AT TERMINALS MOTOR.	110 VOLTS	65	84	125	161	202	303	368	548	733	916
	220 VOLTS	32.5	42	62.5	80.5	101	151.5	184	274	367	458
	500 VOLTS	14	18.5	27.5	35.5	44.5	66.5	83	121	161	201
SPEED ALL VOLTAGES GEN.		900	840	770	700	625	625	600	600	550	520
SPEED ALL VOLTAGES MOTOR.		810	765	700	640	600	590	570	570	520	490
PULLEY DIMENSIONS OF GENERATOR	A	13	14	18	20	22	24	25	28	32	33
	B	4	5	6	7	8	10	12	*12	*14	*16
	BORE	1½	1⅝	1⅞	2⅛	2⅜	2⅝	2⅞	3⅛	3⅜	4⅜
	KEY WAY	⅜	7/16	½	9/16	⅝	11/16	¾	⅞	1	1⅛
PULLEY DIMENSIONS OF MOTOR	A	11	12	13	16	18	20	22	26	32	33
	B	4	5	6	7	8	12	14	*14	*16	*18
	BORE	1½	1⅝	1⅞	2⅛	2⅜	2⅝	2⅞	3⅛	3⅜	4⅜
	KEY WAY	⅜	7/16	½	9/16	⅝	11/16	¾	⅞	1	1⅛
BELT SPEED GEN.		3060	3080	3620	3660	3600	3920	3920	4400	4600	4490
BELT SPEED MOTOR.		2330	2400	2380	2680	2820	3080	3280	3860	4360	4230
FLOOR SPACE GEN.	C.	35¼	37⅞	43 11/16	49¼	54 1/16	62⅝	68 11/16	76⅞	87⅛	95¾
	D.	27	27	30	34	34	41	44	51¾	55½	61
FLOOR SPACE MOTOR	C	35¼	37⅞	43 11/16	49¼	54 1/16	64⅝	70 11/16	78⅞	89⅛	97¾
	D	27	27	30	34	34	41	44	51¾	55½	61
WEIGHT	NET	1125	1250	1800	2200	2800	4000	4800	6800	9800	11000
	GROSS	1275	1400	1975	2400	3100	4300	5200	7200	9500	11600



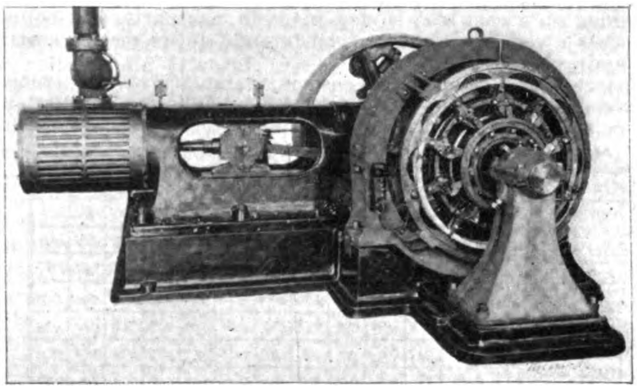
NORTHERN ELECTRIC CO. MOTOR.



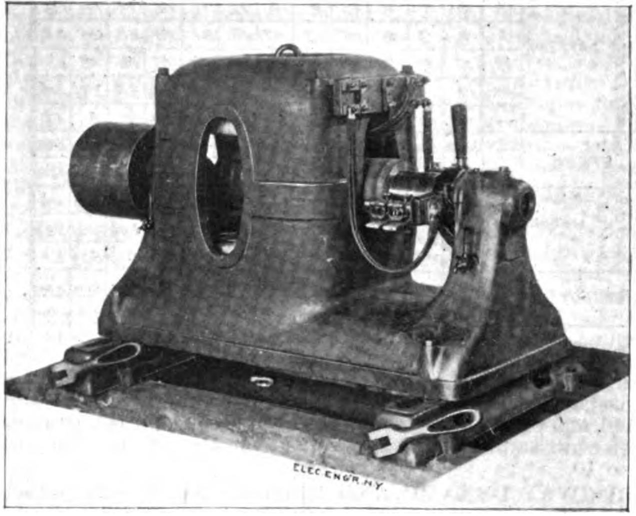
RIKER ELECTRIC MOTOR.



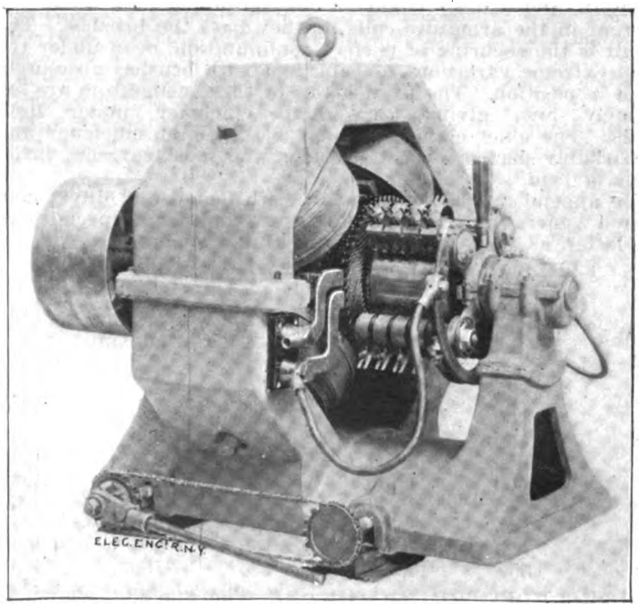
THRESHER ELECTRIC CO. DYNAMO.



RIDGWAY DYNAMO.



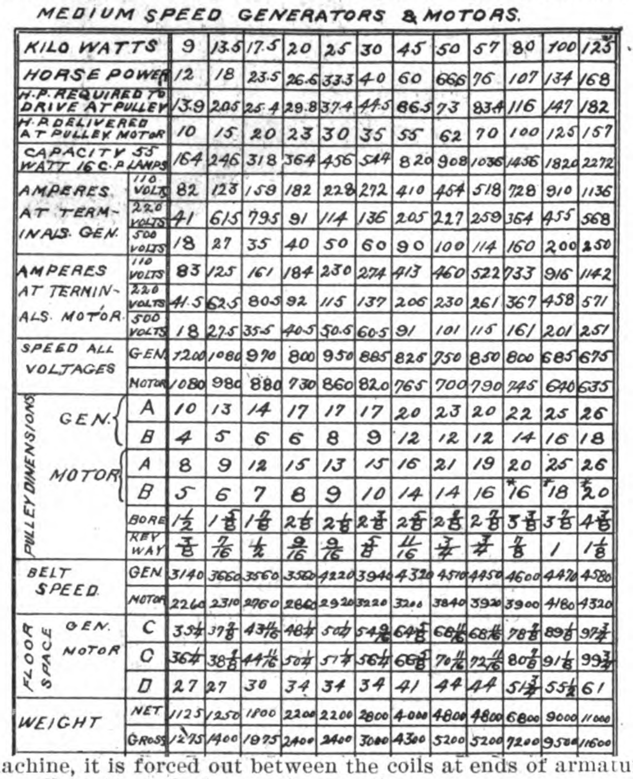
THRESHER IRON CLAD DYNAMO.



WESTERN ELECTRIC DYNAMO.

iron discs, separated at intervals by brass ventilators, is mounted on a cast iron spider, made in two parts, and bolted together after the core has been brought to its proper length by hydraulic pressure.

The change-of-plane-rings, cast on the spider, with openings between them and the flanges, provide means for ventilation; air being drawn from under the ring at the pulley end of the machine, it is forced out between the coils at ends of armature as well as through the openings in the core.



MEDIUM SPEED GENERATORS & MOTORS.

KILO WATTS		9	13.5	17.5	20	25	30	45	50	57	80	100	125
HORSE POWER		12	18	23.5	26.6	33.3	40	60	666	76	107	134	168
H. P. REQUIRED TO DRIVE AT PULLEY		13.9	20.5	25.4	29.8	37.4	44.5	86.5	73	83.4	116	147	182
H. P. DELIVERED AT PULLEY MOTOR		10	15	20	23	30	35	55	62	70	100	125	157
CAPACITY 55 WATT 16 C. P. LAMPS		164	246	318	364	456	544	820	908	1036	1456	1820	2272
AMPERES AT TERMINALS. GEN.	110 VOLTS	82	123	159	182	228	272	410	454	518	728	910	1136
	220 VOLTS	41	61.5	79.5	91	114	136	205	227	259	364	455	568
	500 VOLTS	18	27	35	40	50	60	90	100	114	160	200	250
AMPERES AT TERMINALS. MOTOR.	110 VOLTS	83	125	161	184	230	274	413	460	522	733	916	1142
	220 VOLTS	41.5	62.5	80.5	92	115	137	206	230	261	367	458	571
	500 VOLTS	18	27.5	35.5	40.5	50.5	60.5	91	101	115	161	201	251
SPEED ALL VOLTAGES	GEN.	1200	1080	970	800	950	885	825	750	850	800	685	675
	MOTOR	1080	980	880	730	860	820	765	700	790	745	640	635
PULLEY DIMENSIONS GEN.	A	10	13	14	17	17	17	20	23	20	22	25	26
	B	4	5	6	6	8	9	12	12	12	14	16	18
PULLEY DIMENSIONS MOTOR	A	8	9	12	15	13	15	16	21	19	20	25	26
	B	5	6	7	8	9	10	14	14	16	*16	†18	‡20
	BORE	1½	1⅝	1⅞	2⅛	2⅛	2⅜	2⅝	2⅞	2⅞	3⅜	3⅞	4⅜
	KEY WAY	⅜	7/16	½	9/16	9/16	⅝	11/16	¾	¾	⅞	1	1⅛
BELT SPEED	GEN.	3140	3660	3560	3560	4220	3940	4320	4510	4450	4600	4470	4580
	MOTOR	2260	2310	2760	2860	2920	3220	3200	3840	3920	3900	4180	4320
FLOOR SPACE GEN.	C	35¼	37⅞	43 11/16	48¼	50¼	54 9/16	64⅝	68 11/16	68 11/16	78⅞	89⅛	97¾
FLOOR SPACE MOTOR	C	36¼	38⅛	44 11/16	50¼	51¼	56¼	66⅝	70 11/16	72 11/16	80⅞	91⅛	99¾
	D	27	27	30	34	34	34	41	44	44	51¾	55½	61
WEIGHT	NET	1125	1250	1800	2200	2200	2800	4000	4800	4800	6800	9000	11000
	GROSS	1275	1400	1975	2400	2400	3000	4300	5200	5200	7200	9500	11600

As will be seen from the tables of sizes herewith, all machines have been designed to give their full rated capacities at 110, 220 or 500 volts, the generators being over-compounded 5 per cent. standard, but are wound for any other percentage up to 10.

RIDGWAY DYNAMO AND ENGINE CO.—The Thompson-Ryan dynamo, manufactured by this company, represents a radical departure from the general design of continuous current generators on the market. Its chief distinguishing feature is a bushing ring surrounding the armature and forming part of the magnetic circuit, and carrying coils connected in series with the armature. The chief office of these coils is to neutralize the distorting effects of armature reaction, and to produce an independent commutation field of variable strength, and exactly sufficient for the proper reversal of the current in the armature coils as they pass the brushes. The result is the securing of perfect commutation, even under the most extreme variations of load, and with brushes absolutely fixed in position. The fixed losses of these generators are extremely low, giving very high efficiency under light loads. The chief claim for them is their high efficiency and remarkably perfect operation under the most extreme variations of load.

We append a table of sizes, of both belted and direct connected generators, the manufacturers making a specialty of the latter, as they build both engines and generators.

TABLE OF THOMPSON-RYAN GENERATORS.

Belted.			Direct Connected.		
	Speed.	Weight.		Speed.	Weight.
K. W.	R. P. M.	Lbs.	K. W.	R. P. M.	Lbs.
10	1,000	950	10	350	1,450
15	800	1,300	15	325	1,700
20	700	1,800	20	325	1,900
30	650	2,150	30	300	2,300
40	650	2,450	40	300	3,500
60	600	3,400	50	275	4,000
80	600	4,350	60	275	4,600
100	550	4,850	75	260	5,450
120	550	5,750	100	250	7,800
150	525	7,800	150	200	11,500
200	500	10,500	200	180	14,200

RIKER ELECTRIC MOTOR CO.—The machine shown in the accompanying illustration is of cast steel with toothed armatures.

The armature cores of the smaller sizes are keyed to their shafts and the armature cores of the larger sizes are keyed to a spider secured to the shaft. The construction of this spider facilitates radiation and insures a cool running armature and machine. On all multipolar sizes former wound armature coils are used—giving an electrically and mechanically balanced armature. The field coils are wound upon thimbles with brass ends and are insulated with mica.

The brushes which are of carbon are held in position by a brush holder which feeds the brush automatically and always in the same line. The machines are so designed that the brushes do not require shifting from no load to full load.

The bearings are fitted with phosphor bronze bushings and oil rings. The latter dip into an oil well in each bearing pedestal and efficiently lubricate the shaft. The efficiency runs from 75 per cent. on the small bipolars to 95 per cent. on the larger multipolar machines.

The following table gives the capacity, sizes, etc., of the Riker machines:

TABLE OF RIKER DYNAMOS AND MOTORS.

Kilowatt.	Type.	R. P. M.	Inches Floor Space.
⅛	Bipolar.	1,900	9¾x6¾ in.
¼	"	1,800	12⅛x7½ "
½	"	1,700	15⅛x10 "
1	"	1,600	20 x12½"
2	"	1,500	24¼x15 "
3	"	1,400	30 x17½ "
5	"	1,300	32½x20 "
7½	"	1,200	37 x22½ "
3	Multipolar.	1,200	31 x21½ "
5	"	1,100	36 x22 "
10	"	1,000	38 x28 "
15	"	900	45 x29½ "
20	"	800	45 x34¼ "

THRESHER ELEC. CO.—The illustration shows the iron clad type B machine manufactured by this concern, in sizes from 1 to 30 kilowatts. Its principal features are its strength, simplicity and compactness, all the parts being interchangeable. Owing to its iron clad construction, it is of very high efficiency, the magnetic material being so placed as to correspond with the theoretical lines of magnetic force, thus reducing the leakage to a minimum. It is free from vibration, the center of gravity being very low, and the openings are so arranged that all parts are easily accessible and perfect ventilation is afforded. The bearings are self-oiling and self-centering and universally supported. The armature is exactly balanced and wound in such a manner that the coils of highest potential are farthest apart. One particularly noticeable feature is that the armature and field coils are entirely protected from moisture, dirt or abrasion. The speed is slow and the regulation perfectly automatic. These features are pointed out as making the machine especially desirable in isolated plants, where, as a rule, dynamos and motors receive very little care. Below are given capacity, speed, weights, etc., of the different sizes of these machines.

The company also manufacture belted multipolar machines (see illustration), from 30 to 150-kilowatt capacity and direct connected machines from 4½ to 150-kilowatt capacity. The latter are of the same general style as the belted machines, but run at a much lower speed, the 150-kilowatt machine, for example, running at 225 r. p. m.:

K. W.	Speed. inch.	Height. inch.	Length. inch.	Width. inch.	Weight. Pounds.
2	1600	19¾	29	21⅞	530
4	1475	23⅛	33½	21⅞	864
6	1275	27⅝	41	24¾	1225
9	1250	27⅝	41	24¾	1500
12	1050	30⅝	42⅜	23¾	2000
15	950	36⅝	49	33	3255
18	900	37⅝	49	33	3950
24	825	40⅞	54⅝	38¾	4660
30	775	42⅛	56⅝	38¾	5030

WALKER COMPANY.—The engraving gives a general view of the standard direct-connected Walker generator. The sparkless running of the Walker machine is secured by a number of ingenious points of design. First, that of the brush holder; the brushes have a most liberal contact in proportion to the amount of current they are required to carry and the commutator bars are sufficiently long to permit of enough brushes being placed upon them for the ready accomplishment of this requisite. The armature winding is exactly symmetrical and there is but one coil of wire per commutator bar. This greatly diminishes the self-induction of the commutator coil and practically eliminates the sparking due thereto.

The field poles are wound with absolute accuracy even to the fraction of a turn and as all of the coils are in series the magnetizing power of each is the same, thus preventing the sparking of individual sets of brushes. Lastly the field is so strong that it completely quells the armature reaction, but so well designed is its magnetic circuit that only a small percentage of magnetizing current is necessary. Prompt and accurate regulation is secured first by having an armature of extremely low resistance so that the range of magnetization in the field necessary to produce the appropriate change of voltage of the armature is very small; and, second, the use of laminated iron pole pieces which by their freedom from eddy currents allow any change in the magnetizing current to almost instantly establish itself. The field frame of the machine is of cast iron. The combined losses of the machine at full load are stated to be less than 5 per cent., thus giving an efficiency of 95 per cent. at full load.

WESTERN ELECTRIC CO.—The general type of this company's belt driven machines is shown in the accompanying engraving, the lower half of frame, the sub-base, and bearing pedestals for the 4-pole type being made in one casting, with the exception of the 17-kilowatt, which has a separate subbase. For all sizes less than 17-kilowatt capacity, the whole frame, including pole pieces, is made a part of one casting with the sub-base and bearing pedestals.

The armatures are of the iron-clad type, having copper bar conductors imbedded below the surface in insulating tubes, and, for the larger sized machines, are connected at the ends by spiral end connectors, there being no band wires used. The insulating tubes are made up of alternate layers of press board, oil paper, and mica, and are made to completely surround the conductor.

Special attention is given to the point of proper ventilation of the armature so as to prevent the accumulation of heat in any part as well as to prevent the general heating.

The field coils are machine wound on brass spools, making them interchangeable. The wire is insulated from the spools with press board and mica. The coils are thoroughly ventilated and are so mounted on pole pieces as to be perfectly insulated from the pole pieces and dynamo frame.

All brushes are of carbon and are so arranged in their respective holders that each one may be removed or adjusted independently while the dynamo is in operation, or all may be moved simultaneously about the commutator. The brush holders are so constructed as to force the brushes in the direction of rotation of the armature, thereby doing away with chattering. The brushes are clamped rigidly by their holders so that the current passes through clamped joints only and does not depend on any sliding contacts for a conductor. At the same time each brush is perfectly free to move, and is given tension on the commutator by a phosphor bronze spring. The tension spring is not depended upon for carrying current; therefore there is no possibility of its becoming heated and losing its elasticity.

These machines are built in sizes from ½ kilowatt to 250 kilowatts, the larger sizes having six and eight poles, depending upon the speed at which they are to be run.

The company's direct-driven dynamo follows the constructive details of the belt-driven machines quite closely. It is built in capacities from 5 to 500 kilowatts and from 120 to 550 volts.

V. ALTERNATING GENERATORS.

ALTHOUGH a later arrival on the scene of heavy electrical engineering work, the alternator has more than held its own alongside of its older brother. The efficiency of alternators, at first somewhat inferior to that of the direct current machine, is now fully abreast of it. In addition to the single phase the two and three-phase generators have been reduced to standards and not a little of the work of the future may be expected to be done with these types.

IDEAL ELEC. CO.—The toothed armature of this company's La Roche alternator is built up of the best quality of Norway iron, well laminated and ventilated, the plates being separated by a specially prepared paper. The coils, which are well taped and insulated from the core with mica, are easily put in place and removed, as required, and are entirely below the surface of the armature where they cannot possible be injured. The ends of the coils are furthermore protected by an ornamental brass shield, which, besides giving the armature a handsome appearance, improves the ventilation. The coils are so connected that the e. m. f. between adjacent coils is reduced to a minimum.

The fields are of the separable ring type and the field magnets are readily detachable, being held in place by an improved locking device. The bearings are of the self-aligning and self-lubricating type, and are of large size to ensure cool and smooth running.

The Ideal Electric Co. also manufacture multiphase machines as well as machines of any frequency. These machines are either simple shunt, compound wound, or entirely self-exciting, as may be desired. This company also build a small line of alternators and has recently made a specialty of alternators for college and scientific uses. The commercial machines range in size from 2 kilowatts to 500 kilowatts. The machines used for laboratory, school and scientific purposes, range from 2 to 10 kilowatts.

FORT WAYNE ELECTRIC CORP.—This company's Wood alternator connected with exciter is shown in the engraving on this page. It represents their low frequency machine of 150 kilowatts, wound for 1,000 or 2,000 volts, and running at 450 r. p. m.

GENERAL ELECTRIC CO.—The accompanying illustration shows this company's 32-pole, 250-kilowatt monocyclic generator running at speed of 470 r. p. m. and serves to illustrate the general construction of the smaller sizes of this type.

NATIONAL ELECTRIC CO.—This company's new line of alternators are designed for a frequency of 125 periods per second, and operate at speeds from 1,500 r. p. m., for the smallest size, which is of 500 lights capacity, to 1,050 r. p. m. for the 2,500-light size. These machines are constructed with laminated steel pole pieces cast in the field ring. The armature is of the iron clad toothed type with removable coils. The coils are machine wound in standard forms and are finished up complete and tested before being applied to the armature core. The armature core is built up in the usual manner of thin sheet steel discs supported on a hollow spider. The discs are punched with slots of a particular shape which line up longitudinally when the discs are assembled and form recesses in the core for receiving the armature coils. The armature core is divided into sections perpendicular to the axis of the shaft, distance pieces being provided to preserve fixed distances between the sections. These spaces between the sections of the core serve the two-fold purpose of receiving the metal links which hold the coils and of providing air channels for ventilation.

The coils are easily slipped in place on the core without driving, bending or wedging. They are held in place by means of aluminum-bronze links, or retaining pieces, which have the shape of an inverted U. At the end of the armature finish rings are attached for the purpose of covering and holding down the ends of the coils and to give the whole a neat appearance.

These generators are provided with multipolar iron clad direct,connected exciters attached to the main dynamo frame. The alternators are compounded so as to maintain a constant potential or to develop any desired percentage of increase in voltage proportionately with the load.

THE ROYAL ELECTRIC CO.'S alternator is an inductor dynamo. The dynamo is provided with a single field magnet core, closely surrounded by a single exciting coil. In its complete state the exciting coil is invisible, being covered by the projecting pole pieces of the field magnet, which embrace the armature blocks on which two sets of armature coils are mounted.

The machines are built in sizes of 500, 650, 750, 1,000, 1,250, 1,500 and 2,000 lights. The standard pressures are 1,000 or 2,000 volts. They are adapted to be connected from 100 to 2,000 volts, but the lower pressures require special connections.

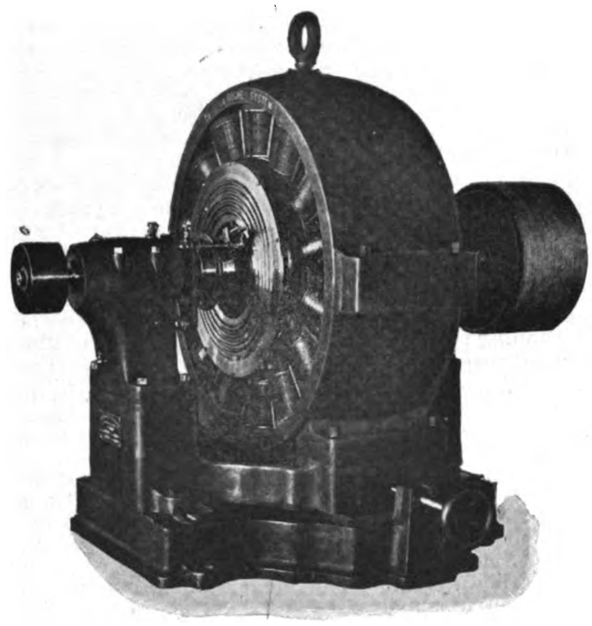
The table below gives the approximate floor space, weight and speed of the dynamos:

Capacity in 16-c.-p. lights.	Speed. R. P. M.	Floor Space in inches.	Approx. wt. in pounds.
500	1100	41 x 62	3000
650	1100	41 x 67	3400
750	1100	45 x 72	4000
1000	950	48 x 80	6000
1250	860	48 x 86	7200
1500	860	56 x 92	8500
2000	800	56 x 98	10000

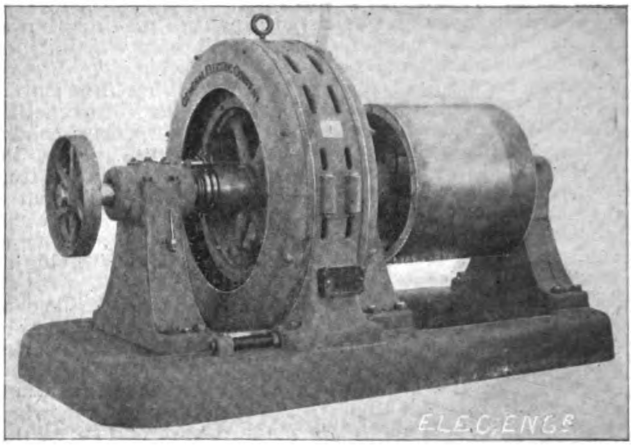
The smaller machines have an efficiency of 93 per cent. at full load, and the larger ones 95 per cent. Owing to the more than ample cross section of conductors as compared to the current they carry, the heating is below that required in the most stringent of specifications. The magnetic density is kept very low.

This special type of machine has a particular wave form factor, which reduces the transformer core losses.

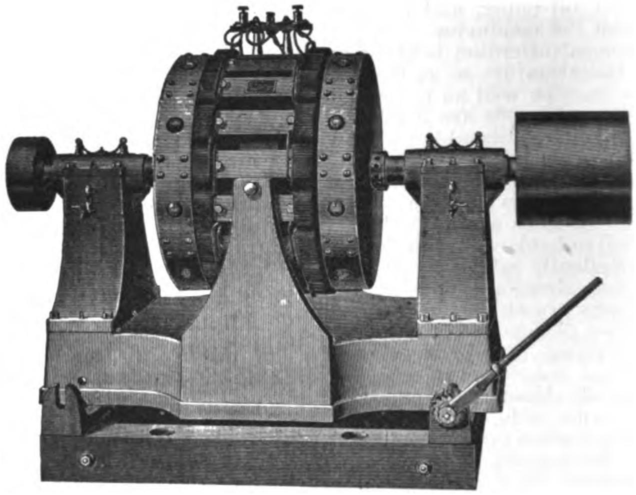
STANLEY ELECTRIC MANUFACTURING CO.—The S. K. C. generators of this company are built for operation either as two phase or three phase machines and by slight modification can be designed for operation as single phase machines. The generator has no moving wire and consequently no collector rings, commutators or brushes. In gaining these points nothing is sacrificed in electrical properties. The armature is stationary and split vertically so that either half of the armature



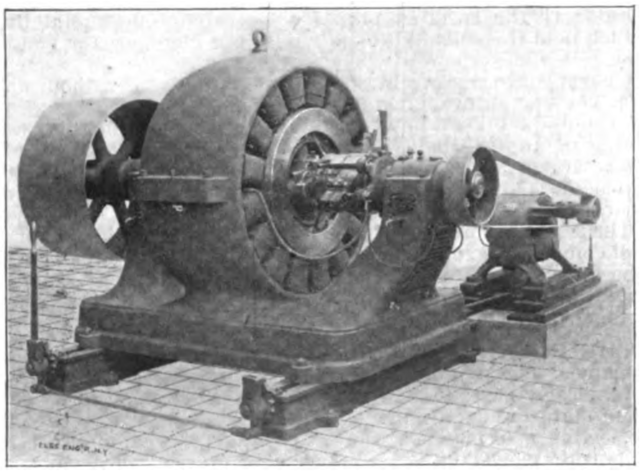
La Roche Alternator.



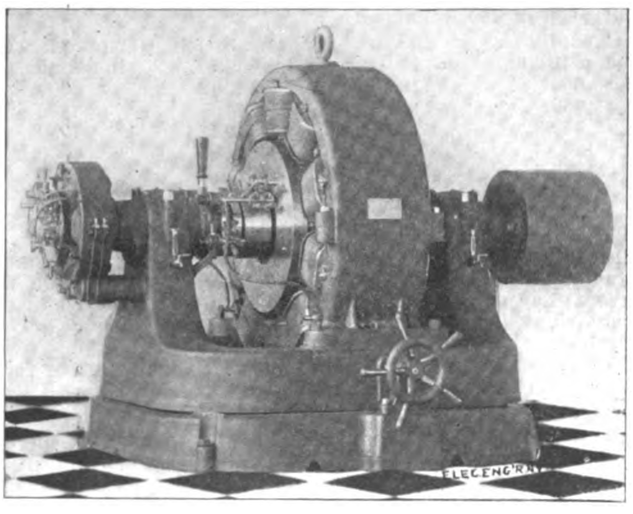
General Electric Monocyclic Alternator.



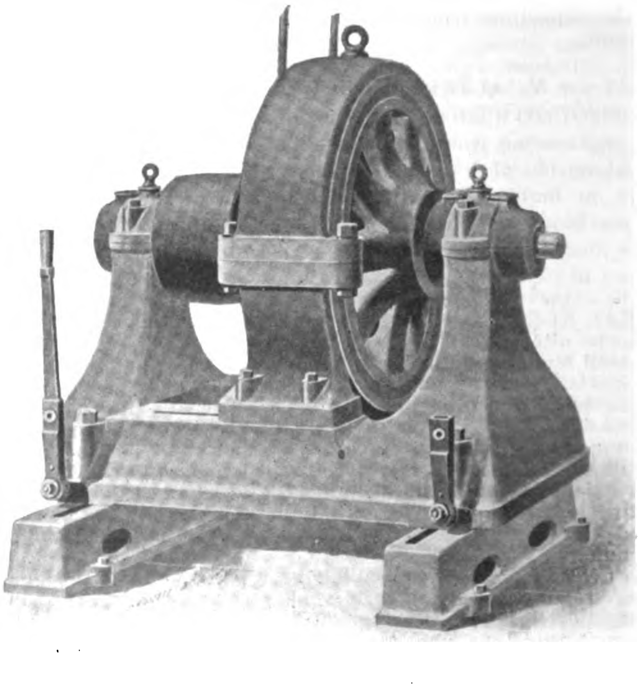
Royal Electric Co. Alternator.



Fort Wayne-Wood Alternator.



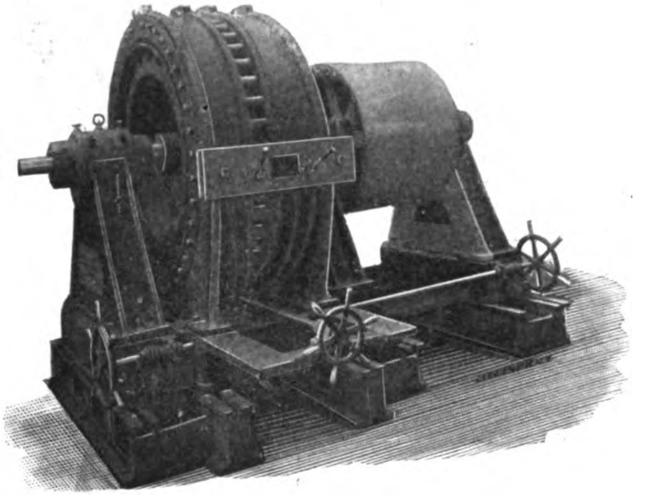
National Electric Co. Alternator.



Walker Inductor Alternator.

can be drawn back a sufficient distance to allow access to the coils. The field coil is stationary and is supported by the armature frame. The revolving part, or inductor, corresponds to what might be called the core of the field in the older types of alternating current generators. Proper devices are attached to the machine for drawing back the two halves of the armature and for shifting the machine as a whole upon its bed frame. The bearings are self-aligning and of the self-oiling ring type.

All wires from the generator are brought to a marble terminal board attached to the side of the generator. On this marble board are provided terminals for connection with the line or switchboard and also two regulator heads by means of which the effective length of armature wire of each phase can be increased or diminished through considerable latitude, thus allowing each phase to be regulated independently. The inherent regulation of these generators is very close and the efficiency high. The generator is exceedingly simple, the bearings being the only part of the machine subject in any way to wear.



S. K. C. Inductor Alternator.

WALKER ALTERNATOR.—This machine is of the inductor type and having been described in detail in a recent issue of the Engineer, an exhaustive description is not necessary. The machine has no moving wire, the rotor consisting of a pair of discs with projecting iron spokes, the ends of which are laminated. A single field coil serves to excite them and they distribute their magnetization to the coils of the armature, which is also stationary. The armature teeth are so arranged that it is a matter of but an hour's work to remove all the coils and replace them with either a two or three phase winding and any system of connection can be easily obtained. Like the direct current generators, the stationary portion of the Walker generator can be slid sidewise over the pulley, thus exposing all of its windings to ready inspection or repair.

WESTINGHOUSE ELECTRIC AND MANUFACTURING Co.—The company's two-phase generator of 75 kilowatt capacity, runs at 300 r. p. m. This particular machine delivers current at a potential of 440 volts and a frequency of 60 cycles per second, or 7,200 alternations per minute.

III.—ARC DYNAMOS.

THE most marked improvement which the standard arc machines of to-day exhibit is their excellent regulating qualities and their high insulation. It is this latter fact that has made it possible to construct machines operating 150 full arc lights of 2,000 candle power nominal, and machines of still greater capacity are in course of cosntruction, a 300-lighter being actually on the tapis.

BRUSH ELECTRIC CO.—While the general type of the dynamo is the same as the early dynamos, yet great improvements have been made, and they are modern in all respects. Their efficiency is at least 15 per cent. above the original machines. The mechanical features have received special attention. The dynamos can be very quickly and easily taken apart, so that the removal of an armature, field magnets and other parts of the machine is a matter of a few moments. Any one armature coil can be repaired without disturbing any of the others. The regulator attached to the machine itself, is belted to the shaft. Magnetic clutches control the shifting of the brushes and at the same time throw resistances into and out of the circuit as needed. The wall controller in connection with the regulator ensures perfect regulation of the current.

The 80, 100 and 125 lighters have been the most popular of these machines. Others of much larger capacity are being designed. When these are completed, the Brush Company will have about eight modern improved Brush arc dynamos, each of a different capacity, and ranging from 50 lights up to 300 lights.

The question of high potential is an exceedingly interesting and important one in connection with these large arc dynamos. The demand for large dynamos and the objection to very high potential on the lines, led to the necessity of some method permitting of the former, and solving the latter problem. Mr. C. M. Green, one of the electrical engineers of the Brush Company, solved the problem by designing what is now known as the Brush multi-circuit arc dynamo. The circuit of the dynamo may be divided into two or more separate circuits. The greatest potential around the interior circuit of the dynamo and the exterior or lamp circuit will be that of the greater circuit. The arc lamps may be divided equally on two or more circuits, or they may be divided with any number of lamps on any one circuit, provided the total number of lamps does not exceed the total capacity of the machine.

The most popular of these multi-circuit dynamos have been those with two circuits of 62 lights (about 3,100 volts) each, on the dynamos of 125 lights capacity. These have been used largely for central stations. In isolated plants, the 125-arc light dynamos, divided into three circuits of 42 lights or about 2,000 volts, have been the most popular.

The advantages of these large arc dynamos with the multi-circuit arrangement are numerous. They effect saving in floor space, engines, cost of attendance, oil, belts, flexibility in the handling of circuits, use of large units with corresponding increase in efficiency and reduction of high voltages on the circuits.

EXCELSIOR ELEC. CO.—This company's arc light generator consists of two field cores connected by a cast-iron yoke at one end, and provided with pole pieces at the other, which encircle the armature on three sides. The armature is so placed that its shaft rests in bearings which are on the interior of the machine, so that the armature can be entirely exposed. This is facilitated by the pole pieces, which are hinged, and which can be turned out so as to expose the armature completely, and allow it to be drawn out a sufficient distance for thorough repair, if necessary, without removing the shaft from the journal bearings.

The regulation is effected by shifting the brushes in conjunction with a regulating resistance, both of which are simultaneously operated by a small auxiliary motor. This motor, which is entirely hidden from view, is situated in the hub-like projection bearing on the arms which span the two pole pieces beside the end of the armature shaft, and which might be mistaken, except on closer scrutiny, for the bearing of the shaft. This small motor is fixed in a magnetic field, which is produced by attaching the cast iron arms shown to each pole piece and bringing them together so as to surround the armature of the small motor.

The machines are built in sizes from 15 lights up to 150 of 2,000 candle power, taking 9.6 amperes, and up to 200 lights, 1,200 candle power on 6.8 amperes.

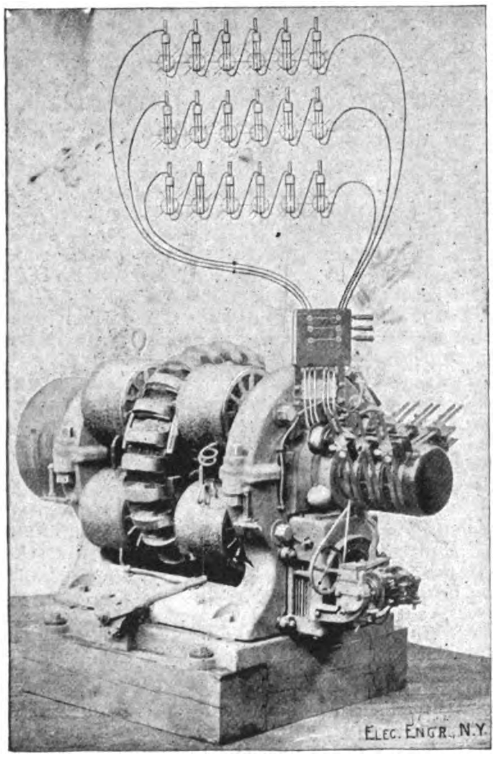
WALKER ARC MACHINE.—The Walker Co. are in possession of a number of patents on arc lighting and an arc machine is in progress of construction. It is expected to construct larger units in its arc lighting than have heretofore been supposed to be possible.

WESTERN ELEC. CO.—This company's arc machine is of the bipolar, horseshoe type, with the magnets horizontal. The magnet cores are made of wrought iron and the pole pieces and yokes of cast iron. The bearings are of the self-oiling and self-aligning type, being provided with visual oil gauge and drain.

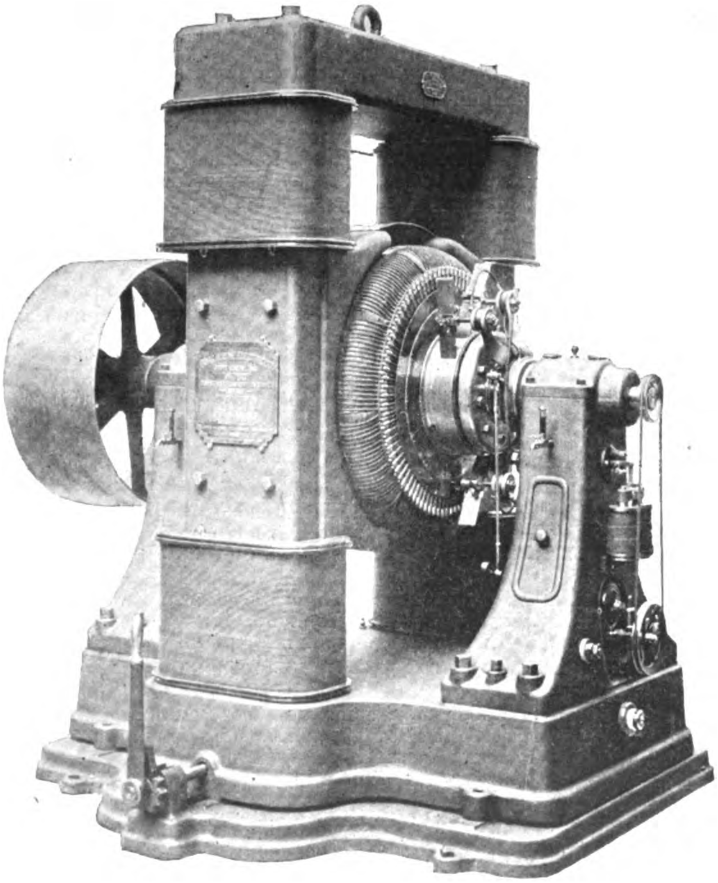
With the construction adopted, the removal of the armature for examination or repairs is a very simple matter. The bearing may be removed in about five minutes, the pulley in three, and the commutator in ten. The average time taken for one man and helper to wind an armature coil for an 80-light machine is fifty minutes, this armature being of average size.

The armature is of the iron clad type and particular attention has been paid to the insulation and ventilation.

On the yoke of the machine shown is mounted a pair of reducing switches which cut out part of the field winding. The lower switch is for the purpose of adjustment so that there is very little liability of flashing the machine when it is operating under extremely variable loads. The other switch is for the purpose of reducing the current output of the dynamo so that if it is desired to run the machint part of the time at a lower current than its normal amperage, this switch can be closed and the regulator adjusted to the lower current. In this way considerable fuel can be saved when it is not necessary to run the lights at full brilliancy.

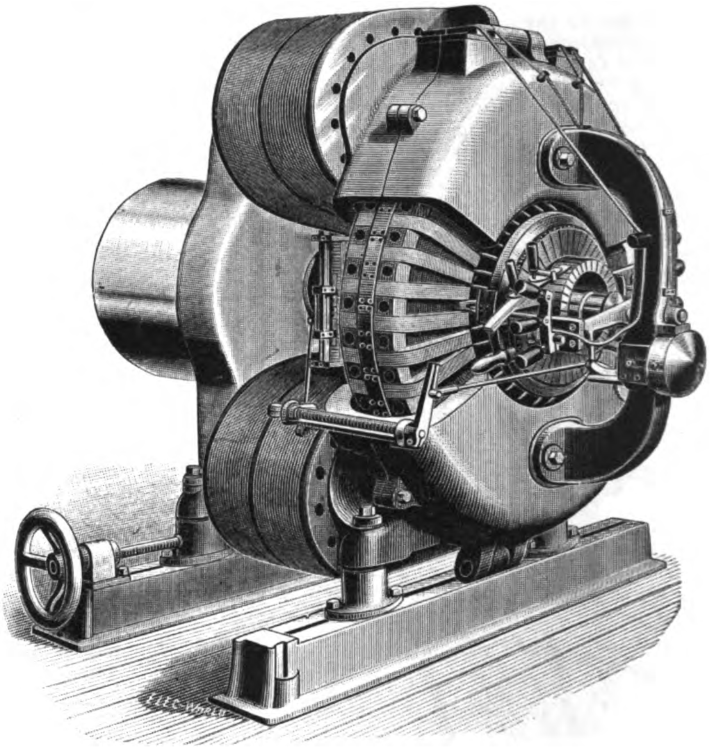


BRUSH ARC DYNAMO.

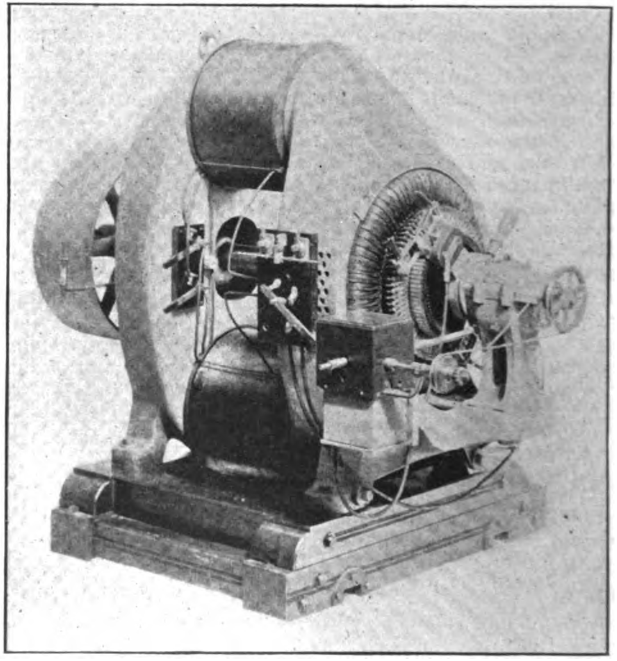


FORT WAYNE ARC DYNAMO.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.—The company's 75-light direct current series arc machine is of the open coil type, delivering a unidirectional though not an absolutely continuous current. It is claimed that the open coil dynamo, with its pulsating orm of current, is particularly well adapted for arc lighting, as the pulsating effect, while giving a steady mean value to the current, causes a very slight but constant vibration in the mechanism of the lamps, thereby reducing the chance of sticking, or failure to feed, to the minimum. The company have introduced a decided novelty here, however, by using a two-phase armature, the current of course being commutated. The resulting direct current seems to adapt itself practically to all forms of series arc lamps in use.



EXCELSIOR ARC DYNAMO.



WESTERN ELECTRIC ARC DYNAMO.

The armature is made of high grade laminated steel sheets, punched with "T" shaped teeth at the periphery. The armature coils are wound on molds with great care, are very thoroughly insulated and tested independently; afterwards being mounted on the armature teeth, where they are held in place by wooden wedges, dove-tailed in. This is the same form of armature that is employed by the company in their alternating current incandescent generators. There is no wire on the outside of the armature, which can be handled, or even rolled upon the floor, without fear of damage to the winding. The commutator segments have seldom to be renewed, but are readily replaceable when worn out. By the use of the two-phase current above referred to it has been possible to produce a direct current on the open coil form of dynamo which does not yield vicious sparking at the commutator.

This machine regulates its current with great nicety, simply by the reaction between the armature and the field, without the introduction of any wall regulating devices whatever. Once adjusted for a given current, the dynamo will maintain this current under considerable fluctuations of speed and wide changes of load. In addition to this fact, should it be desired to reduce the current to any point below its normal amount, this can be done by an adjustment of the field current, and the dynamo will maintain the same close regulation at the reduced current as at its normal current.

A small direct current machine furnishing a 100-volt current is employed to excite the fields, which are therefore free from chances of grounds.

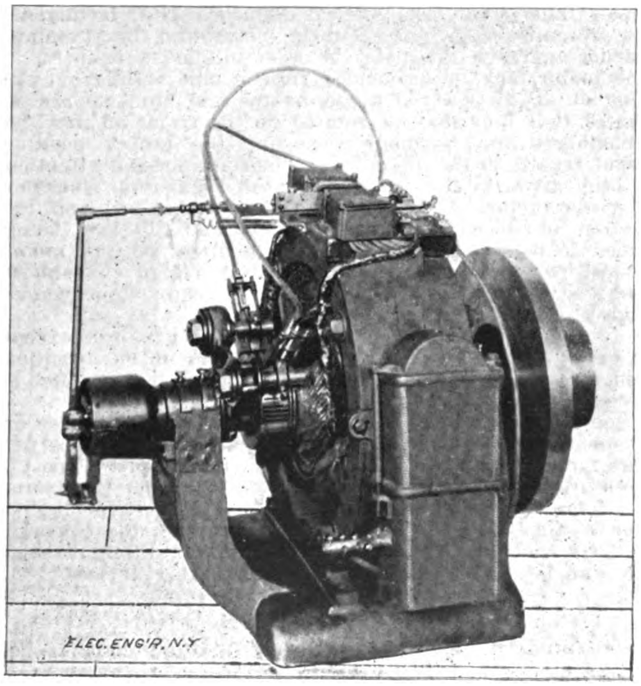
These machines are built in capacities from 40 to 75 lights.

FORT WAYNE ELECTRIC CORP.—This company's Wood arc generator has reached a high state of development. Its automatic regulator, in connection with the variable double-brush contact, effect a remarkable regulation of current even under the greatest fluctuations.

ALTERNATING MOTORS.

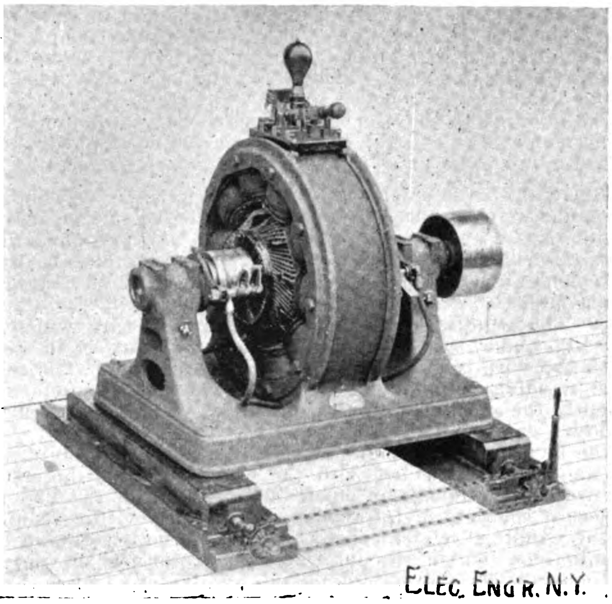
THOUGH the number of types of alternating motors is small, they present an interesting exhibit of the methods employed for solving one of the most difficult problems that has ever been presented to the electrical engineer. It may fairly be claimed that the main difficulties have been conquered, though the straight out-and-out, non-synchronous single-phase alternating motor has still to make its appearance.

EXCELSIOR ELECTRIC CO.—This company's new Churchward motor is a single-phase machine. It is provided with an automatic synchronizing switch and operates on 25 to 150 cycles per minute.



Excelsior Electric Churchward Single-Phase Alternating Motor.

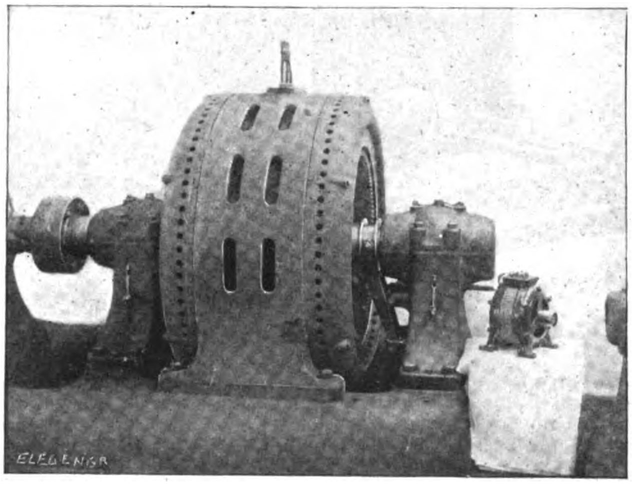
FORT WAYNE ELECTRIC CORP.—The armature of this motor is of the ring type, and carries two windings, one a distributed winding, wound in the teeth on the periphery and connected to a commutator which is placed on one end of the shaft; the other winding is a concentrated one, having as many coils as there are field poles, and connected to two collectors at the other end of the shaft. The fields are laminated. The machine runs as a simple continuous current series motor at the start, and hence with full torque. When synchronism is reached, the switch at the top is thrown and the machine then operates as a synchronous single-phase motor.



Fort Wayne Single-Phase Alternating Motor.

GENERAL ELECTRIC CO.—The General Electric Company now manufacture a complete line of three-phase and single-phase induction motors for 60 cycle and 125 cycle circuits. The three-phase motors can also be wound as two-phase machines, with only minor changes.

In all of these motors the construction is simple and substantial. Both the armature and the stationary field are of the iron-clad type, wound with machine-formed interchangeable coils. The field windings are covered at their ends by shields which protect them from dirt and mechanical injury. Both armature and field cores are thoroughly ventilated to insure cool operation. The bearings are spherical-seated, self-aligning and self-oiling, and the pillow blocks are cast in one with the base.



General Electric 3-Phase Motor.

In all but the smallest sizes, a self-contained starting resistance is used to secure good starting torque with a small amount of current. With this construction there are no moving contacts, a simple device consisting of a movable sleeve and stationary contact points being used for short-circuiting the starting resistance when the motor has reached its speed. In the smaller sizes, where a large starting torque is not required, no starting resistance is used.

The three-phase motors for 60 cycles are made in sizes ranging from 1 to 150 horse-power, the illustration showing a 100 horse-power motor of this type. They are wound for 110, 220 and 550 volts, and the 50 horse-power and larger sizes can also be wound for 1,040 or 2,080 volts.

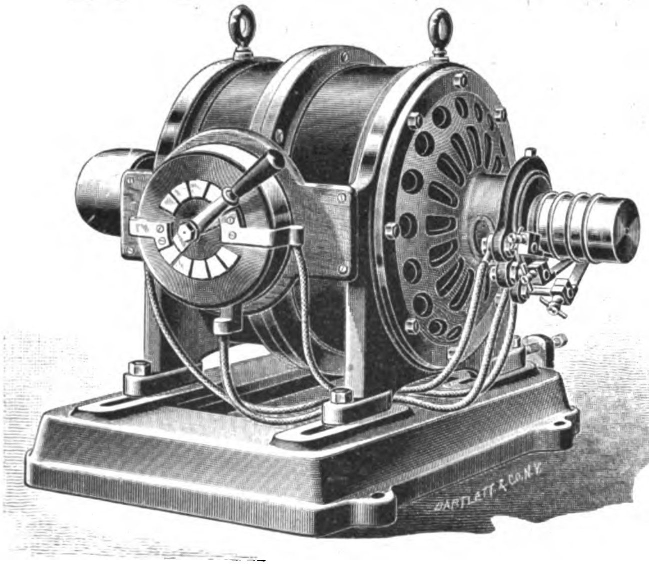
For 125 cycles, three-phase motors are made in sizes ranging from 1 to 20 horse-power, and single-phase from 1 to 15 horse-power, and are wound only for 104 volts. These latter require a starting box which is cut out of circuit when the motor comes up to speed.

The illustration shows a ¼ horse-power special motor of this type, which has been placed beside the 100 horse-power three-phase motor in order to compare their respective sizes.

STANLEY ELECTRIC MANUFACTURING CO.—The S. K. C. motor may be best described as consisting of two parts, a motor proper and a rotating transformer, the two parts alternately exchanging their functions. It consists electrically of two fields, which are fed by currents differing 90 degrees in phase, and two armatures, although mechanically there is but one. The winding is so connected that the wire which lies directly under the field poles on one armature is in series with the wire lying between poles on the other. The armature winding is not connected with the circuit, and consequently the only current flowing in it is an induced current of low e. m. f.

The field coils are wound separately and are the only parts of the motor connected with the circuit. These motors are all wound for operation upon 500 volts e. m. f. The pole pieces of the field of the motor are provided with a "compensating winding," which consists of short-circuited coils of high conductivity which are placed in the motor for the purpose of neutralizing the self-induction of the armature. These motors have a starting torque which varies from 50 per cent. to 200 per cent. greater than the running torque of the motor.

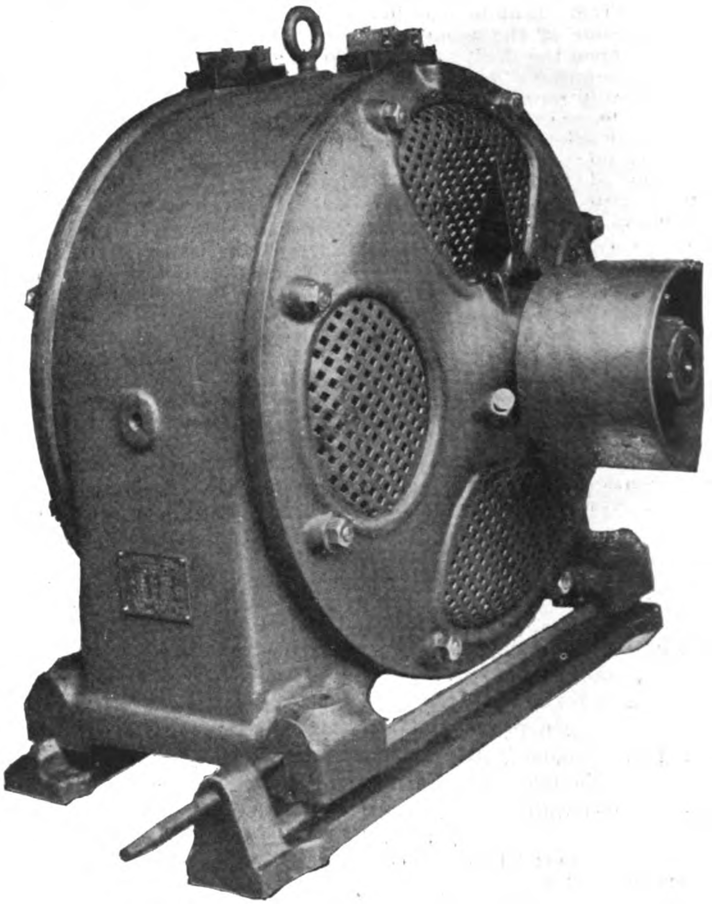
The unique and striking feature of this motor is the use of a condenser, the function of which is to make the motor take a current in proportion to its load, substantially as direct current motors do. The condenser is connected in multiple with the field winding of the motor, and when so placed supplies the lagging component of the current, or, in other words, the false current. The motor is provided with self-oiling bearings, and is substantially built so that when in operation it requires no attention, except to see that the self-oiling bearings are properly supplied with lubricant.


BARTLETT & CO. N.Y.

S. K. C. 2-Phase Alternating Motor.

WESTINGHOUSE ELECTRIC MANUFACTURING COMPANY.—The latest form of Tesla polyphase induction motors manufactured by the Westinghouse Company is illustrated herewith. The machine is reduced to the simplest possible form and consists of a stationary primary, the winding of which is permanently connected to the main circuit by means of the terminals shown on the top of frame, and a revolving secondary, the winding of which is purposely short-circuited, and consequently no accidental short-circuit can possibly cause any damage. The construction is also practically indestructible from heating, raising of coils or mechanical injury in handling.

The housing consists of a cylindrical frame of cast iron in which the primary is mounted and which forms a base for the machine, and also supports the two end brackets carrying the self-oiling bearings. Perforated plates fitted into these brackets both protect the rotating element and permit excellent ventilation. It will be noted that the housing completely encloses the primary and secondary elements, and protects them from any external damage. The starting devices are entirely separate from the motor, and the attendant need not approach the motor in order to start or stop it.



Latest Westinghouse Tesla Alternating Motor.

The motor may be suspended from a side wall, from the ceiling or at any desired angle, as the end brackets are so mounted that they may be rotated on the frame so that the oil chambers may be made to assume the proper position without regard to the angle of suspension. Special attention has been given in the design, to speed regulation, efficiency and power factor. The motor is self-starting at full load, the variation of speed between no load and full load being claimed to be less than that found in direct current motor practice. The efficiency is maintained at a high and almost constant value from full load to one-half load. This secures a high all-day or average efficiency.

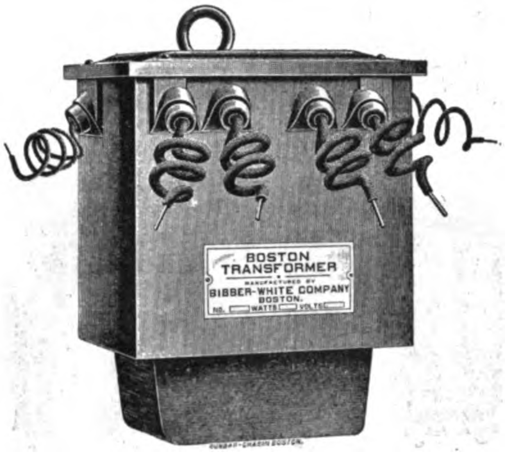
As there are no sliding contacts or friction whatever except that of the journals in the bearings, the amount of attention required is exceedingly small and the cost of maintenance is reduced to a minimum.

"Type C" constant speed motors are built for two-phase or three-phase circuits, for 7,200, 3,600 or 3,000 alternations per minute; and in capacities from 1 horse-power up. "Type C" motors are also designed for a variable speed, for the operation of cranes, elevators, hoists, etc. The variable speed motor is almost identical in construction with the constant speed type, but is especially designed to give a different speed curve and is supplied with suitable regulating devices.

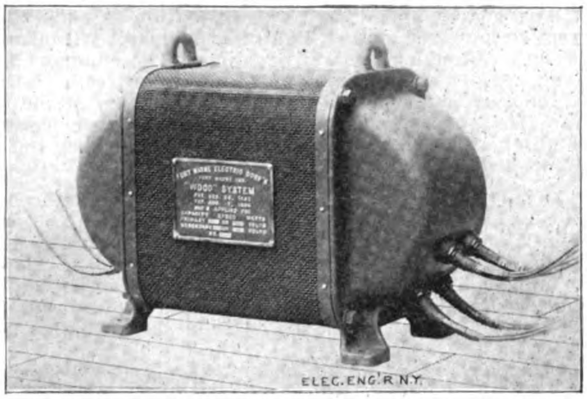
V.—TRANSFORMERS.

THE standard transformer of to-day may lay claim to being among the most efficient apparatus for converting energy in existence, albeit the conversion in the present case involves only a change in potential. The efforts of manufacturers have been largely concentrated on securing the highest possible all-day efficiency, rather than a maximum full-load efficiency. Soft steel properly "aged" has become to be the recognized material of construction of the core.

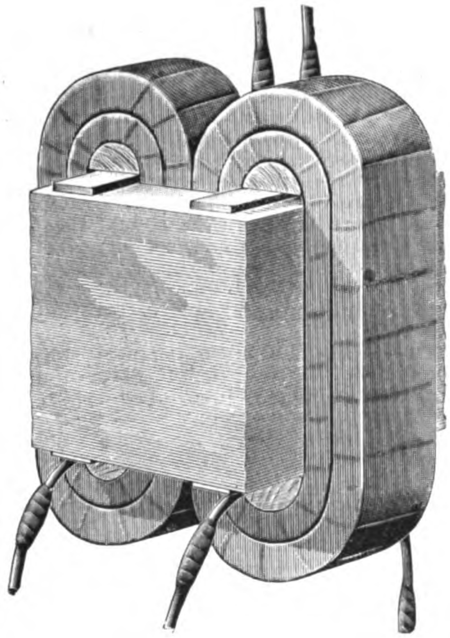
BIBBER-WHITE CO.—In this company's "Boston" trans-



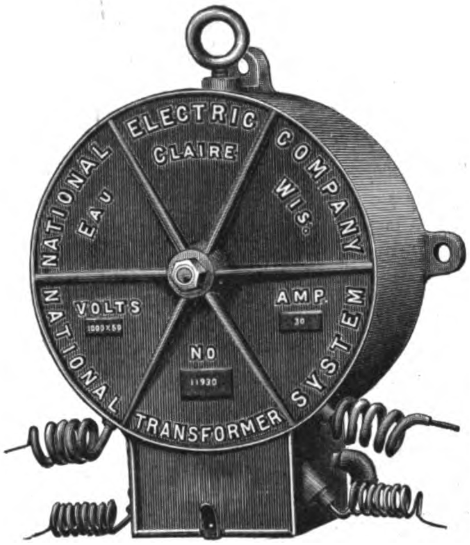
THE "BOSTON" TRANSFORMER.



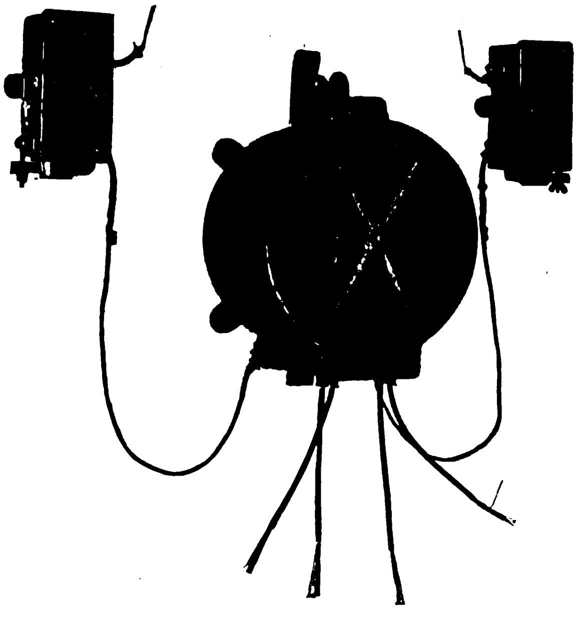
FORT WAYNE TRANSFORMER.



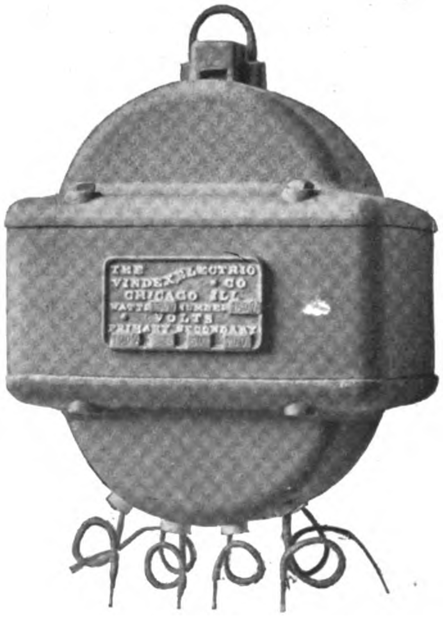
DIAMOND TRANSFORMER.



NATIONAL ELECTRIC CO. TRANSFORMER.



PACKARD TRANSFORMER



VINDEX TRANSFORMER.

former high efficiency and close regulation have been the features particularly aimed at. The insulation is such that a two year's guarantee against lightning is given. All terminals are brought through porcelain bushings. The company advocate the complete separation of transformer from the fuse box. Each transformer is furnished with two single pole, separate fuse boxes, made with removable fuse contacts, which automatically switch off the main circuit when the fuse box is opened.

DIAMOND ELECTRIC CO.—The Scheffer transformer is of the core type, and the coils are divided, making the points of potential far apart, and the danger of current cutting across less than when one coil is used. The ventilation in this type is also enhanced, the copper being thoroughly ventilated. This type is also claimed to be lighter for the same out-put than that of the shell type. Below is a table of sizes, weights, etc.

Watts	Lights	Watts on open secondary at 50 or 100 volts.	Weights	Full load efficiency	Regulation
500	10	20 to 23	49 lbs.	94.4	2%
1,000	20	20 to 24	87 lbs.	95.1	2%
1,250	25	22 to 27	93 lbs.	95.2	2%
1,500	30	30 to 33	98 lbs.	95.6	2%
3,750	75	50 to 60	150 lbs.	96.5	2%
5,000	100	50 to 65	202 lbs.	97.	2%
7,500	150	70 to 80	300 lbs.	98.	2%

FORT WAYNE ELECTRIC CORP.—This company's Wood transformer is shown in the illustration which represents their 37,500 watt transformer.

NEW YORK & OHIO CO.—The Packard transformer, made by this company, is distinguished by a circular coil, the primary and secondary being wound on a vulcabeston spool. The insulating material used in winding is a compound which makes the finished coil a compact mass, impervious to moisture, heat, over-load and lightning. The iron discs used on this coil have but one break in their circuit, making in this way a very perfect magnetic circuit.

The following table gives a very fair average of the efficiency and regulation of the Packard transformer.

The two latest types are type "G" and type "O." The type "G" is provided with self-contained fuse boxes of the single pole type, one on each side of the box, the plugs being very accessible from the outside. This type has also a changing block which can easily be gotten at by taking off the lid, by means of which the secondary connections are readily made for 100 or 50 volts as may be desired. This type can either be supported by the usual hanging straps or by bolting the same to cross arms through the lugs.

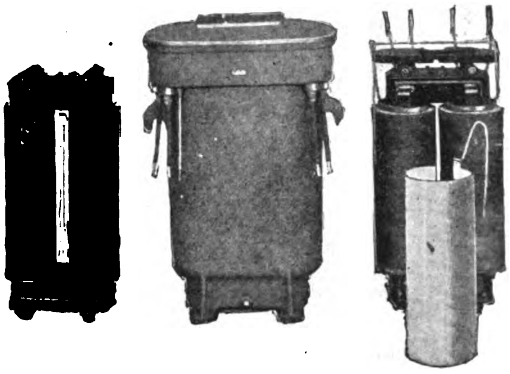
The type "O" transformer has been brought out on account of the increased demand for high potential transformers. The interior construction is practically the same as that of type "G," the change in shape having been made to secure better ventilation. There is a constant current of air passing around the outside edges of the inside of the case, and to this are exposed the iron discs of the transformer, which are not closely packed, but present a large radiating surface. The air space between the radiating discs also serves as a perfect insulator and prevents increased iron loss through ageing. Single pole fuse boxes are used in connection with this type and all secondary connections are readily made outside the box, the four secondary wires making possible either 50 or 100 volts, or 100 or 200 volts as desired. The hanging device is very simple, consisting of a single strap which can be bolted by means of lag screws to a cross arm or other support; the transformer case is provided with two eye bolts, one of which can be used in hoisting and into the other the hook of the hanging strap fits.

TABLE OF PACKARD TRANSFORMERS.

Capacity watts	500	1,500	2,500	5,000	10,000
Lights	10	30	50	100	200
Full load	92.7	95.9	96.1	96.9	97.0
¾ load	90.6	94.2	95.2	96.2	96.4
½ load	87.9	92.5	92.9	95.2	95.5
¼ load	82.9	90.1	90.8	91.4	92.5
Drop in volts at full load	2.1%	2%	1.8%	1.4%	1.5%
Iron loss in watts open sec.	21	40	61	89	120
Weight complete (lbs.)	48	101	142	241	503

Larger sizes show slight increase in efficiency over the above 200 light test.

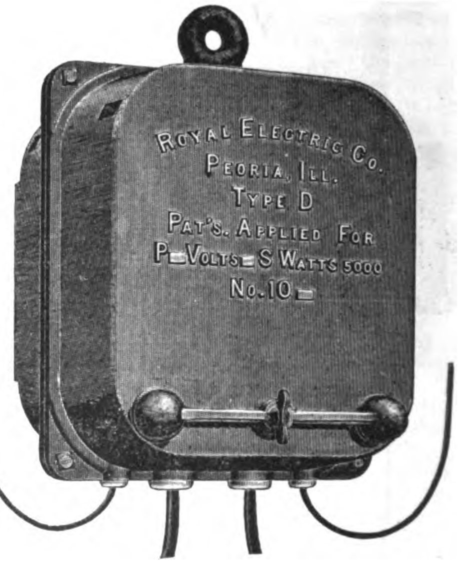
GENERAL ELECTRIC CO.—This company's type H transformer is shown in the accompanying engraving. The core is built up of single rectangular punchings assembled into a rectangular bundle with notched ends. The bundle, compressed under great pressure, is compactly held by a casing of insulating material, around which is wound one-half of the low potential winding, leaving the toothed or notched ends only obtruding. Around this winding is an insulating wrapping and over it one-half of the high potential coil is wound. Two such cores and sets of coils placed side by side with the ends of the cores interlocked into another set of rectangular punchings, complete the interior construction of the transformer. To form as strong a barrier as possible against a high potential on the secondary, a protective device is added to the insulation. This is the so-called "earth shield," which is simply a sheet of copper placed between the primary and secondary windings and connected to earth. Thus even should the insulation between primary and secondary become pierced, this grounded shield would prevent any part of the secondary system being at any great difference of potential from the earth, and remove the danger to life and property due to high potential on the secondary winding.


GENERAL ELECTRIC TYPE H TRANSFORMER.

The engraving shows a 10-kilowatt transformer of this type partially completed, the right hand core equipped with its shield and another shield standing in front of it.

ROYAL ELECTRIC COMPANY.—This company's transformers are built standard from 5 light to 200 lights; standard induction from 2,500 lines per square centimeter to 2,000. Tests show that the regulation is exceedingly close and the core losses are low.

The accompanying table gives the capacity in watts and approximate weights of their standard transformers, which are wound for 1,000 and 2,000 volts. Step-up transformers and step-down transformers of any capacity or voltage are built as ordered. One of the features is the hanging device, which is a separate plate easily attachable to a cross arm or pole, without necessitating handling the heavy weight of the transformer before the plate is secured. After it is put in



THE ROYAL ELECTRIC CO. TRANSFORMER.

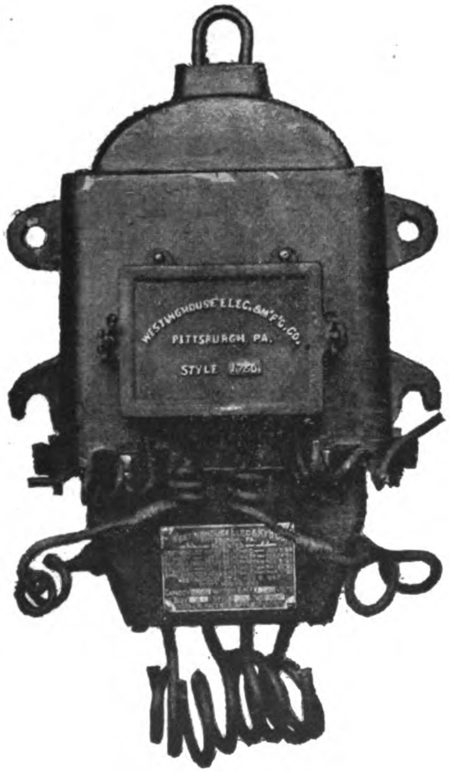
position, the transformer is raised and readily drops into position, without requiring any further attachment.

Capacity in watts.	Approx. weight.	Capacity in watts.	Approx. weight.
250	36	4,000	239
500	45	5,000	300
1,000	85	6,250	365
1,500	106	7,500	430
2,000	138	10,000	500
3,000	185	...	...

THE LAKON COMPANY.—This company has devoted its attention exclusively to the manufacture of transformers and accessories. Their standard type of apparatus is illustrated in the accompanying engraving. As will be seen the coils are subdivided so that they can be coupled up as desired for various potentials.

LAKON TRANSFORMER.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.—The company's standard transformer is shown in the accompanying engraving. It is of the outdoor type, and the fuse block mounted directly upon it. It is noteworthy that the Westinghouse Company does not employ lead fuse wire for transformer currents over 10 amperes. Above that limit copper or aluminum wire of the proper gauge is employed as being more reliable than lead.



WESTINGHOUSE TRANSFORMER.

VINDEX ELECTRIC CO.—This company's transformer is shown in the accompanying illustration. The case consists of a cast iron top and bottom piece shrunk to a steel drum; by this method of construction a very light case is secured, the same being weather-proof and symmetrical in appearance, and the cost of it being materially reduced. All transformers are equipped with single-pole primary fusing devices.

Tests of a 50-light Vindex transformer show leakage and core losses to be 53 watts, and the regulation 2½ per cent. In a 100-light transformer the regulation was 2¼ per cent.

The weights and sizes of these transformers are as follows: 10-lights, 50 lbs.; 30-lights, 95 lbs.; 50-lights, 140 lbs.; 100-lights, 250 lbs.; 200-lights, 450 lbs., and 300-lights, 600 lbs.

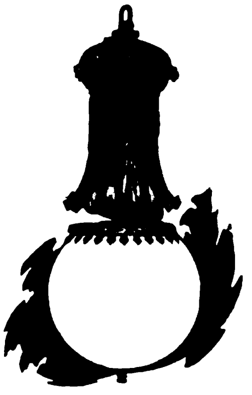
THE NATIONAL ELECTRIC CO.—This company manufacture the ring type of transformer illustrated in the accompanying engraving. The fuse box is cast directly to the transformer case.

VI.—ENCLOSED ARC LAMPS.

WHAT central stations managers were looking for for years has been accomplished,—a carbon with long life. But the method of its accomplishment is as remarkable as the results obtained. The fruitless attempts to secure a long burning carbon per se have been discounted by the simple expedient of enclosing the arc within a small globe and preventing the free circulation of air around it. The use of these enclosed arc lamps, as they are called, has spread with marvelous rapidity. Taking as they do 60 volts and over, they are specially economical to operate on incandescent circuits to which their use has thus far been chiefly confined. But it seems that this very fact has militated against their employment on series currents, though their economy in other respects is admitted.

ADAMS-BAGNALL ELECTRIC CO.—The accompanying cut shows the enclosed arc lamp of this company. The general appearance is the same as those for constant potential or constant current. It is short, and made in a large variety of finishes to match any suroundings.

This lamp, used on the common 110-volt circuits, burning 125 to 150 hours, according to the amount of light required, has already been described in these columns, but the less well known lamp to burn on series circuits has some points of interest. This lamp separates the carbons at starting to immediately give the proper voltage and when the carbons are consumed will reliably cut out like any open arc series lamp.



THE ADAMS-BAGNALL LAMP.

The function of "cutting out" in a lamp burning an open air arc is but a question of a few minutes after the carbons have ceased to feed. The same lamp burning an enclosed arc would not cut out properly, because the hour or two required would give time for the fine wire to overheat, and weaken its action so much that the lamp or inner globe would be damaged before cutting out took place. The loss in the dead resistance peculiar to arc lamps run from constant potential circuits, being saved where the lamps are run in series, added to the saving in carbons and trimming with all enclosed arcs, makes this type of arc lamp specially economical.

These advantages, it is claimed, will induce the winding of dynamos for the smaller ampere current most suitable for enclosed arcs. This small ampere current appears to be the only obstacle to the extensive use of series enclosed arcs. Of course, if glass-makers could produce inner globes that would not melt or break, users would not be compelled to observe the conditions for success now necessary, easy though they be, but with the existing quality of glass, the amount of light the public is accustomed to, can be reliably furnished. The most common mistake of users, strangely enough, is, that with a given size and quality of carbon, a lamp will not burn as long with six or seven amperes as it will with four or five. By using five to six amperes, and 65 to 75 volts in enclosed arc series lamps, the results desired can be obtained.

ELECTRIC ARC LIGHT CO.—The illustration represents the latest design of the "Pioneer" lamp. It is 32 inches long and especially adapted for low ceilings. The trimming or outer shell is made of brass, highly finished, with artistic ornamentation, and makes a very handsome appearance. It is intended for indoor purposes on direct current, constant potential systems and burns singly on 100 to 150 volts. It is also furnished for factory or mill purposes, the trimming or outer shell being a composition of metals, plain in design and painted black.

The length of carbons required is 9 inches upper and 4¾ inches lower, and will burn from 100 to 150 hours. It consumes between 4½ and 5 amperes, which is the standard, but higher or lower amperage lamps are also built by the company.

GENERAL ELECTRIC CO.—This company's enclosed arc lamps have recently been adapted for operation in series on railway and power circuits. These lamps are similar in design to the standard 100 and 150 hour lamps for 110 volt circuits. Five lamps are connected in series on 500 volts, each lamp taking 100 volts at its terminals.

The standard current is 5 amperes and a potential of 80 volts is required at the arc. The difference between the voltage at the arc and 100 volts at the terminals is taken up by a resistance self-contained in the lamp, which also acts as a regulator, steadying the potential at the arc. Two of these lamps are connected in series on 250 volts and operating under the same conditions. A cut-out is provided self-contained in each lamp, which operates automatically to cut out a lamp should it for any reason fail to burn. This is accomplished without interfering with the operation of the other lamps on the circuit.

The single solenoid lamp built by the company is for operation independently on 110 volt circuits and was designed to meet the demand for a short lamp. It operates under the same conditions as the regular 100 and 150 hour lamps, requiring 80 volts at the arc and 5 amperes. Its length over all is but 26 inches, and it is particularly suited to restaurants, hallways, vestibules and places where ceilings are low. This lamp has a life of 100 to 125 hours. In some cases a less powerful light is desired, and the lamp is, therefore, designed to operate also at 3 amperes. Under these conditions a smaller carbon is used and the life of the lamp is approximately 75 hours.

HELIOS ELECTRIC COMPANY make enclosed arc lamps for all constant potential circuits. The latest type of lamp is intended for power circuits of 220 volts or 500-volt railroad circuits, burning two in series on 220 volts, and five in series on 500-volt circuits. They are made to take from three to six amperes. The length from the top of the lamp to the bottom of the globe is but 32 inches for the five ampere lamps, which burn from 130 to 180 hours. The life of the three ampere lamps is about 100 hours.

To insure a maximum life of carbons, the lamp is provided with an automatic cut-out, which, when any individual lamp burns out throws in a compensating resistance equal to that of the arc, and insures the proper burning of the remaining lamps in series with it. This is especially important in factories where one lamp may burn out in the middle of the night while the other still has a half inch of carbon left, which will insure its burning until morning. The shunt magnets are wound so that if 220 volts are thrown on one lamp it will not burn them out. The lamps burn with a uniform brightness and will take care of a line variation of 20 per cent. without change in current. The cylinders are made so as to facilitate cleaning and trimming, which insures a minimum breakage.

IDEAL ELECTRIC CO.—The La Roche alternating current enclosed lamp of this company is designed to be connected directly across the constant potential mains and is built for any voltage from 80 to 110. Both upper and lower carbon feed at the same time, this maintaining the arc in the center of the globe and with 7½-inch carbons; the length of burning is 100 hours, and this with a lamp whose total length is but 30 inches. Each lamp is thoroughly tested in the laboratory before being sent out. The lamps manufactured by the Ideal Electric Co., of New York, are furnished in plain black, polished brass or ornamental brass cases as desired.

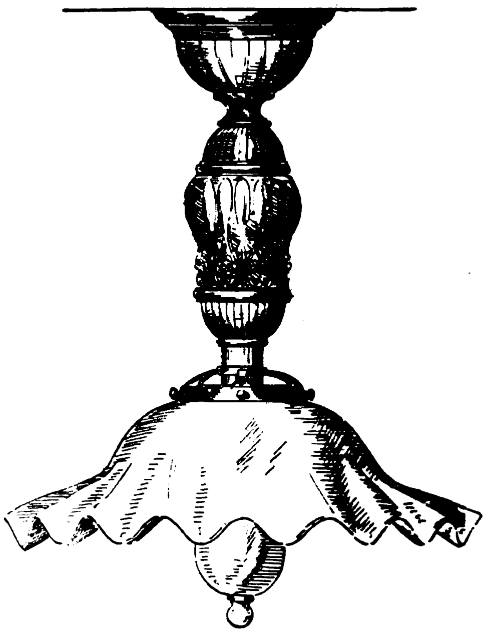
MANHATTAN GENERAL CONSTRUCTION CO.—The accompanying engraving shows the Manhattan "Standard" long burning enclosed arc lamp. The "Standard" lamp is 36 inches long, can be adjusted from 4 to 6 amperes, and is designed to burn singly on circuits of 100 to 125 volts. Under average conditions of burning these lamps require retrimming with a pair of ½-inch carbons about every 150 hours. This same type of lamp is made to burn 2 and 5 in series, respectively, on 250 or 500-volt circuits with the same life.

The "Junior" lamp is 24 inches long, can be adjusted for from 3 to 4 amperes, and is designed only for 100 to 125-volt circuits. The life of this type of lamp is 100 hours with a pair of ⅝-inch carbons.

The mechanism of the lamp is concentric to the central stem. The entire upper part of the mechanism is enclosed in the brass shell, the rheostat being placed in a canopy, at the top for the inside lamps, or at the bottom inside the outer globe for the outdoor lamps. The working parts of the lamp consist only of the clutch-pan and rings attached to the lower end of the solenoid core. The drawing up of this core causes the rings to clutch the carbon and thus establish the arc. The lowering of the core causes the carbons to feed as they are burned away.

The outer globe is secured in place at the upper opening by the yoke and there made air-tight with asbestos gaskets. At the bottom is a hand hole large enough to permit of trimming the lamp and cleaning the globe. This hand hole is yieldingly closed by a detachable dust pan.

INTERNATIONAL ARC LAMP CO.—The distinguishing feature of this company's Macintire lamp is its highly artistic design which adapts it to any interior, however ornamental. The entire lamp weighs but 5½ pounds, and contains no springs, adjusting screws or other delicate devices. The height of the lamp is only 16 inches, and its greatest diameter at any point is 3⅛ inches. The lamp operates on 5 amperes at a potential of 110 or 125 volts. The arc consumes 80 volts, and the carbons burn 150 hours.



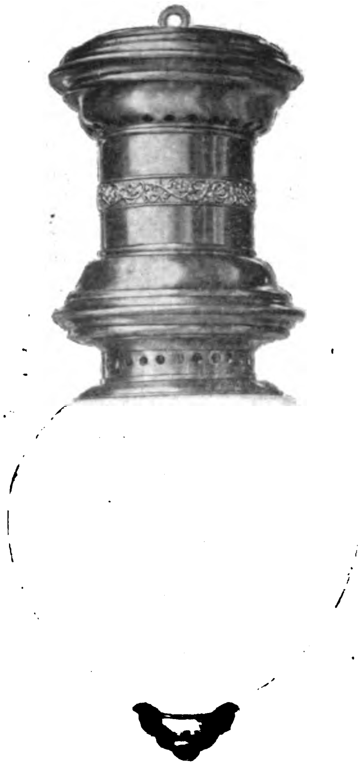
THE MACINTIRE LAMP.

THE PARAGON ARC LAMP COMPANY'S long-burning series arc lamp, for direct current high potential circuits, is shown in the accompanying engraving. This lamp is suitable for either interior or exterior lighting, and will work perfectly on circuits of from 6 to 10 amperes. The working mechanism is simple, strong, and durable, and not liable to get out of order. The lamp has a new globe-lowering device which is strong and simple, and will allow the globe to be lowered sufficiently so that the lamp can be trimmed easily.

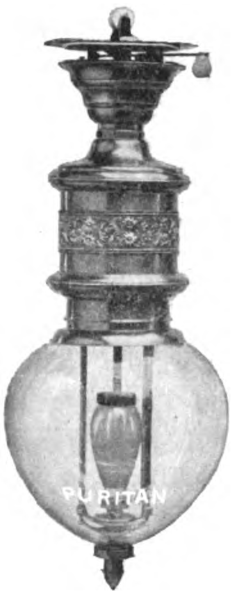
The lamp burns steadily throughout the entire life of the carbon, with a life of 100 hours per trimming. The lamp operates nicely on the current generated by any series arc machine.

PURITAN ELECTRIC CO.—This company's lamp is very simple in construction and short in length, measuring only 33 inches over all, and as shown in accompanying engraving is of highly ornamental appearance. The humming usual in the working parts of alternating lamps has been entirely eliminated, and the slight noise of the arc thoroughly subdued by the double enclosure.

This lamp burns for 100 hours with one pair of 7½-in. x ½-in. cored carbons. It is constructed for circuits of any frequency,

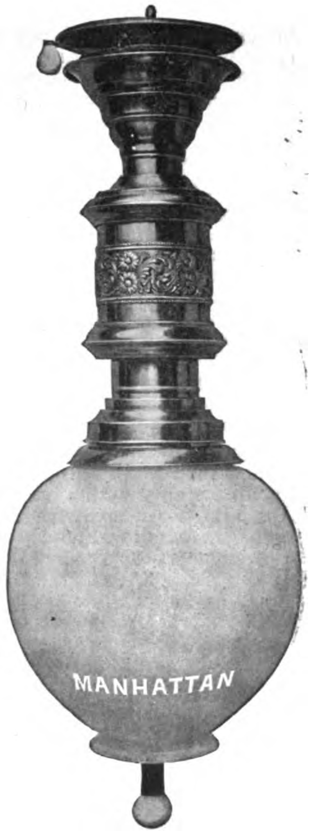


General Electric Lamp.



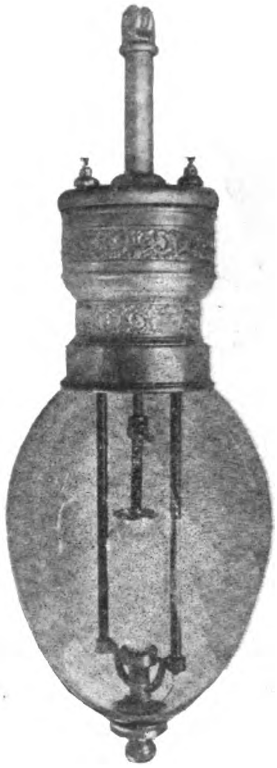
The Puritan Lamp.

The Helios Lamp.



The Manhattan Lamp

The Pioneer Lamp.



La Roche Lamp.

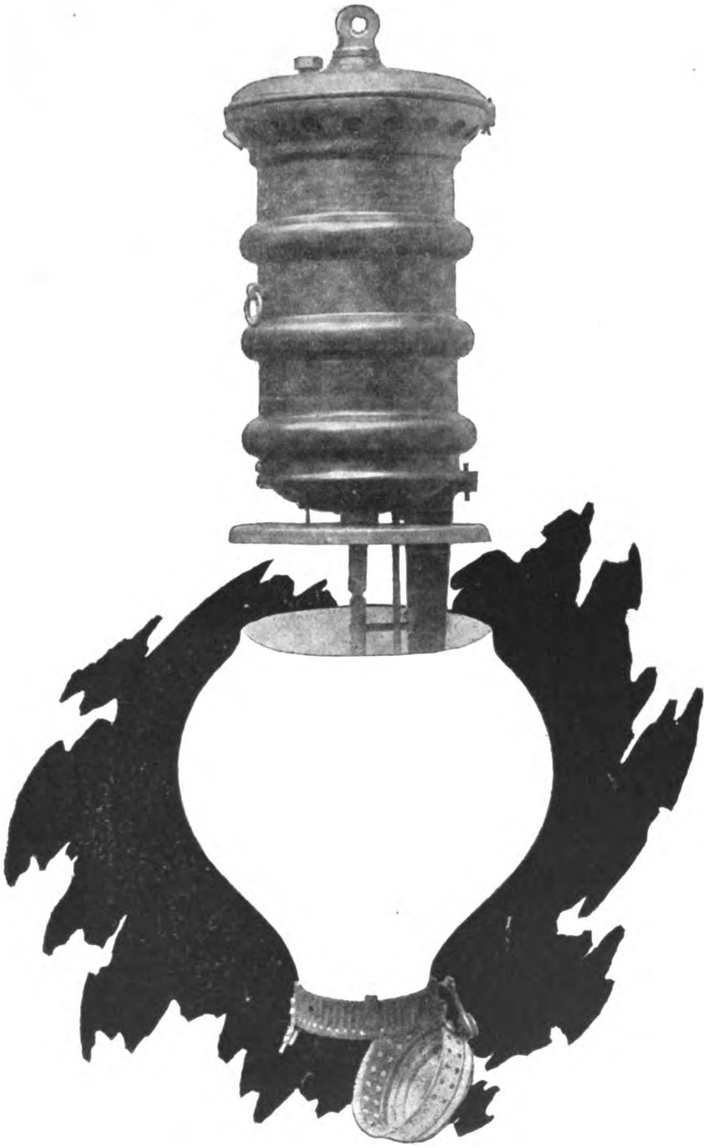
Paragon Enclosed Arc Lamp.

and secondary voltages between 100 and 120. Its current consumption can be adjusted from 4¾ amperes upward according to the candle-power desired. The Puritan enclosed arc lamp is also constructed for 6.8 ampere series arc, constant current, circuits taking 64 volts at the arc without any resistance and burning 100 hours, giving 2.000 candle-power.

NOWOTNY ELECTRIC CO.—In the design of this lamp special pains have been taken to avoid all rods, chimneys, clockwork, gearwheels, springs, and side rods and the outer globe-stand which cast shadows. The carbon is gripped directly without the intervention of any carbon rod; the clutch is composed of four porcelain balls, maintained in position by a retaining receptacle and performing all the functions of a ball-bearing, arc-maintaining device. The outer globe is supported by a ring at its top, which when lowered is held by three chains in such a manner that the globe can be raised or lowered without detaching it. The outdoor lamp shown is fully weatherproof, preventing any moisture from getting into the mechanism. It is furnished to consume 4 amperes, 4½ amperes and 5 amperes at 80 volts across the arc, with 110 volts on the line. The life of the carbons is from 125 to 150 hours.

WALKER COMPANY.—The accompanying engraving illustrates the Walker enclosed arc lamp for one hundred hours burning at one trimming. The same symmetrical shape of the casing and globe as used in the open arc system of the Walker Company has been preserved, and a slight change in the regulating apparatus together with the addition of the enclosing globe have been all that is necessary to create this new lamp. The Walker lamps, series constant potential, or enclosed, can be readily changed from one to the other by the substitution of a few parts. The mechanism of the lamp is simple and not liable to get out of order, and it has been subjected to exacting tests before being offered to the public. It was described in detail in a recent issue of the Engineer.

GENERAL INCANDESCENT ARC LIGHT CO.—This lamp is designed for use on constant potential circuits, the lamp burning singly with a current consumption of about 5 amperes. A single trimming with 12 by 7-16-inch upper and 5 by 7-16-inch lower solid carbons results in a life of from 100 to 125 hours. Fully equipped with such carbons the extreme length of the lamp is but 28 inches. The upper cap on the bulb through which the upper carbon passes centrally is an iron casting fitting the top of the glass and has its upper side coned so as to exactly fit the conical seat in the lower side of the mechanism base plate, when pushed up in position for operation. For feeding and regulating the operation of the lamp, a single concentrically placed series solenoid coil is used, acting on a hollow iron core, which surrounds the upper carbon.

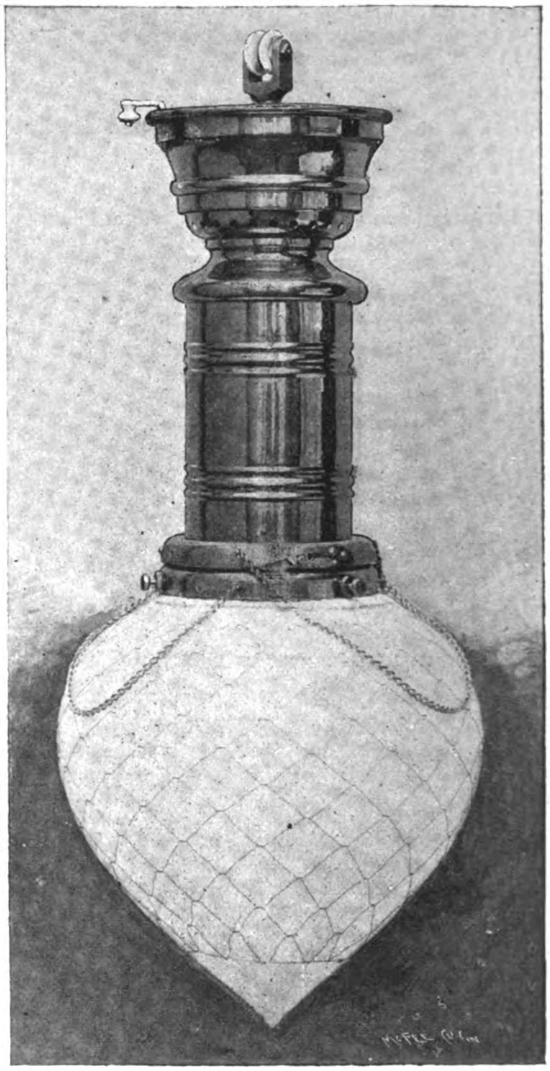


THE NEW WALKER ARC LAMP.

A telescopic tube arrangement allows the globe to readily slide down so as to clear the inner bulb and allow of the trimming of the lamp. When it is desired to obtain the maximum light and minimum height, the outer globe is dispensed with and in its place an opalescent reflecting shade is used fastened to the lower part of the casing, so arranged that the lamp only measures 24 inches.

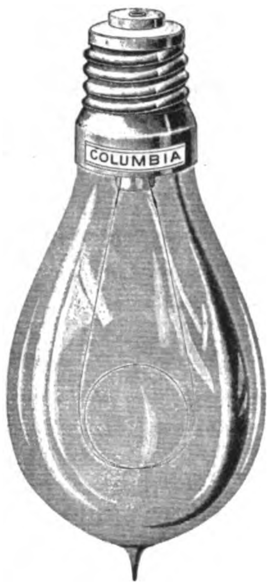
VII.—INCANDESCENT LAMPS.

THE incandescent lamp of to-day differs little from that of 1880, so far as essential principles are concerned. But in all that goes to make for economy and durability it has made great strides. Improved methods of manufacture have increased its useful life threefold and more, and its efficiency has been fairly doubled. The 50-watt 16-candle-power lamp is now the standard and will probably continue to hold its place for some time to come. The most recent tendency, however, is in the direction of the 220 and 250-volt lamp, and though this lamp is not yet quite as efficient as its low volt prototype, its use has some advantages which have begun to make for it an apparently lasting place in the art.

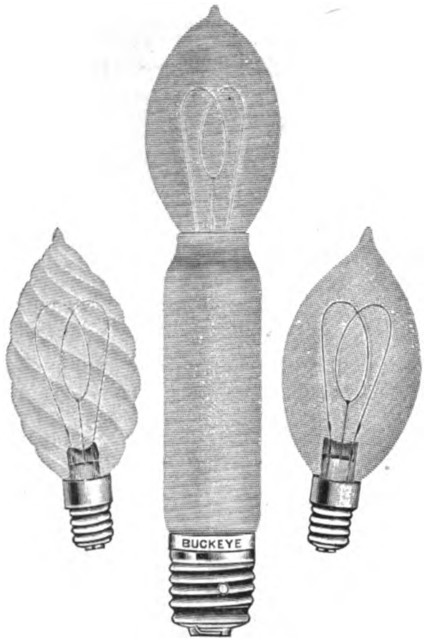


THE NOWOTNY LAMP.

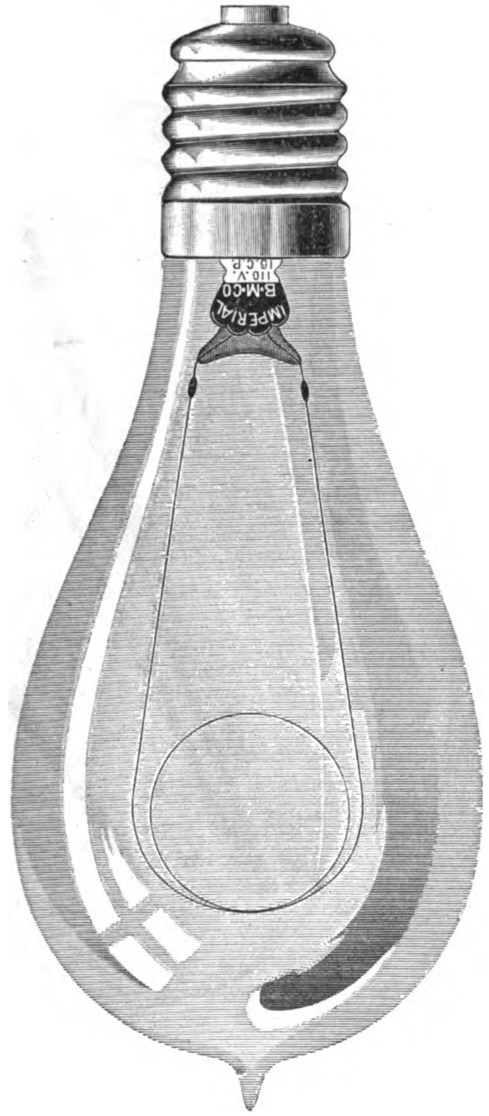
BUCKEYE ELECTRIC CO.—One of the latest novelties manufactured by the Buckeye Electric Company is shown on next page. The center figure shows a candle socket made of etched, opalescent glass which fits the Edison standard socket and carries a socket in the top in which candelabra lamps can be used. Only the glass portion is visible when the lamp is in place, and, when lighted, it presents the appearance of a



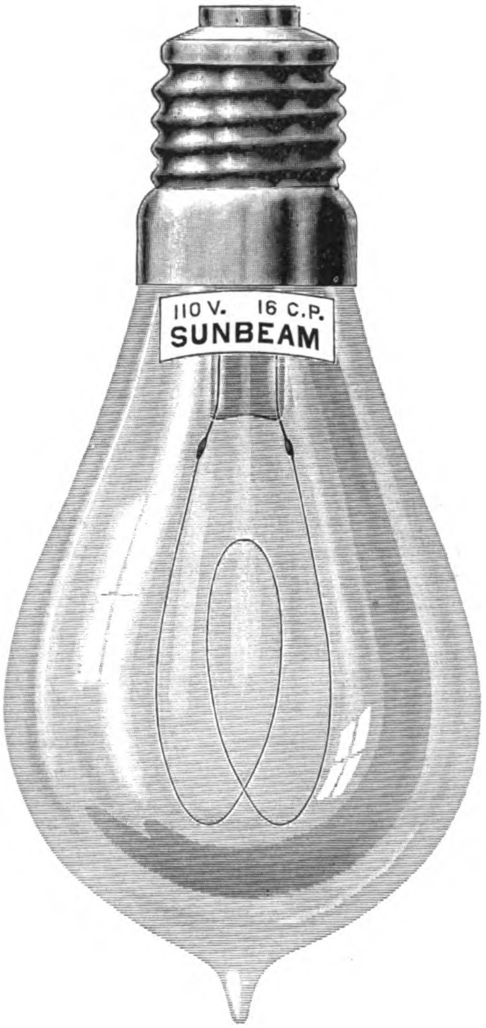
Columbia Incandescent Lamp.



Buckeye Candelabra Lamps.


IMPERIAL
B·M·CO
110 V.
16 C.P.

Bryan-Marsh Lamp.

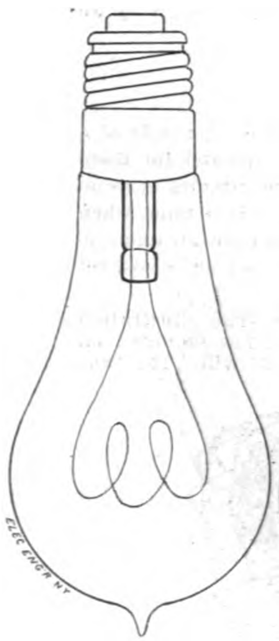


Sunbeam Lamp.

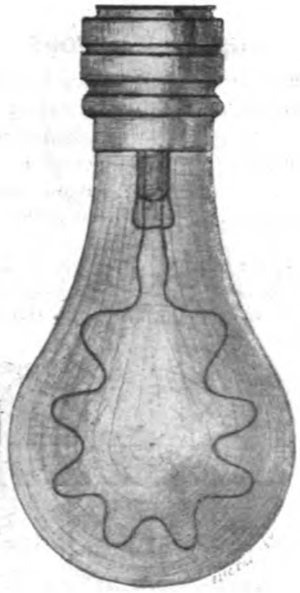
burning candle. The side figures show two of the many styles of lamps that can be used in the candle. A distinctive feature is that the lamps are made not only of low voltages, but for 100 to 120-volt circuits, thus obviating the inconvenience of using two lamps in series.

The standard Buckeye lamps range from 6 to 100 candle 24 candle power, 3.1 watts per candle.

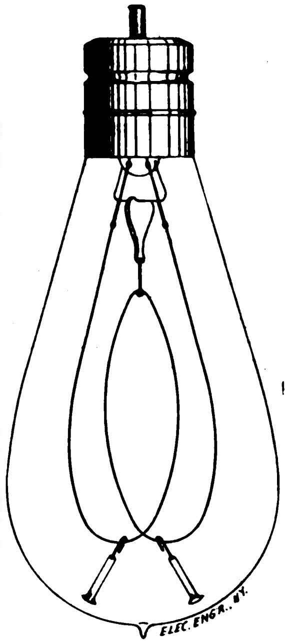
GENERAL ELECTRIC CO.—The accompanying engraving shows in exact size the latest type of the standard new type Edison lamp. This type of lamp is furnished in voltages from



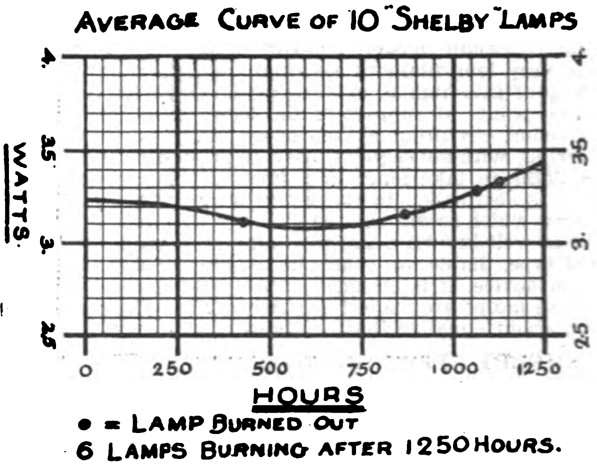
WORMLEY.



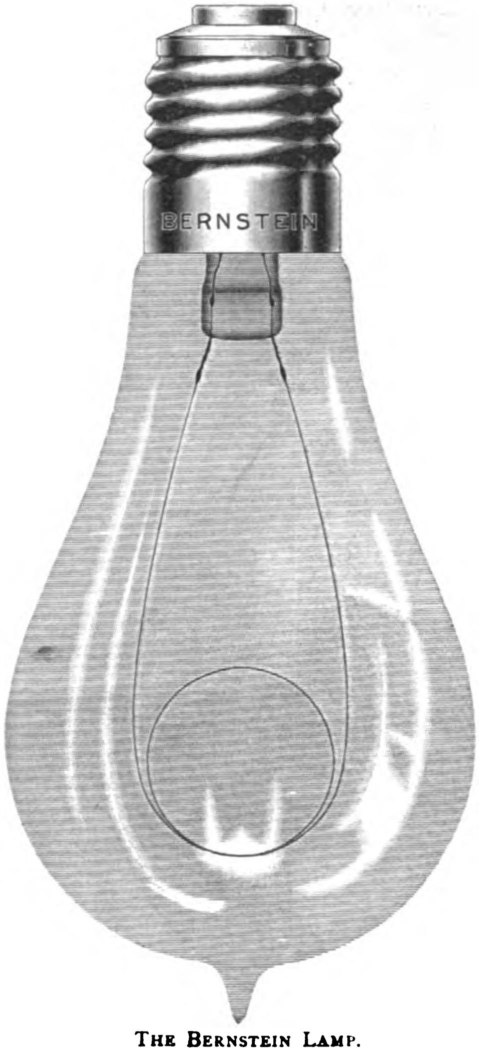
THE SHELBY STAR.



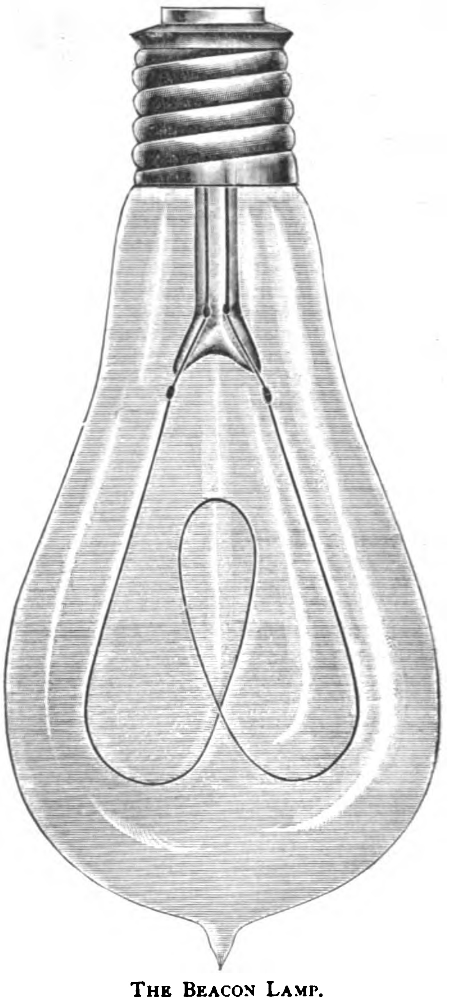
SAWYER-MAN.



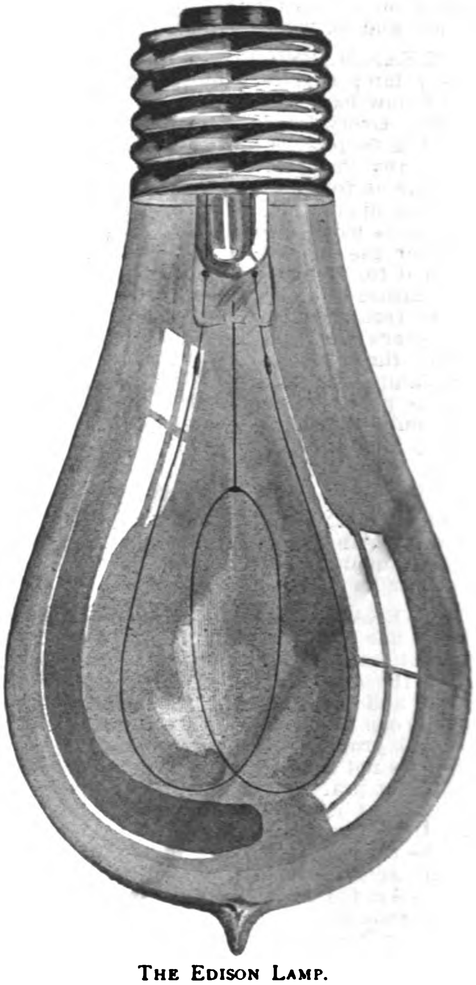
SHELBY INCANDESCENT LAMP CURVE.



THE BERNSTEIN LAMP.



THE BEACON LAMP.



THE EDISON LAMP.

90 to 125 volts, and in 10, 16, 20 and 24 candle power, and of the following efficiencies:

24 candle power, 3.1 watts per candle power.
20 candle power, 3.1 and 3.6 watts per candle.
16 candle power, 3.1, 3.6 and 4 watts per candle.
10 candle power, 4 watts per candle.

The engraving illustrates the mechanical features of the lamp, among which are the following: The carbon filaments are wound in oval form, filling and fitting the bulb with a bright sphere. The carbon filaments are anchored to the stem of the lamp; the anchor holding the filament securely in position, prevents it from touching the glass, avoids interlocking of the branches of the filament and overcomes vibration. The bulbs are thoroughly uniform in size, all bulbs being molded to one standard gauge.

These lamps, manufactured by the General Electric Company, are all exhausted by the new process of chemical exhaustion, as described in The Electrical Engineer of March 31.

SAWYER-MAN CO.—The old Sawyer-Man lamp is so well known that any description of standard types is unnecessary. We give herewith an illustration of the latest form of 16, 20 and 25 candle power, 220-volt lamp. It will be noted that the very long filament essential for a thoroughly satisfactory lamp of this high e. m. f. is rendered perfectly stable by the three points of support of the loop. This renders impossible the short circuiting of the carbon due to excessive vibration or jarring, with subsequent disaster to sockets and fittings which is liable to take place in a lamp not so constructed. Attention is also called to the glass bridge between the leading-in wires which serves as a support for the anchor from the stem. As is well known a 220-volt lamp is, if made after the standard type, liable to short-circuit across the leading in wires. This device, it is claimed, entirely prevents any such action. These lamps are made from 200 to 250 volts, the efficiency being about equal to that of standard voltages.

SHELBY ELECTRIC CO.—The design illustrated is one of many that are made by this company, and is called the "Shelby Star." The diagram shows the average curve of ten Shelby lamps as tested by Charles F. Stillwell.

JAS. C. WORMLEY & CO.—This is a double coil lamp. This form was adopted as the company's standard commercial lamp for the reason that it can be used on steamships, cars and other places where great vibration is found, with the best satisfaction. The spiral spring effect is claimed also to have the advantage over straight and single coil filaments for horizontal use as the filament will not sag.

These double coil filament lamps have an efficiency of from 3 watts per candle power upwards and are made from 8 to 50 candle power, in voltages of 100 and over. The company guarantee on 3½-watt lamps of this type an average life of 800 hours and on 3-watt lamps 600 hours.

BRYAN-MARSH CO.—While it is not yet possible to make every lamp so it will burn out after the same life, the company now have reached as near that condition as it is possible to do. Every Imperial lamp, before the photometric measurement in factory, is burned a sufficient length of time to determine any imperfection in the filament or the vacuum. This is done as follows: After the lamps come off the pumps, they are put upon a spark coil to determine the degree of vacuum, and as is usual, poor lamps are weeded out.

After the spark coil test the lamps are put on racks, and burned for from ten minutes to half an hour (depending upon the nature of the filament), to see if any occluded gases will come from the filament. They are then again passed over the spark coil, and any filaments which are not perfect, and which throw off gases, are weeded out. In consequence, when the lamps are taken to the photometer to be measured, they are as nearly perfect as it is possible to make them, and are not only regular in candle power, but are of uniform brilliancy and life.

The company's lamp is illustrated in the accompanying engraving.

THE BERNSTEIN ELECTRIC CO.—The illustration shows this company's regular coil filament 16 candle-power lamp. The company makes a large variety of lamps in all voltages and candle powers.

SUNBEAM INCANDECENT LAMP CO.—This company's lamp has been recently reconstructed and a new and improved seal has been adopted, but the principal improvement is in the shape of the coil, which gives the best diffusion of light, and is so constructed as to be self-supporting. It cannot droop against the glass. The filament is subjected to a special process of "ripening," the result being that the filament is not further changed by either heat of cold, and it remains at practically the same resistance throughout its entire life; or at its normal voltage it will, during its whole life, give its original candle power. A considerable more time is given to the exhaustion of the Sunbeam lamps than it usual in lamp manufacturing. The Sunbeam Company has made a specialty of its 4 c. p. lamp, taking 18 watts, and of these a great many thousands are in use in signs all over the country. It also makes a 2 c. p. night lamp and all other standard candle powers up to 150 and for any voltage up to 250.

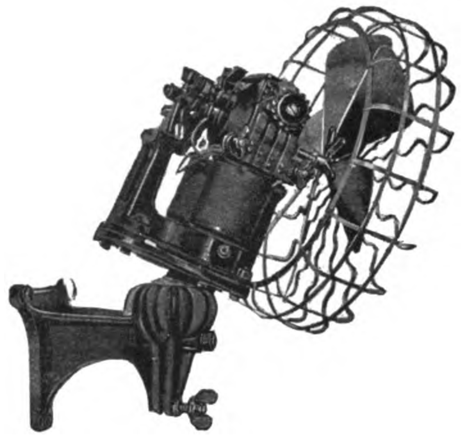
THE BEACON INCANDESCENT LAMP CO.—The engraving shows this company's lamp full size. Special features are embodied in the mount. In addition to the standard 16 c. p. lamp the company manufacture a large variety of special types from 1 candle power up to 500 c. p.

THE COLUMBIA INCANDESCENT LAMP CO.—This company manufacture lamps for all varieties of service. Their standard 16 candle-power lamp illustrated is made in efficiencies from 50 to 60 watts according to demand. The filament is of the cellulose type and is joined to the leading-in wires by an electro-plated joint.

VIII.—FAN MOTORS.

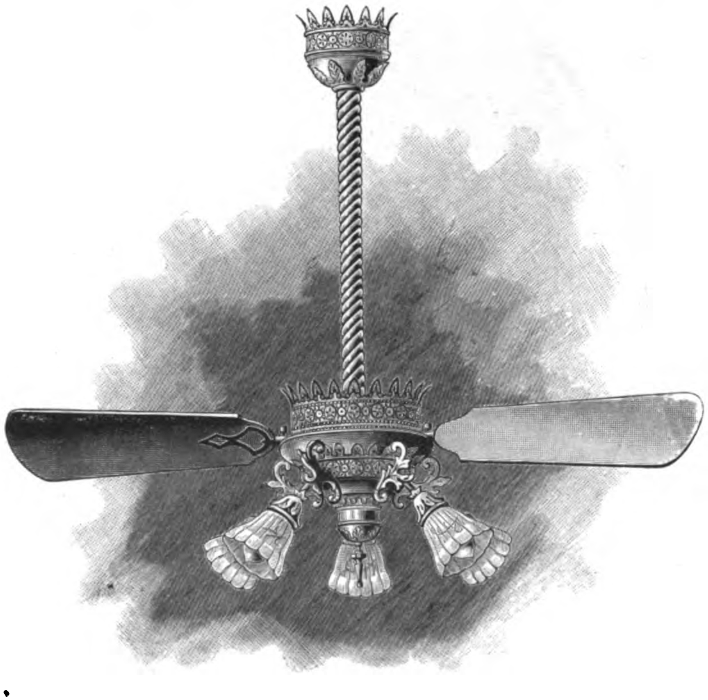
THESE welcome little blowers have become the staple of a large and increasing trade. The heavy demand for them has called for designs to go on all classes of circuits even on 500-volt motor circuits. The time seems not far distant when they will be as common as push buttons, and not an inappreciable part of the day load of some central stations is now set down to their credit.

CROCKER-WHEELER ELECTRIC CO.—The illustration represents this company's standard type of fan mounted on bracket so that the breeze may be directed at will. The fans are built in capacities of 1-6 and 1-12 horse power and for all direct current voltages up to 500.



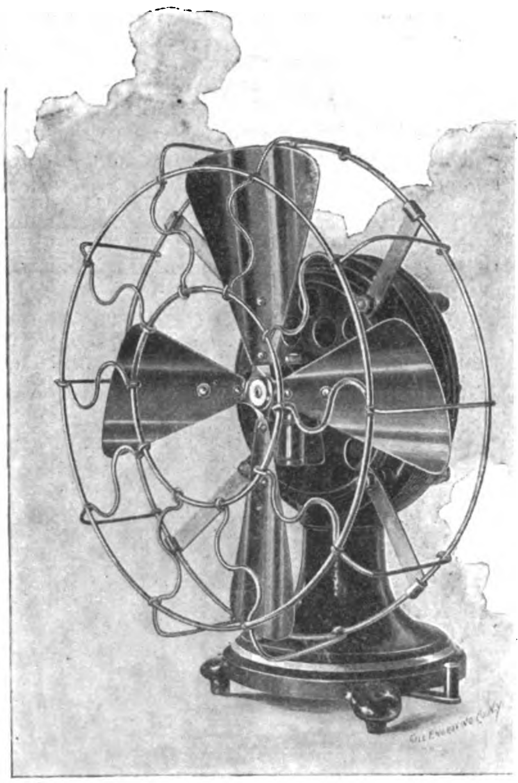
CROCKER-WHEELER FAN MOTOR.

DIEHL MANPFACTURING CO.—The electrolier and desk fans of this company, illustrated herewith, are adapted for all direct currents from 125 to 500 volts, and for direct arc currents for 6.8, 9.6 or 18 amperes. On 500-volt circuits they may be operated successfully singly or in series of two fans, each wound for 250 volts; three fans each wound for 170 volts, or four fans each wound for 125 volts.

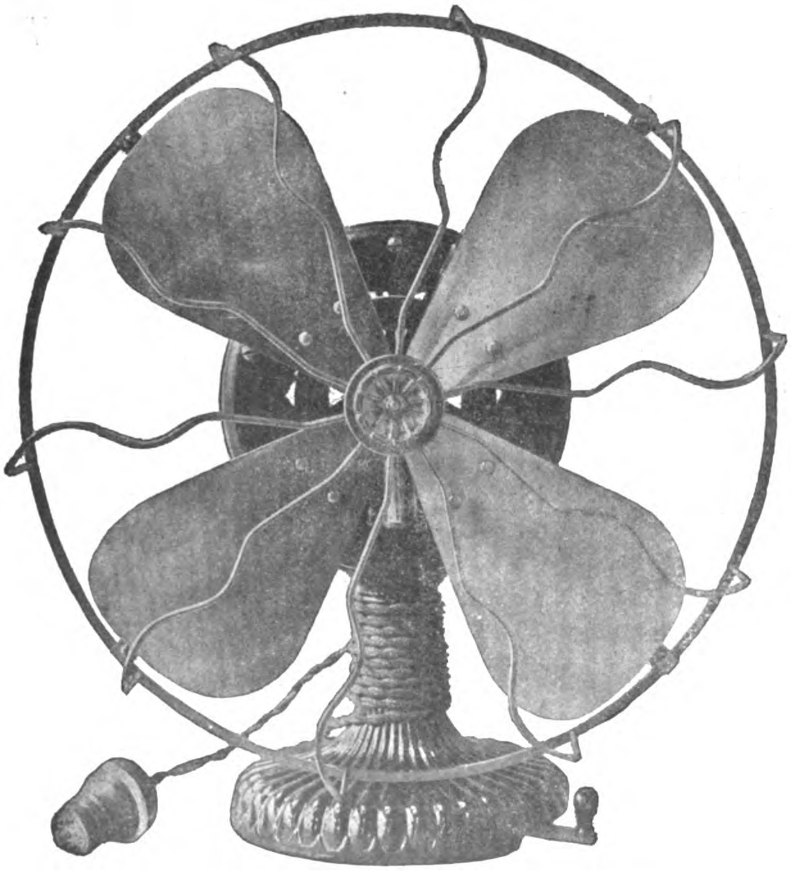


DIEHL CHANDELIER FAN.

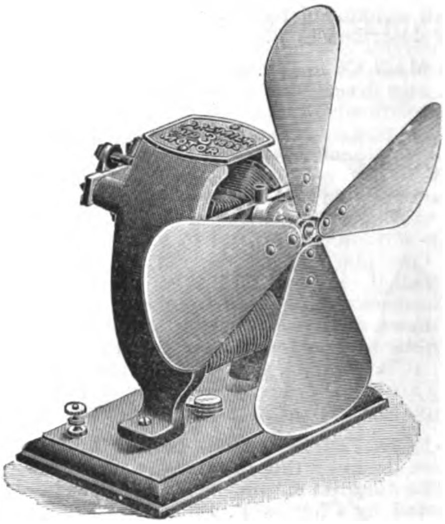
Each fan contains its own motor, directly coupled to the fan shaft, and is provided with an improved oil cup.



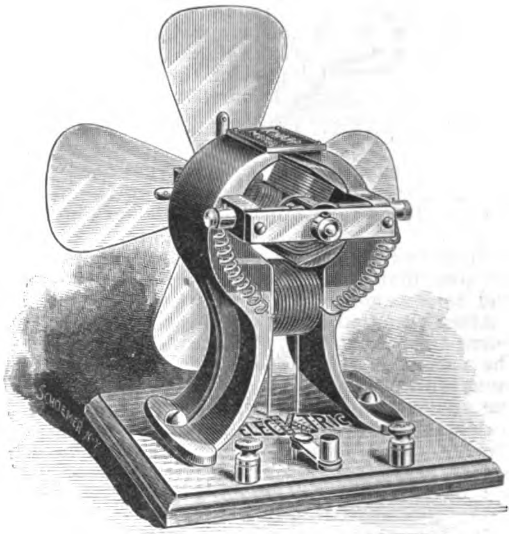
Lundell Alternating Fan Motor



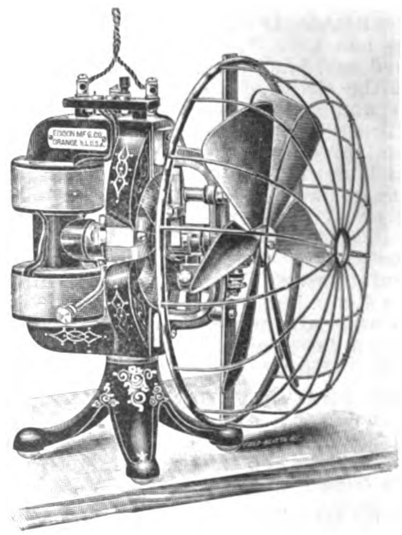
Westinghouse Alternating Fan Motor.



Premier Battery Fan Motor.

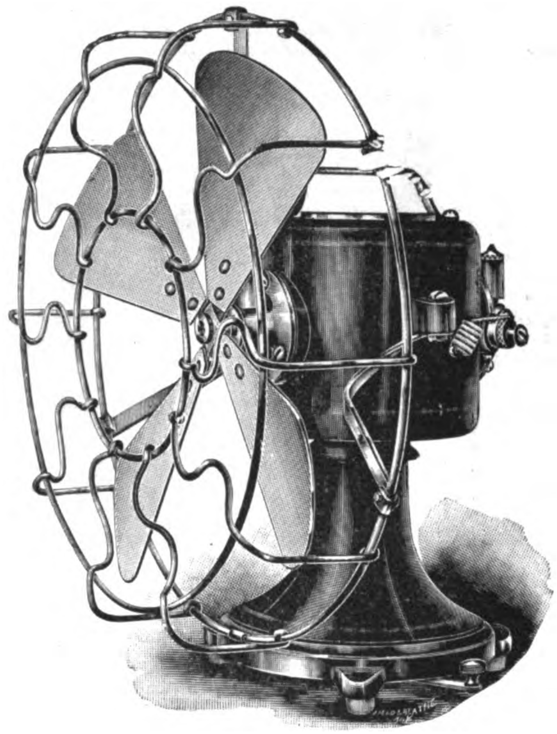


Knapp Battery Fan Motor.


EDISON MFG. CO.
ORANGE N.J. U.S.A.

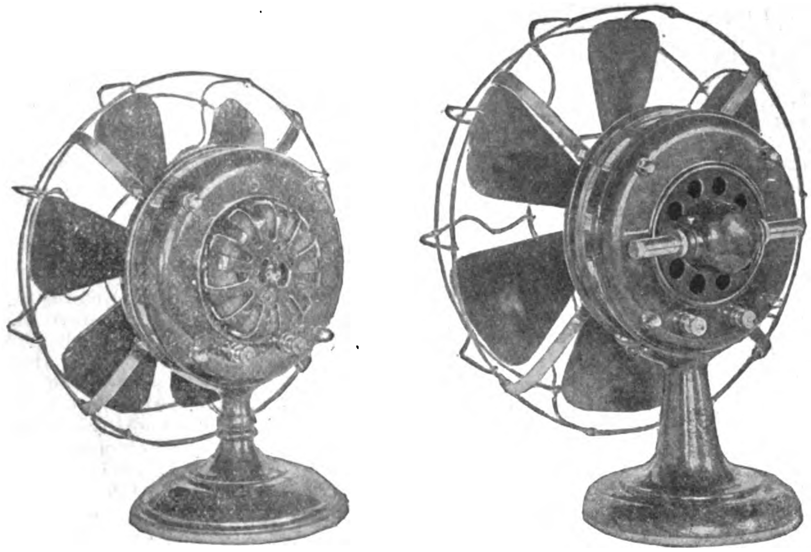
Edison Fan Motor.

EDISON MANUFACTURING CO.—The iron clad outfit of this company carries a 7-inch fan and is now provided with a guard. The batteries operating this motor consist of three Edison-Lalande cells type "S," and the motor runs at about 1,200 r. p. m. The battery will run the fan for 150 hours before requiring to be recharged.


WILLIAMS FAN MOTOR.

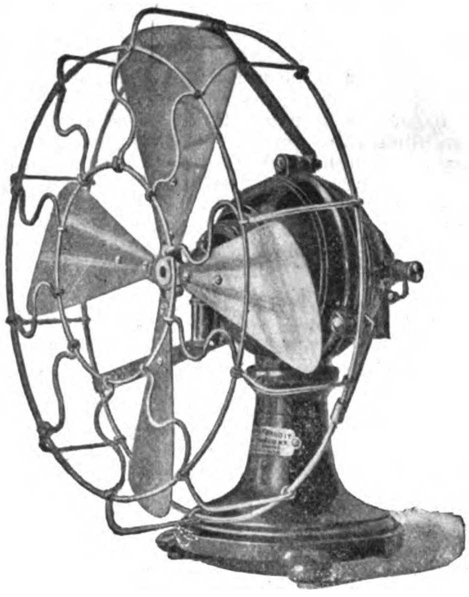
The 9-inch Edison fan motor outfit, made by the same company has been considerably improved this season. The motor is more efficient and now runs the fan at about 900 r. p. m. on a little more than 2 amperes of current, when using the battery supplied with this outfit which consists of four Edison-Lalande cells type "S" in polished oak box. The motor is provided with self-oiling bearings.

This company has made a new departure this year, in bringing out a 9-inch fan motor to run on the 110 to 120-volt direct current. This motor is similar in construction to the 9-inch Edison battery fan motor, but is wound for the electric light circuit, and will run right across the line. It is provided with 3 speeds, namely 1,400, 1,700 and 2,100 r. p. m., the watts used at these three speeds being only 36, 48 and 60 respectively.

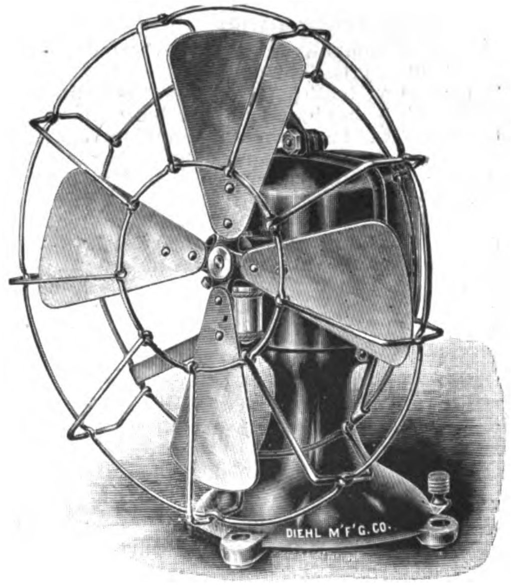

GENERAL ELECTRIC ALTERNATING AND DIRECT CURRENT FAN MOTORS.

GENERAL ELECTRIC CO.'S '97 model fan motors are shown in the accompanying illustrations. In addition to the alternating type, they have a motor for use on direct currents. In general appearance both motors are similar to earlier productions, retaining their characteristic compactness and simplicity while possessing definite features of improvement.

The alternating current fan motor is made for either 60 cycles or 125 cycles. It contains a speed regulating device consisting of an inductive resistance operated by a three-point snap switch capable of giving full speed and half speed, the third position of the switch cutting the motor out of circuit. This controlling switch not only permits a change of speed, but allows the motor to be wired directly to a circuit without the introduction of a lamp socket and plug connection.


LUNDELL FAN MOTOR.

The electrical design of the motor is essentially the same as the '95 and '96 models. The field core is a ring of iron punchings upon the inwardly projecting teeth of which the field coils are placed. The armature has no insulated wire, but consists of the customary laminated core through which, near the periphery, bare copper rods are run, their ends being riveted to copper discs at the ends of the core. As the rotation is produced by inductive action, no commutator or brushes are required. This permits the armature core to overhang the bearing to such a degree that together with the fan, a bal-


DIEHL M'F'G. CO.
DIEHL FAN MOTOR.

ance is effected in the single bearing of the motor. This bearing is long and is provided with a self-oiling device so that it does not heat. By this method of lubrication the flying of oil is prevented.

The direct current fan motor has a single self-oiling bearing. The commutator is completely enclosed and the brushes are small carbon rods encased in tubes which may be easily unscrewed for inspection. The motor circuit may be opened and either half speed or full speed obtained by a regulating device and switch located in the base. The fan is 12 inches in diameter.

INTERIOR CONDUIT AND INSULATION CO.—The company manufacture a large variety of direct and alternate current outfits, of different types such as desk, bracket and suspended, fans of the propeller type. Also ceiling and column fans. The illustration shows the direct current desk outfit. This has starting and regulating switch giving three speeds, viz., 1-12 horse power, 1,800, 1,400 and 1,100 r. p. m., 1-6 horse power, 1,500, 1,200 and 800 r. p. m. at 110 volts. They are provided with self-oiling and self-aligning bearings, and all outside brass fittings polished or nickeled. The company also manufacture a variety of ceiling fans.

THE KNAPP ELECTRIC AND NOVELTY CO. manufacture small battery motors designed for driving fans, experimental work, and running light machinery. Pulleys are attached to each of these motors and switches to the three largest sizes.

The name of the smallest type is "Little Hustler," being a five-inch fan driven by a 2-volt battery.

Type B. drives a four blade 6-inch fan on two to four volts. Type C an 8-inch fan on two to six volts and type D a 10-inch fan on two to eight volts. Fan guards are furnished with the two largest types.

M. R. RODRIGUEZ.—The accompanying table gives the details of the various sizes of the "Premier" battery fan motors:

No. of Motor.	Weig't	Height	Speed Without Fan.	Diam. of Fan.	Speed with Fan.	No. of Cells.	Voltage.	Amp. required
2	38 oz.	4½ in.	1,600	6 in.	900	1	2	.5
3	72 "	6 "	2,700	6 "	1,400	2	4	.5 to .75
3	72 "	6 "	3,000	8 "	1,900	3	6	.75 to .1
3B	94 "	7 "	3,000	10 "	1,400	3	6	1 to 1.5

Taken with freshly charged primary cells, "Premier" No. 2 Battery, one charge will operate motor from 20 to 40 hours, at an average cost of 1 cent per hour. The manufacturer recommends storage batteries, when a steady current is desirable, and charged from bluestone cells.

THE WESTINGHOUSE ELECTRIC MANUFACTURING CO.—This company's fan is of the induction alternating type. The field ring is built up of thin soft steel plates, with inwardly projecting teeth to which the field winding is applied. The armature is laminated, being built up of steel discs, slotted to receive the bare copper conductors. No insulation is needed; consequently there is nothing to burn out. The motor has neither commutator nor brushes. The bearings are self-oiling and self-aligning, thus reducing the friction to a minimum. They are provided with oil chambers, requiring but one filling for the season. The motor carries a 13-inch four-blade fan which is protected by a substantial guard. A switch in the base permits of its being run at two speeds or cut out at will.

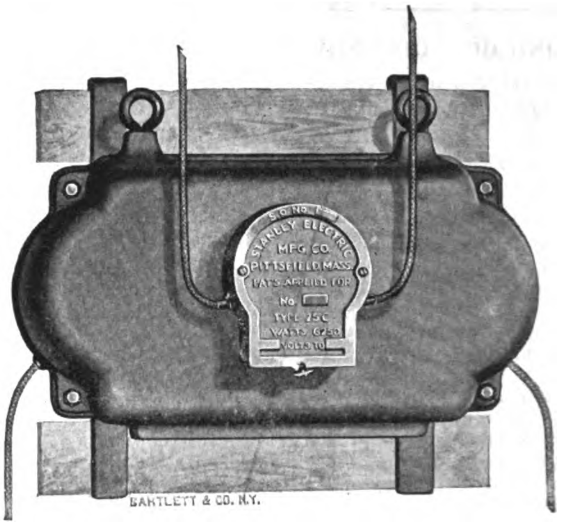
These motors are manufactured for use on circuits of 7,200 and 16,000 alternations per minute and for 50 and 100 volt service.

J. P. WILLIAMS.—The illustration represents the Paragon iron clad fan motor. It is also designed as a bracket motor, which can be fastened to a side wall and placed in any position by means of a thumb screw. The fan of this make called the "White-Flyer," is finished in white and gold.

THE EAST ORANGE FAN CO.—This company are manufacturers of high-grade electric fans of all types, and are about to erect a power plant to be operated by water power, in order to meet the demand of a rapidly increasing business. The fan built by this company is made of steel with multipolar fields, ironclad armature and drop-forged commutator. The fans are very light in weight and are built for three speeds and for 110, 220 and 500 volts, and can be used either for desk or wall. The bearings of these fans are self-greasing (no oil being used), which especially, as regards the wall type of fan, is a decided improvement, as whenever it is required to tilt a fan, where oil is used, it is universally found that the oil will run out at the end of the bearings.

ADDENDUM—TRANSFORMERS.

STANLEY ELECTRIC MFG. CO.—This company's transformers are designed particularly for high efficiency over a wide range of loads and for safety and reliability. Their efficiency at full load, depending upon the size, is, for full load, 97½ to 93 per cent.; half load, 97.1 to 90 per cent.; quarter load, 96 to 85 per cent. The variation of the secondary e. m. f. between no load and full load is from 1 to 1½ volts on 50-volt circuits, depending on the size of the transformer. The insulation is such that the coils can be submerged in water without injury. Both coils form a solid mass with the insulation and are thoroughly protected from contact with the iron core.



STANLEY CO.'S TRANSFORMER.

TEST OF AUTOMATIC CIRCUIT BREAKERS BY THE EDISON ILLUMINATING COMPANY OF NEW YORK.

CONSIDERABLE interest has recently been taken in the working of automatic circuit breakers and motor starting rheostats, and in order to determine which of the devices on the market were of the most satisfactory character, the Edison Illuminating Company, during the past week, invited all the manufacturers of these devices to make a test at their Duane street station, with the object of determining their various merits for their own satisfaction, and that of the Board of Fire Underwriters. The following companies had their specialties on exhibit, and the tests were made under the superintendence of Mr. Arthur Williams, chief of the Inspection Bureau of the Edison Illuminating Company, and Mr. J. Van Vleck, chief of the engineering department: American Rheostat Company, C & C Electric Co., Automatic Circuit Breaker Company, Cutler-Hammer Manufacturing Company, American Electric Heating Corporation, Ward-Leonard Electric Co., Excelsior Electric Co., General Electric Co., Cutter Electrical and Manufacturing Co., Crocker-Wheeler Electric Company and D. and W. Fuse Company, of Providence. Mr. Williams made a short speech before the tests were commenced, explaining the object for which they were made, and thanked the manufacturers for putting their apparatus at disposal, and also thanked the inspectors of the Fire Department for their kind attendance. Mr. Van Vleck then went on to explain the object to be obtained by a starting box, and stated that the tests would be of three characters. First, to break current at a standard amperage; secondly, to break promptly in case of an interrupted current, and, thirdly, to break the current in case of overload. While we are not yet in a position to give the actual particulars of the tests, it is interesting to know that they were all of a most satisfactory character, that all present were greatly interested, and that the investigation brought forth a valuable amount of information on points hitherto obscure.

The Edison Illuminating Company also served a slight repast, which had been cooked in their own electrical kitchen. The automatic circuit breaker tests made were of the most elaborate kind, and extended over a period of about three days.

TELEPHONY AND TELEGRAPHY

MEETING OF INDEPENDENT TELEPHONE COMPANIES.

A MEETING of independent telephone manufacturers took place at the office of the Western Telephone Construction Company, Chicago, on June 1st. Among those who were present were H. A. Coit, Missouri Telephone Manufacturing Company, St. Louis, Mo.; C. H. North, North Electric Works, Cleveland, O.; F. F. Sapp, Connecticut Telephone and Electric Company, Meriden, Conn., and others.

Mr. J. E. Keelyn, having been appointed chairman of the meeting, some matters of business were transacted, the most important being the drawing up and adoption of the following resolutions:

That the manufacturers of independent telephone apparatus should form a harmonious association for promoting the mutual interests of its members.

That the independent telephone manufacturers establish a bureau of information to further the development of the independent movement and disseminate data and statistics counteracting the false or misleading statements sent out in the interests of the Bell monopoly.

That the manufacturers of independent telephone apparatus should make an effort to aid in extending the influence and strength of the National Association of Independent Telephone Exchanges and tender its hearty support thereto.

It was also agreed upon to attend along with the independent telephone companies the convention which will be held in Detroit on June 22, and afterwards to hold another meeting in Chicago on June 25.

DAMAGES FOR TELEPHONE POLE ENCROACHMENTS.

A special dispatch from Medina, N. Y., of May 28 says: The first of the series of suits brought by farmers in Western New York against the Bell Telephone Company because of the setting of poles along the roadway, has just been decided by commissioners in Medina. The verdict was in favor of Joshua Sharpsteen against the company for about $150, which included the costs of the action. Twelve poles were set in front of M. Sharpsteen's premises and he refused to accept the $25 offered by the company in settlement of his claim. The case was argued before Judge North, of Batavia, Wells D. English, of Albion, and Charles Baker, of Shelby. More than 1,000 cases are pending in Western New York against the Bell Telephone Company and the American Telegraph and Telephone Company on these grounds, although many of them will be settled at the rate of from $4 to $5 for each pole with extra damages in special cases. Other cases will come up at once. Austin Wadsworth, of Genesee, has a claim for damages on 1,000 poles set in front of his many farms.

A LESSON FOR A TELEPHONE SUBSCRIBER.

So strict has the telephone company become here, says the "Pittsburg Dispatch," that almost every instrument is a pay station and the law forbidding the free use of private instruments by anyone but subscribers is generally enforced with the utmost rigidity. This is, of course, especially the case with instruments which have long distance connections, every call over which is charged to the renter's account. It is that which makes the joke on the District Attorney especially choice. He was buncoed beautifully a day or two ago by a stranger whose unctuous politeness won him the privilege of using the city's instrument. The stranger entered the sound-proof box and occupied it for several minutes. Nothing was thought of that, as the service often involves delay and the number called might have been engaged, but there was wrath when Central called up just after the stranger had vanished and announced, in conformity with rule and custom, that there was a charge of $6.40 for calls to Buffalo. Now the District Attorney doesn't know what to do about it.

STRANGE TELEPHONE TALK IN ST. LOUIS.

A special dispatch from St. Louis of May 29 says: "We don't have to go into the anti-Bell combine to secure long distance connections," said Manager Hopkins J. Hanford of the Kinloch Telephone Company to-day. "The Western Union Telegraph Company is prepared to start a long-distance telephone system that will be far superior to any the Bell company can ever have. The Western Union for many years had a contract with the Bell company by which the Western Union agreed to stay out of the telephone field. That contract expired last fall. In anticipation of its expiration the Western Union for ten or twelve years has been stringing copper wires for metallic circuit telephones, and now it has 19,000 stations connected by these copper wire circuits. The Bell company has only about 1,100 long distance stations.

"The Western Union can put its long-distance telephone system in working order by simply attaching receivers and transmitters to the wires it uses for transmitting messages. By the time the Kinloch company is ready for business the Western Union will have its long-distance telephone service in operation, and we will have no trouble securing their service."

THE USE OF TELEPHONES BY ROYALTY.

AN unaccredited item in one of the daily papers gives the following information, which is alleged to be correct, about the use of the telephone by the "crowned heads of Europe:"

Now that Queen Victoria has at length permitted the installation of the telephone at Windsor Castle, Osborne house, Balmoral and Buckingham palace, there is not a sovereign in Europe who does not utilize this instrument for communicating royal and imperial wishes, as well as commands to subjects and officials. Even the Pope, who has decided that, while a confession may be heard over the telephone, the priest cannot use the wire for the purpose of granting absolution, has had a receiver installed in his private apartments by means of which he often communicates with the Propaganda Fide, which is situated on the other side of the Tiber and at a considerable distance from the Vatican. It is generally his valet, Cintra, who does the talking over the wire for him, but he occasionally speaks over it himself, and only the other day, when a Jesuit priest was taken suddenly ill during a private audience, the Pope rushed to the little red-lined booth and personally called up the Jesuit college, says an exchange.

King Leopold is enabled by means of the telephone, to communicate with his ministers at Brussels without leaving his palace at Laeken or his marine residence at Ostend. When, a year ago, the little King of Spain was prostrated with the measles, and secluded at one end of the huge palace at Madrid, the Queen Regent was able to hold intercourse with him, located in a distant wing of the edifice, not only daily, but almost hourly, over the wire.

Queen Victoria, however, is so ultraconservative that it is most difficult to get her consent to any modern innovation, and it was only two years ago she permitted the installation of electric light in the state apartments of Windsor. Previously electricity, as well as gas, had been uncompromisingly barred from her private apartment. Yet it is almost impossible to exaggerate the importance of thus placing the various residences of the Queen in telephonic communication with London, as far as the transmission of official business is concerned.

Until now, whenever the Queen was desirous of consulting one of her constitutional advisers upon any point or when any cabinet minister had some matter of urgency to impart to Her Majesty the unfortunate dignitary had to travel all the way from Windsor to Balmoral—a twenty-four hours' journey—or to Osborne, which entailed a sea trip across the stormy Solent, very often only for the sake of ten minutes' talk with the sovereign. Then, too, Lord Salisbury and even Mr. Chamberlain, both of them busy men, have had to spend a good deal of their time explaining matters to the Queen in writing.

In the same proportion that the Queen is old-fashioned in her views, in her surroundings, in her manner, and in her appearance, so is the Prince of Wales up-to-date. Marlborough house and Sandringham are fitted up with telephones and electric lights, in the most approved style. Should the prince survive his mother, his advent to the throne is likely to be marked by all sorts of innovations, which will have the effect of simplifying the present intricate manner of conducting the business of state.

In this respect he resembles his nephew, Emperor William II., of Germany, whose predilection for the telephone is a source of disgust to the various government officials at Berlin. There are instruments in his library and working room.

Although it may flatter the pride of the telephone people at Berlin to have the Emperor among the subscribers of the system, yet he gives them far more trouble than any other subscriber. For when he telephones to any of the government departments the operators at the central office are under the strictest orders to abstain from listening to the conversation.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription
United States, Canada and Mexico - - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, JUNE 9, 1897. No. 475.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

FEW of those who remember the storm and agitation that attended the last convention of the National Electric Light Association at Niagara Falls several years ago, would have believed it possible that the organization could survive such a disruptive performance. But the seasons have rolled by, each finding the association more useful, vigorous and influential, and it may be truthfully said that the body was never stronger than when it returns to the Falls to-day. In the interim the art has enormously advanced and the industry has grown with great rapidity; but the association has gained ground with equal strides, and takes its place high in the ranks of the representative national organizations devoted to the interests of great enterprise affecting the welfare of millions of people.

It is to be devoutly hoped that these encouraging conditions will continue to exist and that central station men and the managers also of isolated light and power plants will assist the association more and more as time goes by, with their personal membership and active co-operation. The association is built up and kept alive by individual effort, which in turn makes the combined action effective on public opinion and technical progress. So much is this true that we cannot do better than point with admiration to the work of President Nicholls and Secretary Porter. These two gentlemen have more than upheld the honorable traditions of the past. They have given the body an administration so energetic, harmonious, intelligent and broadly beneficial in its results that it will indeed be hard to surpass such a record. To President Nicholls the association is under the deepest obligations for his devotion to duty and his skillful guidance of its affairs, and his term of office will always stand out in bright relief, no matter how much good work precedes it, nor how earnestly his successors strive to leave a brilliant record also.

A CHART OF CENTRAL STATION LOSSES.

EVERY electrical engineer in charge of a central station knows that of the heat value of the coal thrown upon the boiler grate scarcely more than 1 per cent. appears as light in arc lamps, and but a small fraction of 1 per cent. appears as light in incandescent lamps. In this there is nothing startlingly new, but we think that there are not many central station engineers who could point out, with any great degree of accuracy, just where the losses between the coal pile and the lamp occur, and the amount of each such loss. With this in mind, we have believed that the industry as a whole would be benefitted by placing before engineers a chart which shows in a graphic manner a complete cycle of the energy as consumed in a simple central station. Such a chart, in several colors, forms the object of the special free supplement included in this week's Electrical Engineer, and the story which it tells is so plain as to require for itself no further elucidation on our part. It merely remains to point out that the chart represents the condition of affairs exhibited by the majority of stations now in operation, that is, a simple central station operated by high speed automatic engines driving countershaft. For the stations operated in a different manner, the intelligent engineer will readily be able to introduce, or eliminate, the factors brought into play by the different method of working. Taken as a whole, the chart forms a most impressive exhibit of the enormous wastefulness of our present methods of using fuel and steam and of generating and distributing current for lighting purposes. Though larger than the standard size of data sheets, which have become such a prominent and appreciated feature of The Electrical Engineer, the present chart will, we feel sure, find a prominent place among the handy data of every station engineer.

THE LATEST TYPES OF STANDARD ELECTRIC LIGHT AND POWER APPARATUS, 1897.

"OUR 1897 model" is the label which goes with every up-to-date bicycle, though the modification from last year's model is hardly distinguishable with the naked eye. We are glad to be able to say that such minute differences are not universally the characteristic of this year's models of standard electric light and power apparatus. Indeed, we know of scarcely any industry in which standard apparatus has undergone, and is still undergoing, such marked changes and genuine improvements as can be found in the materials of electrical engineering. These improvements can be traced not only in the improved forms and better designs of apparatus, but in the improved methods of manufacture, which make the older apparatus better adapted to its work than ever before. In order to show what the character of the present standard apparatus of to-day is, we have in this issue collated with the kind aid of the makers, the product of a large number of manufacturers; and we venture to say that the exhibit constitutes about as favorable a record of the art in America as could well be got into the space to which it is necessarily restricted. To those whose bent of mind lies in the direction of critical analysis, the various types of apparatus illustrated will furnish abundant food for the indulgence of their propensities, while for those who are contemplating a choice from a commercial standpoint the variety submitted will show how wide the field of choice is. Moreover, it is not unlikely that the record will prove very useful for future reference.

ELECTRIC TRACTION ON RAILWAYS.

CRITICS of the advances of trolley traction and its effect on steam railroads, do not fail to point out, very properly, that the trolley is exposed to some very severe limitations chiefly in having to stop so frequently, in running at lower rates of speed on a cheaper track and in operating on a lower basis of income. All this and much more is perfectly true, but it seems to us to fall short of the entire truth in failing to recognize the great probability that the limitations are on the part of steam, and that the advantages of greater range and wider flexibility lie with electricity. In other words, the trolley parallels, the long suburban extensions, the links between large cities and the newer rural electric roads have come in simply because steam has failed to give what is wanted. The reasons of failure are many but may be summed up broadly in the items of too great rigidity and expense. The trolley is giving service over an area and at a cost that steam cannot touch. But it is assumed that electricity is to stop short here, and to be restricted to the work of filling in the crannies and niches left vacant by steam. Is there any foundation for this? We venture to express the opinion that the present work on steam roads, done by trolley methods of frequent small units, is only a step. We see no reason why electricity should not cut both above and below this service. On the one hand it is likely to enable a man to go to a road at any time and run out a small vehicle over the track for his individual convenience; and on the other hand it has begun already to invade the domain of the big locomotive flying at express speed between points widely apart. The electric locomotive is already the subject of much attention but the "telpher" system lingers in the shade of undeserved neglect.

POSSIBILITIES OF CULM PILE AND COAL POWER TRANSMISSION.

THE potentialty of the culm or slack in the coal mines as a source of energy for electrical transmission has frequently been pointed out, and the cheapness of this material has led enthusiasts to predict for it a great future. Power transmission with coal as a source of energy has until recently resulted only in academic discussions, but if reports are to be believed a genuine project of this nature is now under way, and may within a short time be among the realities. The scheme involves the erection of a steam plant of no less than 20,000 horse power at Leavenworth, Kan., in the immediate vicinity of the coal mines in that town, which power is to be transmitted to Kansas City and to other points in the vicinity. Leavenworth, it may be added, lies in the center of a district having a population of two and one-half million, within a radius of forty miles. This, coupled with the fact that the railway rate per ton from Leavenworth to Kansas City, a distance of barely twenty-five miles, is $1.00 per ton, makes it possible it seems to convey the energy cheaper in the form of current than in the potential form of coal. As the first instance of this kind on record, this plant will of itself attract attention, but the engineering features in connection with it will make it particularly the subject of earnest inquiry among electrical engineers. It is contemplated, we understand, to build the steam plant in very large units, single engine units of ten thousand five hundred horse power being spoken of, and individual boilers of no less than 5,000 horse-power each. These figures overtop in magnitude any yet attempted in stationary engineering practice, and if they are carried out, as proposed, we may expect to see some novel results in steam practice.

We are glad to learn that the projectors of this new enterprise will work in harmony with the electric light and power distributing companies already established in Kansas City. Of course the success of this plan, if it should be carried out successfully, will again draw attention to the neglected culm pile. It is just as well, therefore, to reiterate the caution that the culm pile may or may not be a gold mine for power transmission purposes. It will simmer down to the simple question whether it is cheaper to burn the coal on the spot where it is mined, or haul it to the place where the energy is to be used. On the one side, the low price of the coal may be offset by the cost of maintenance of the transmission lines, while on the other must be included, of course, the freight charges for hauling coal. The enormously high freight rates at Kansas City may, and probably do, make it quite possible to transmit cheaper by electricity than by railway, but these conditions may not, and in the majority of cases probably will not, for a long time to come hold good as a general rule, nor are they permanent even there. But railway freight rates are likely to go higher, before they go lower. They seem to have touched bed rock.

NIAGARA

THE beauties and wonders of Niagara have been sung in verse and portrayed on canvas ever since the Falls became known to the white man. It has remained, however, for this utilitarian generation to look upon Niagara as something beyond a mere spectacle of nature, inspiring though that spectacle may be. As a source of power Niagara has now come to be the greatest example of the utilization of natural forces, and the meeting of the National Electric Light Association beside its banks is well calculated to bring the members of that body in closer touch with some of the most important work which has been accomplished in the whole history of electrical engineering. Within the last few years more than one manager of a station operated by steam has suddenly become aware that a copious water power within reachable distance was available for electric transmission, and there is now great development along that line. The trip to Niagara affords an excellent opportunity of examining the very high class of work thus far carried out at that spot. Under ordinary circumstances we should have felt inclined to devote some space to a description of the existing electrical work at Niagara, but we have been doing that persistently for some years past. The readers of our own articles on the subject in these pages, and of the numerous excellent contributions from Mr. Orrin E. Dunlap, our Niagara correspondent, have learned all that is worth knowing, except as to the results of actual operations, and at the present writing there is literally nothing to add, except by way of wearisome repetition. The contents of this large current issue of The Engineer will therefore be conspicuous for the absence of familiar news about Niagara, but, we trust, of such an interesting nature as to justify us fully in giving Niagara a well-earned rest.

MOTORS IN FACTORIES.

ONE hears funny things at conventions. For example, at the recent meeting of the American Society of Mechanical Engineers at Hartford, in the discussion of the use of motors, a sapient Mr. Rockwood said he knew of several concerns that had adopted electric driving unwisely, bankruptcy following! He thought that the least useful place for a motor was in the machine shop! We are reminded of a street railway convention we participated in some years ago when one of the delegates grumbled bitterly about the devotion of any time to this "new fangled thing 'lectricity." He had come to the convention to find out how to shoe his horses and dispose of their manure, and he had neither money nor leisure to waste on the new craze. The trouble with that street railway hostler and with Mr. Rockwood, the latest mouthpiece of prejudice, is their evident inability to distinguish between mere crazes and deep seated social and industrial revolutions.

MR. TESLA announces in the Sunday "Sun" that by his well known system of transmitting intelligence by means of electrical "resonance" between points widely apart, without any connecting wires, he has lately been able to signal twenty miles. This is a splendid achievement. Mr. Tesla confesses that the system is still liable to break down in bad weather, but such results will doubtless encourage him to persevere until the distance is many times greater and the method is quite independent of disturbing atmospheric or terrestrial effects.

THE present issue of The Electrical Engineer consists of no fewer than 136 pages, and a four-page special supplement. That this journal in these dull times should be able to give such noteworthy evidence of progress and prosperity is a matter of pride to the management, and, it is believed, will be a source of gratification to the friends of the paper.

OPENING OF THE NIAGARA N. E. L. A. CONVENTION.

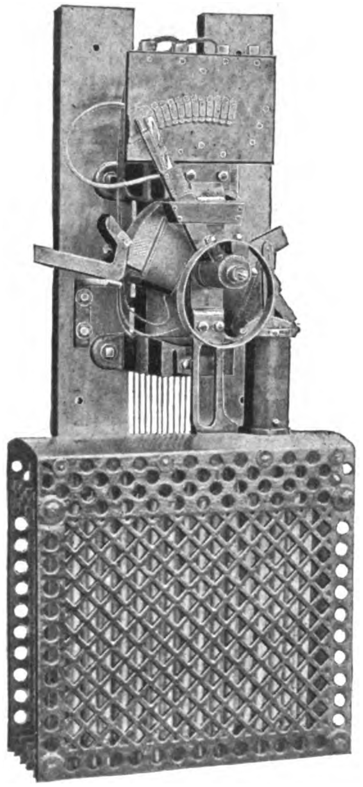
Special Dispatch to The Electrical Engineer.

Niagara Falls, N. Y., June 8.—Convention opened this morning with an attendance of over three hundred and a great many more are expected to-day. Frederic Nicholls, J. I. Ayer, E. A. Armstrong, C. R. Huntley, A. M. Young and Samuel Insull are among those present. Several of the delegates are accompanied by ladies. A noteworthy feature is the large number of city and state officials attending, charged with the regulation of electrical service. There is a good muster of central station men, including delegates from as far away as California and Louisiana. The special trains all made excellent runs. The weather is most unfavorable, but promises to clear. If the delegates stick to business, there is every indication of an unusually hard-working and useful convention. The papers are in the secretary's hands almost without exception, and the special committees have interesting reports to file. Universal regret is expressed at the unexpected news of the resignation of Secretary George F. Porter, whose intention is to enter commercial life again. Convention rumor points to Mr. A. M. Young, of Waterbury, Conn., for next president. T. C. M.

CARD AUTOMATIC MOTOR STARTER.

FOR some months past the Card Electric Company, of Mansfield, O., have been experimenting and making careful tests with various forms of automatic starters or controllers for elevator motors, with the result that we illustrate in the accompanying cut a motor starter, containing features of construction that would seem to make it a very effective and durable apparatus for the hard duty of operating the common every-day kind of freight or passenger elevator.

The rheostat and operating parts of the starter are mounted on a neatly finished wood frame, and all the connections between the rheostat and cut-out are made before leaving the factory. The construction of the automatic rheostat cut-out is simple in the extreme and the magnetic force to operate it is very strong, far in excess of any possible requirements. This part of the apparatus has received careful attention since the practical success of the starter depends almost entirely on the reliability of the swinging arm to divert current properly from the rheostat when the circuit is closed. The electromagnet used for this purpose is a powerful one and has a swinging armature wound and energized by the same current which creates a powerful torque, and this torque is so controlled by the connecting mechanism that a constant steady pull is maintained throughout the full movement of the arm. The speed of the cut-out can be made anything desired. All the bearings and moving parts are mounted on rollers or balls, dispensing entirely with the necessity of ever oiling them, and eliminating any possible danger of sticking because of accumulated dirt or friction.



Card Automatic Motor Starter.

The dash-pot for controlling the "on" movement of the swinging arm has some novel features to insure regularity and constant speed, and the relase valve in it is so proportioned and constructed that an almost instantaneous throw of the swinging arm to the "off" position is effected whenever the current is interrupted.

The rheostat used with this starter is of the well known Card type, made up of iron wire coils, mounted on iron frames, put together in a substantial manner with free ventilation on all sides. Perforated iron plates protect the front and back. The reversing switch, which is a part of the Card company's elevator equipment, is of the quick throw type and has carbon break tips on all the contact blades. A combination of this starter and switch with any one of the several types of motors built by the Card Company makes a very substantial equipment for either freight or passenger elevators.

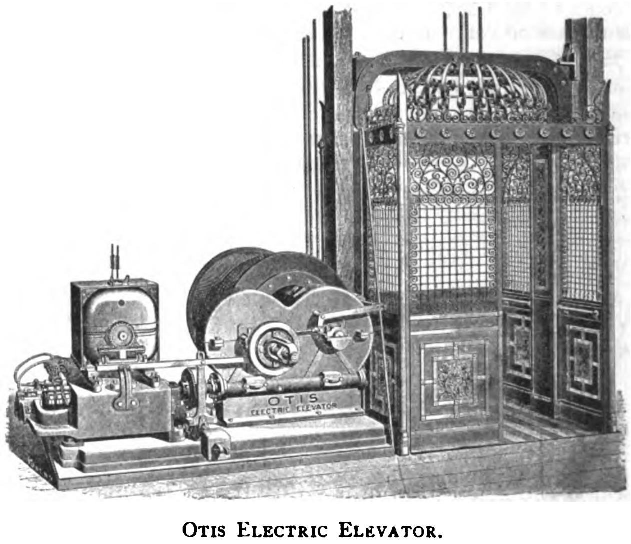
NIAGARA FALLS POWER CO.

At the annual meeting of the Niagara Falls Power Company, held at Niagara Falls, N. Y., on June 1, officers and directors were elected. They were the same as last year. The capital stock of the Power Company was increased from $3,000,000 to $3,500,000. The contract for the building of the addition to the power house, and for the structural steel work for the wheel-pit, will be awarded at a meeting to be held in New York shortly by the directors of the Power Company.

THE OTIS ELECTRIC ELEVATORS.

THE grand stairs in office buildings, in many of our luxurious and private residences have in these days of mechanical locomotion become largely traditional ornaments, having ceased to be used as a means of communication between the various floors of these buildings. The feeling of annoyance and fatigue incident to climbing in buildings has become so universal that even the most conservative insist on the luxury of the modern elevator. The opportunity offered by the many central stations for supply of power and light for private residences made an elevator service for these places possible where any member or guest of a household could operate the elevator with absolute safety.

Since 1884 Messrs. Otis Brothers & Co. have been the pioneers in introducing electrical devices, which as far as human foresight goes must insure absolute immunity from accidents. The principle on which these devices are constructed is that any interference with the control and operation of the elevator by any other person except the one having possession of the car must be made impossible. It must also be impossible to start the car from any other place, or even from the car itself, until all the entrance doors are closed and until the occupant has left the car and closed the entrance door after going out.



Otis Electric Elevator.

Outside of these special safety devices for enabling the operation of the elevator by any person, or without a permanent operator, the apparatus is provided with the best regular safety devices which have made elevator travel safer than any other mode of conveyance. A stop-motion is provided to stop the car automatically at the upper and lower landing, and in case the car stops itself in its down-motion, by its safety device or by an obstruction. Any excess over the safe speed is prevented by the automatic governor safety, and a toggle safety brake.

The motor is of the Eickemeyer iron clad type, with the Eickemeyer armature winding and limit switch. This limit switch automatically insures a start with an amount of resistance in the armature circuit to admit no more than the maximum working current, when running with maximum load. The field is arranged to start with a number of series coils in combination with the shunt coils, but at normal speed the series coils are cut out automatically, and the speed is controlled by the pure shunt field. These elevator motors will lower the load without a brake. The combined electrical and mechanical compression brake is used only to stop the car and keep it in place at the landings.

The electrical and mechanical details of construction are complete and the best in every respect, and produce the highest economy in the consumption of power and in the cost of maintenance of the whole apparatus. This successful result is greatly due to the careful distribution of surface pressure by means of the duplicate worm gearing, and to the utmost limitation of the starting current.

NORTHERN ELEC. MFG. CO.'S SPEED REDUCING DEVICE FOR ELECTRIC MOTOR DRIVE.

The Northern Electrical Manufacturing Company, Madison, Wis., are putting upon the market a novel arrangement by which they use a standard motor in their various sizes, at the same time imparting to driven machines any required slow speed. This is accomplished by the use of their patented invertible bonnet and back gear device. Absolutely no outboard bearings are used, and the construction is such that there is no possibility of the mechanism getting out of alignment. All the bearings are self-oiling, and the entire mechanism may be run without using any floor space. All of the Northern motors and their various equipments are so built as to run inverted, if necessary, and attached to the ceiling, or half inverted and fastened to side wall or post without so much as removing one bolt. All their standard motors are also furnished with tight fitting portable covers for keeping out any dripping from floors above, or dust and dirt. These are immediately attachable to their regular standard bonnets, so that they may be used or not, at the will of the operator. These motors are especially well adapted to factories where there is much dirt and moisture and to mines and foundries.

THE C & C ELECTRIC CO. IN CHICAGO.

The C & C Electric Company have recently concluded arrangements with Messrs. Sargent and Lundy, of 13 and 15 Monadnock Block, Chicago, Ill., whereby this firm on and after August 1st will act as their selling agents for Chicago and the Western States. Early intimation of this important deal was given some time ago in The Electrical Engineer. During the interim Mr. F. D. Sweeten, who has long been the manager of The C & C Company's Philadelphia office, will look after the company's interests in the territory above mentioned.

The company's Western office is for the present at 934 Monadnock Building, where Mr. Sweeter can be found and where business will be transacted until the change alluded to above shall go into effect. Mr. Martin J. Insull, of Messrs. Sargent & Lundy, will have special charge of the interests of The C & C Electric Company.

NEW AMERICAN TURBINES AT GREAT FALLS, MONTANA.

THE Dayton Globe Iron Works Company, of Dayton, Ohio, have recently finished the construction and erection for the Boston and Montana Consolidated Copper and Silver Mining Company, of Great Falls, Mont., of what is probably the largest and most powerful pair of horizontal turbines, for the head of water under which they will operate, that have ever been built.

These turbines are of the New American pattern of the latest design, 57 inches in diameter, and under the head of 50 feet will develop 3,945 horse power. The turbines are placed on a cast iron draft chest and discharge centrally through a draft tube 10 feet in diameter, and are incased in an iron flume 14 feet 4 inches in diameter, 32 feet 6 inches long, made of ½-inch tank steel, with cast iron heads, and the flume is mounted on two pairs of double I-beams, 20 inches deep, 38 feet long.

The shaft in the wheels is 10 inches in diameter, 42 feet 2 inches long, made in two sections, and its weight is over five tons. The clamp coupling which connects these two sections of shafting in the center of the draft chest weighs considerably more than one ton. There are stands, weighing 8,000 pounds each, outside of flume at each end, which carry the journal boxes for this shaft. The two turbines, with their complete outfits, weigh approximately 250,000 pounds, and in their design and construction reflect great credit upon the engineering skill of the Dayton Globe Iron Works Company, and are also an excellent example of their ability to construct this class of machinery on the largest scale.

These turbines operate two Westinghouse electric generators, one coupled directly to each end of the shaft, which runs from 144 to 160 revolutions per minute, and are used for electrolytic refining. The varying revolutions are required in order to increase or diminish the current as conditions may require.

The power of these wheels is also utilized for driving an arc light dynamo and the two 50-horse-power exciters for the large generators, the power being transmitted from wheel shaft to dynamo by means of a 20-inch double leather belt, and there still remains a surplus power in the wheels, which is not being utilized at present.

It is further estimated that if a pair of these 57-inch New American Turbines of this design and capacity were placed in operation on the new water power at Niagara Falls under 140 feet head they would develop 18,494 horse power, and would require a shaft 15 inches in diameter to safely transmit the power, estimating the power to be taken off at each end of the shaft, as is the case at Great Falls, Mont.

Before shipping these wheels to Great Falls, the builders had them tested at the testing flume of the Holyoke Water Power Company, Holyoke, Mass., and both the right hand and left hand turbine showed an average efficiency from three-quarters to whole gate, inclusive, of 81¼ per cent., which is a remarkable performance, particularly in view of the fact that these turbines were the first ones ever made of that diameter by the Dayton Globe Iron Works Company. These wheels were sold on a guarantee that they would show an average efficiency of 80 per cent. from three-quarters to whole gate and would develop 2,800 horse power under 40 feet head, and they exceeded the guarantee both in horse power and efficiency. These wheels are shown very faithfully in the advertisement on pages xxxiv and xxxv.

IMPULSE WATER WHEEL EXPERIMENTS.

BY E. A. HITCHCOCK.

THE ever-present genius of mankind, to utilize as he may need, the force of nature, has led to a development, during comparatively recent years, of that class of water motors known as the tangential or impulse wheel, designed especially for the utilization of water powers under high heads, where the conditions are such that the use of gravity and pressure wheels, that is, overshot, breast wheels, turbines, etc., would be mechanically impossible on account of the excessive heads, reaching in some instances 2,100 feet.

On the other hand, the impulse wheel can be used, for small powers, to advantage on heads as low as 50 feet on account of their greater simplicity, ease of repair, lubrication and reduced first cost, at the same time showing a high efficiency.

The theoretical action of the wheel lies simply in a jet of water impinging on buckets of such a shape that the direction of the stream will be completely reversed and the velocity of jet on leaving the wheel equal to zero, all the energy of the stream being imparted to the wheel. In the mounted impulse wheel, there may be considered, three sources of loss, the nozzle not being considered a part.

1. Loss due to non-reversal of stream.
2. Loss due to mechanical action, interference of particles and friction of water on the surface of the buckets.
3. Loss due to friction of the wheel in its bearings, which can be determined graphically as follows: Make A A', Fig. 3, equal to the diameter of the pitch line of the buckets and N N' the diameter of the shaft in its bearings. Now, D C E is the angle of action of the jet on the buckets and F F' the direction of that jet intersecting the pitch line at the point of bisection of the angle D C E. Make C W equal to the weight of the wheel, shaft, etc., and A' B to the pressure of the absorbing brake, then will G W B be the position and direction of the resultant of these two parallel forces. From the intersection of F F' and G W B, lay off E W B equal to C W + A' B and draw the diagonal E R passing through the center of the shaft. Then E R will be the resulting pressure on the bearings in the case of no friction and W B R will represent the energy required on the part of the jet in the case of no friction. For the case of friction make ϕ, whose tangent is the coefficient of friction, equal to the angle of repose. From the intersection of C H with the circumference of the shaft, and through E, draw E R'. This will be the resulting pressure with friction and W B R' will be the energy required on the part of the jet, therefore $100-\frac{W B R}{W B R'}$, will be the per cent. of loss, due to friction of bearings.

Although from the above relations, it is noted that high efficiency depends principally upon such a shape of bucket as to give as near as possible a complete reversal of stream and a periphery velocity of one-half that of the jet, yet it has been found by a series of experiments, carried on by Messrs. Donham, Frayer and Cilly in the hydraulic laboratory of the Ohio State University, that the maximum efficiency for a certain width of bucket, depends upon the size of tne jet and also the position of the jet in the plane of the pitch line.

The wheel used in the experiments is known as the Cascade, manufactured by James Leffel & Co., of Springfield, O., and was 25⅞ inches in diameter and had 28 buckets, located alternately on each side of a sharp cutting ridge, which serves to divide the jet before reaching the buckets. A 10 x 7 x 10 inch duplex pump was used for furnishing the necessary water supply, pumping from a water bay of 2,500 gallons capacity, into a stand pipe or air chamber 24 inches in diameter by 24 feet high, to which was connected by a 5-inch pipe, the Cascade wheel tested. The wheel was located over another water bay of the same capacity as the former, a weir connecting the two. Calibrations of the nozzles used indicated the amount of water discharged, and the Prony brake the amount of work developed.

Running the Cascade wheel under various speeds at a constant velocity of jet, the results, from which the curve, Fig. 2, is constructed, are as follows:

Diameter of nozzle 1 inch: Length of brake arm 3.183 feet.

Number of trial—	1	2	3	4
Velocity of jet. Ft. per sec...	102.4	101.7	102.3	102.1
Wt. of water discharged per minute	2086	2075	2085	2078
Energy of jet. Ft. lbs.	339600	333219	338750	336278
Net load on brake, lbs.	25	30	35	40
Revolutions per minute	542.3	482.8	447	377.4
Energy developed. Ft. lbs...	271150	289680	312900	301920
Efficiency of wheel	79.84	86.93	92.36	89.78

Results for the best efficiencies of the same wheel with different diameters of nozzles, are as follows, and curve of Fig. 1 constructed from the same.

Size of nozzle.	⅞"	1"	1¼"
Velocity of jet. Ft. per sec...........	99	102.3	103.5
Weight of water discharged per min..	1548	2085	3340
Energy of jet. Ft. lbs................	235518	338750	555524
Net load on brake....................	20	35	55
Revolutions per minute	483.9	447	445.2
Energy developed. Ft. lbs............	193560	31290	489720
Efficiency of wheel..................	81.76	92.36	88.15

Taking the highest efficiency as found by trial, that is, the ratio of the work given ou at the pulley to that stored in the jet after leaving the nozzle, the three losses would be:

First, that due to non-reversal of jet. With the wheel in question, the angle of deviation from the original direction of the jet, is 163 degs. Therefore $E = \frac{1}{2}(1 - \cos 163^\circ) = 97.81$ per cent.; or 2.285 per cent. loss.

Second, that due to the friction of the bearings. Making an application to Fig. 3, trial No. 4, where the diameter of the shaft is 1¾ inches, diameter of the pitch circle 23¾ inches, weight of wheel 200 lbs., the net load on the brake 35 lbs., and assuming the tangent of the angle of repose to be .01, the coefficient of friction, $100 \frac{W B R}{W B R^1}$, (Fig. 3) equals .26 per cent., giving a total loss due to non-reversal of stream and the friction of the bearings of 2.545 per cent., which would give for the second loss, that due to the friction of the water on the buckets, mechanical action of particles, etc., for the trial in question, 100 — 92.36 — 2.545 = 5.095 per cent, which will also include the energy of the jet lost, if any, due to the departing velocity being greater than zero. Therefore we have, loss (1), 2.285 per cent.; loss (2), 5.095 per cent.; (3), .26 per cent. Efficiency of wheel, 92.36.

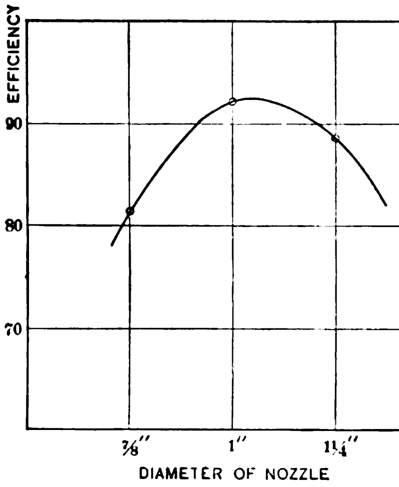


FIG. 1.

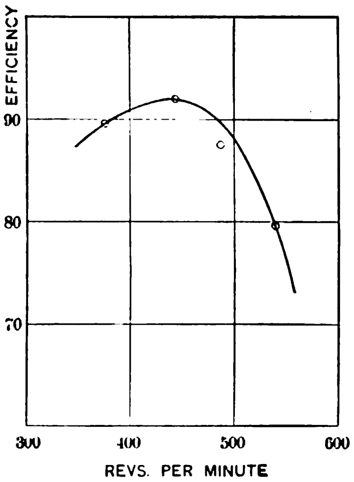
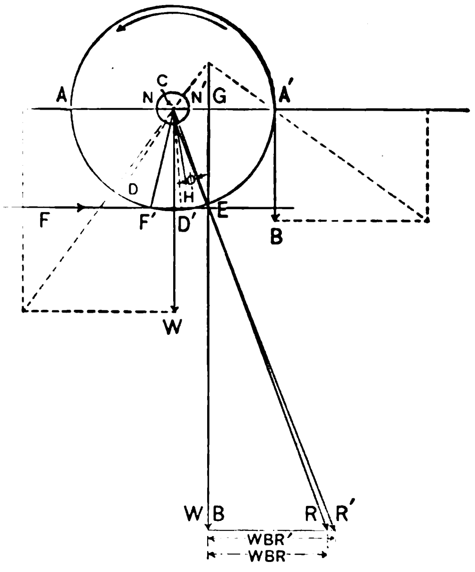


FIG. 2.



Elec. Eng'r, N.Y.

FIG. 3.

NEWS AND NOTES.

METHOD OF RENDERING FUSES RELIABLE.

BY LOUIS W. DOWNES AND WILLIAM C. WOODWARD.

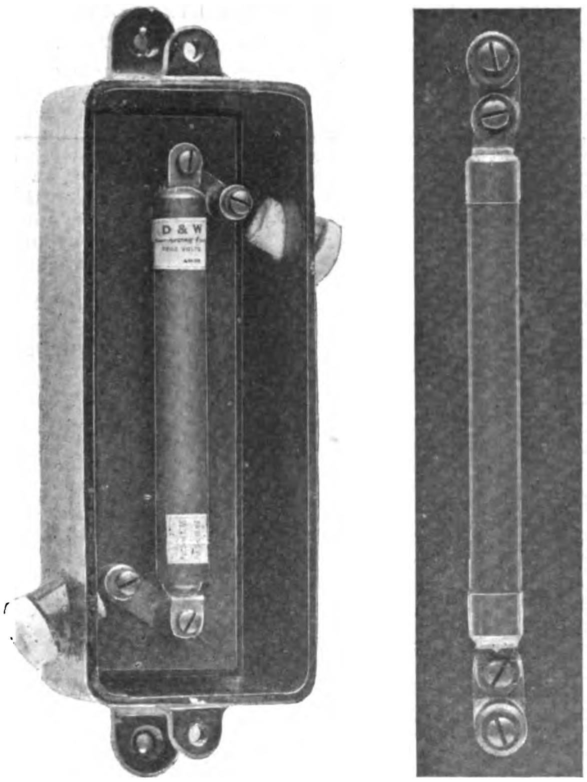
CONSIDERABLE interest has been manifested during the past year or two on the subject of fuses, and so much has been written and said that one might readily believe tne subject had been thoroughly exhausted, with the result, judging by the papers so far presented, that fuses as protective devices were almost universely condemned. Believing, however, that the defects shown were due more to the manner in which the fuses were used and the poor design of the apparatus, we determined to investigate the matter, and the results of our tests, extending over a period of more than two years are now made public.

The so-called inherent defects of the ordinary fuse are, as is well known, an apparent variable melting point, and the liability of fierce and destructive arcing at the moment of rupture under heavy load or short circuit.

Let us carefully examine the conditions and see if the fault is not more in the way in which it is used than in the fuse itself. A variable melting point may result from several causes, viz., location, exposure to draught, contact with adjacent bodies, variation in length or irregularity of cross section; also size and composition of terminals. The first three are, however, the most frequent causes of uncertainty and yet have had the least attention in the way of remedy. A fuse exposed to a strong draught will naturally carry a larger current without melting, than one so placed or arranged as to be free from draught; again a fuse left in contact with a body a better heat conductor than air, will act in the same manner, and it is astonishing how great an effect the slightest contact will have. We have observed instances where a contact not extending more than one-eighth of an inch in a length of 2½ inches with so poor a heat conductor as paper, would change the time of blowing for a given current about 30 per cent. A sensitive device is demanded and yet complaint is raised when it demonstrates its sensitiveness.

The fault of arcing under short circuit is a much more serious trouble, when we consider high potential circuits, but with low potential main line cut-out and branch blocks we believe it to be due largely to the imperfection of the design. The distances between terminals are often ridiculously short, often less than the length of the fuse, which has to be bent to get it in place. No attention has been given to the amount of energy represented by the severe discharge of a short circuit or sudden heavy overload; convenience and appearance apparently having determined the proportions of the so-called safety device.

If we consider that an arc is the result of the formation of a stratum of conducting vapor, due to the volatilization of the fuse metal (and that, once formed, it tends to feed itself by the destruction of the terminals), the matter of overcoming it is not so difficult as might at first appear. To prevent its continuance we have naturally to break up or interrupt this vapor, as we would a metallic circuit, and then dissipate or remove it. If we first enclose our fuse within an insulating tube and then surround it by a mass of suitable, finely divided, material, we have nearly solved the problem of producing a reliable fuse, for, in the first place it is protected from air currents, it is rigidly supported and cannot change its position, and, finally, the multitude of minute paths provided by the space between the filling, disintegrates or divides any vapor formed upon the rupture of the circuit, cooling and allowing it to escape so that an arc cannot be maintained even under the most exacting conditions.



Types of the D & W Non-Arcing Fuse.

A new difficulty, however, here presents itself, due to the fact that the fuse is in contact with another body of variable heat conductivity, throughout its length. If the surrounding material be cold the heat due to the passage of any given current is at start conducted away very rapidly, with the result that the melting point of the fuse is carried far beyond its melting point in air for a given time value. For example, a certain ten ampere fuse 3½ inches long will blow in air at 15.8 amperes in approximately 32 seconds under favorable conditions. The same fuse enclosed as described will carry 50 amperes for over a minute, if cold at the start, or it will carry 30 amperes for thirty minutes. There is what might be called an absorption of heat by the surrounding mass which is gradually raised to a high temperature, the rate of absorption becoming less and less, so that finally the melting point is reached.

This effect would of course be disastrous in practice since the melting point would vary according to the length of time the fuse was in circuit, that is to say, would gradually decrease. Our first effort to overcome this defect was to increase the radiating surface, but this was ineffective, due to the fact that both the tube and the filling were too imperfect conductors of heat to be influenced by any material increase of surface. The method then adopted and found to answer all requirements, was to preserve an air space at the center of the tube within the filling.

Small paper drums or closed cylinders are slid over the fuse and secured at the center. The air confined in this way, being a poor conductor of the heat, prevents its too rapid absorption by the surrounding material at that point, the result being that the melting point is always the same; that is to say, with any given fuse, the melting point always occurs at the same time for any calculated current excess.

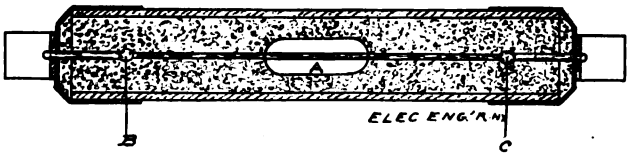
Reference to the accompanying illustration will show the arrangement we have found most satisfactory for the purpose. The fuse wire or link is soldered to copper terminals at points B and C, the air drum A having first been threaded over the fuse and fixed in place by cement. It is then placed within the tube and the filling packed tightly about it, the ends being closed by suitable brass caps in which are cut ventilating slots to allow the vapor produced in short circuit to escape.

By this method it will be found that all the defects of the fuse are overcome. In the first place, its length becomes a fixed value, as are also the dimensions of the terminals. It is rigidly supported in a fixed position which cannot be changed by careless workmen; its insulating covering and the fixed volume of air at the center prevent variation of the melting point, which will be found accurate as regards time and current value to within a small percentage; and finally upon short circuit there is no discharge, flame or noise of any description, and an arc will not be maintained. We have frequently held a fuse in the hand and connected the terminals directly across the mains of a 400-kilowatt, 2,000-volt alternator and could only determine that the fuse had blown by feeling a throb in the tube similar to a pulse beat!

We have enclosed these fuses within an air-tight box connected with a U gauge and upon a short circuit discharge, the liquid would slowly rise, showing but 1.28 ounces per square inch increase in pressure developed, the internal dimensions of the box being but 7 x 2 x 3 inches.

The question of the composition of the filling in the tube was soon found to be an important one. Starting with coarsely granulated marble and with sand it was found that in fuses above three or four amperes capacity there was on short circuit, heat enough developed to melt the silica in the filling, and this combining with the metal of the fuse, formed a peculiar species of slag or glass. Under certain conditions with fuses of high capacity this slag would completely stop the ends of the tube and prevent the escape or dissipation of the vapor, with the result that an arc of the most destructive character would be maintained, sometimes burning its way through the sides of the tube near the center, at times bursting it open with great violence. When the capacity of the tube is great as compared with the amount of metal in the fuse a short circuit would result in the formation of an elongated cylinder of the slag which was readily removable from the case. The material forming the cylinder produced in this way, was sometimes so hard that it would readily cut glass and was probably similar to carborundum in its nature.

A filling was finally discovered which answered all the requirements, as there is now no melting or combination between it and the metal, examination of the filling after short circuit only showing the mass to be slightly blackened at the center with rarely any particles of the metal left, all of it apparently being vaporized. Upon this principle we have constructed fuses up to 100 ampere capacity (by this we mean a fuse that will carry that amount of current indefinitely) and short circuited them on a 500-volt power circuit without flash or discharge of any nature.



The D & W Safety Fuse.

We have also constructed fuses for the 1,000 and 2,000-volt circuits (alternating) with perfect success, although we are limited here as to ampere capacity in our tests, for, although the machines supplying the circuits are of 400-kilowatt capacity, we find that above 20 amperes a short circuit reacts on the fields of the machinery, bringing the voltage down almost instantaneously, so that the fuse simply blows as if from overload.

While this may seem to be a very small fuse, it must be remembered that the rating is for load amperes, that is to say, the current that it will carry indefinitely. The blowing current is consequently much in excess of this, and on short circuit it would rise to a very high value, being controlled only by the resistance and self-induction of the circuit, which are both low. The fact that the field of the alternator is killed shows that the amount of current appearing in the fuse must be something in excess of the output of the machine (200 amperes) at the instant of closing the switch.

We have employed these fuses on 2,000 volt alternating circuits supplying motors of large capacity and on several occasions our fuses have operated on these, with fairly heavy lag currents, without flash or noise. We have also tried them on lines possessing high self-induction with equally good results, and these two conditions would be about the most severe that could be imposed. We have been unable as yet to make any absolute determination of the total energy dissipated in this way within the tube, but are experimenting on a method which we believe will give us this value very accurately.

The question of fuse rating is one that we believe has not been made sufficiently clear to the average construction man, as we frequently hear them speak of a 10 or 25-ampere fuse as one that will melt at that current value, and it is with difficulty that they can be made to understand that without the time factor such a rating means absolutely nothing. There is no definite standard at the present time as far as we can determine, the various manufacturers using different ratings which necessarily leads to a great deal of uncertainty and confusion. Our own tests indicate that the correct method of rating should be by the maximum current that the fuse will carry indefinitely, with the surrounding temperature at 70 to 75 degs. Fahr., and such a method we believe to be the most desirable from both a practical and scientific standpoint. By this method we know definitely from the marking on the fuse just what we have and can allow any necessary overload factor according to the service.

A non-arcing fuse rated in this way will carry a 10 per cent. overload for a considerable period while at above 30 per cent. the time factor is reduced to less than a minute, there being a sharp turn in the curve at that point. This feature gives to the fuse an elasticity which is very desirable, particularly on motor supply circuits, since it admits of slight overloads for some little time, but as soon as this becomes in any way excessive, the time value is so materially reduced that danger to the apparatus is avoided.

The use of fuses of proper design on motor circuits is certainly a more reliable safeguard against continued overload than any mechanical circuit breaker, for in the latter device the current may be long continued at a dangerous point without any action of the automatic breaker, while in the case of the fuse the time factor is a sure safeguard against long continued currents of abnormal capacity.

As an illustration of the above, assume a 10-horse-power motor on a 500-volt current, the normal current at full rated load would be about 17 amperes, but at moment of starting if full load is on, the current may rise to 30 amperes or more for an instant. If the current is controlled by an automatic breaker the "knocking off" point must be set above 30 amperes, or else the breaker will come out when the motor is started. If by any reason the motor is overloaded for any length of time or any fault develops which increases the current strength, say, to 20 or 30 amperes, the breaker is no protection and the motor would burn out before the circuit would open. On the other hand, if a 20-ampere fuse of proper design was used as a protecting device the momentary current increase would not open the circuit, but if long continued the circuit would be interrupted before the amount of current was sufficient to endanger the safety of the motor. We are by no means alone in the stand we have taken, that the fuse when properly designed is the best protection on circuits of constant potential.

THE LYNN INCANDESCENT LAMP CO. AND ITS WORK.

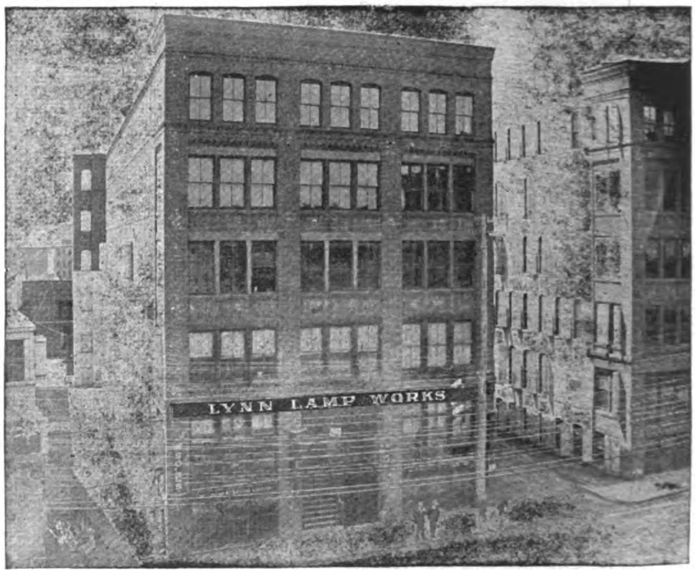
It is with interest that we watch the growth of electrical industries that in spite of the continued slow turning of the wheels of business of the rest of the world, force themselves forward in a compartively short space of time and make themselves necessary factors in the principal branches of electrical practice. The promoters of such enterprises shrewdly take advantage of existing conditions, and assist the station manager to reduce his running expenses and make the most of what he has.

A typical example of this class is the Lynn Incandescent Lamp Company, with their renewal system. While they make a specialty of renewing burned-out lamps, they turn into good lamps or cash, everything in connection with a lamp that is usually thrown away. They began operations about a year ago, and that they struck a keynote, is evidenced by the rapid growth and popularity of their business, soon outgrowing their birthplace. Their working floors are well lighted rooms, 175 feet in length, and covering 10,000 feet each. This enables them to move the work with greatest possible economy.

Upon receiving a lot of lamps to renew at their receiving department, they are first carefully counted, and report sent to the office of the number, kind, etc. This report is checked with the correspondence, and an order placed at once upon the shipping department, to ship this party a certain number of lamps, of such voltage, base, efficiency, etc., it being part of their design not to require a customer to wait for their lamps to go through the factory, but to make him a shipment at once of lamps of the same voltage and base, or whatever he desires, in return.

The first operation the lamps go through is to test them for vacuum, and see if there are any which have burned out on account of the bulb's leaking. Quite a few of some makes of lamps are found to be full of air, having evidently leaked. These are rejected at once and repaired separately or broken up. This feature alone they claim places the total life of a given number of their lamps beyond that of the same number of new lamps.

Next, the bulbs are sorted into their several sizes in order to be fitted with a filament that would look well in the bulb, the coil type being used in the short bulbs, and the loop type in the long bulbs. After this the tips of the lamps are removed with a file, and the opening enlarged to about the diameter of a lead pencil. Through this opening the old filament is removed, and the new one inserted. It is then cemented into position by a cement which is a good conductor, and will stand a high temperature. The invention of this paste was the first step toward rendering possible the business of repairing a lamp, and is due to the company's manager.



The Lynn Incandescent Lamp Works.

A peculiarity of the lamp which claims one's attention at this point, is the manufacture of the filament itself, which is different from anything used by other companies. The filament has a very high specific resistance, and requires a very thick surface of flashed carbon. This flashing process is carried on in chambers, having a vacuum of 30 inches. This is obtained by a special pump of the company's own design. The company has found that the quality of this flashed surface depends to a great extent on the degree of vacuum. The higher the vacuum, the more homogeneous and smoother the resulting carbon. The company also make it a point to have a large percentage of the filament of this nature.

The next operation after mounting the filament, is to clean the bulb of the black deposit from previous use. This is accomplished by revolving the lamp in a suitable holder in large gas burners, which effectually remove every trace of blackening from the lamps. Immediately following this operation, a small glass tube is fused to the opening made in the bulb through which the air is drawn by a system of pumps.

As noted above, this company does not use a mercury pump, but in its place a small mechanical pump of their own design. This pump is a small machine, and is eminently suited for the exhaustion of X-ray tubes, and general laboratory use. The pump has not been put on the market, though the matter is under serious consideration.

The lamps are exhausted one at a time and the entire attention of the operator is given to one lamp until it is finished.

When the lamp is exhausted to the satisfaction of the operator, a small blow pipe flame is directed upon the tube and melted into a point—a perfect counterpart of the tip of the original lamp. The lamp is now ready to be measured on the photometer for candle power and voltage. The lamps are sorted, all lamps of one voltage and efficiency being placed together, and after going through the usual tests, are washed, labelled and wrapped ready for shipment or stock.

Mr. E. F. Dwyer, the manager, states that for a low volt lamp, 3.4 watts per candle is a very popular efficiency; for high volt lamps, 3.2 and 3½, 3½-watt lamps even satisfying those people who desire a very long-lived lamp. For railway work they make a 4-watt lamp with a very short filament, which does not require an anchor. Mr. Dwyer is very confident that he will do a very large business the coming year.

MARRIED

PSCHORR-BERGMANN.

A fashionable wedding on Washington Heights, New York City, June 2, was that of Miss Louise Helen Bergmann to Josef Pschorr, of Munich, Germany, which occurred at the home of the bride's parents, Mr. and Mrs. Sigmund Bergmann of One Hundred and Forty-sixth street and St. Nicholas avenue. The interior of the beautiful house was transformed for the wedding into a veritable flower garden. The ceremony was performed by Dr. Halfmann of the Lexington avenue Lutheran Church, the couple standing in a bower of roses. The bride wore a gown of white satin, trimmed with point lace, and a tulle veil, caught with a sunburst of diamonds, a gift of the groom. She was attended by her sister, Miss D. Bergmann, in pink silk. The bridesmaids, Miss Charlotte Schafer and Miss Adele Friedman, wore nile green. Dr. Robert Pschorr, of Berlin, was best man, and the ushers were Dr. R. Loreck, Mr. Charles Foster, and Mr. Charles W. Ohmeis. A great many handsome presents were given, and the gathering of friends was very large, among them being noticed Mr. S. Insull, who as an old friend had come all the way from Chicago to attend the ceremony. The father of the bride is the well known electrical inventor and manufacturer, who has large interests on both sides of the Atlantic. The couple left during the evening on a brief wedding tour, and will sail for Germany in about two weeks, to make their home in Munich.

Among the guests may be mentioned T. A. Edison and wife, E. H. Johnson and wife, Chas. P. Geddes and wife, Fred Noll and wife, Eugene Lewis and wife, Philip H. Klein and wife, W. E. Gilmore and wife, John W. Lieb, Jr., and wife, and Messrs. Jos. Williams and W. E. Mandelick.

MAHER-GILROY.

All Saints' Church, One Hundred and Twenty-ninth street and Madison avenue, New York City, presented a brilliant scene at noon June 2, when Miss Frances E. Gilroy, daughter of ex-Mayor and Mrs. Thomas F. Gilroy, became the bride of Mr. Edward A. Maher, Jr., son of ex-Mayor of Albany Edward A. Maher, now a resident of Harlem. The ceremony was performed by the Rev. John J. Keoghan, pastor of the Church of St. Thomas the Apostle, assisted by the Rev. J. Power, pastor of All Saints'.

Following the ceremony was a reception at the residence of the bride's parents, 7 West One Hundred and Twenty-first street. The young couple received many beautiful presents, including a silver service of 270 pieces from the employés of the North River Electric Light Company, of which the bridegroom is treasurer.

EDWARDS—STAFFORD.

The wedding of Miss Ida Maud Stafford and Robert Edwards was celebrated on June 2 in the Calvary Methodist Episcopal Church, Seventh avenue and 129th street, New York City. The Rev. Dr. McChesney, the pastor, performed the ceremony at 8 o'clock. The bride's sister, Miss Bessie Stafford, attended her as maid of honor. A reception, with supper, followed the church ceremony, at the home of the bride's parents, Mr. and Mrs. Harlow H. Stafford, 225 West 126th street. The bridegroom is an active member of the New York electrical manufacturing firm of Edwards & Co., in which he is associated with his father.

OBITUARY

CHARLES LEE CROWLEY.

Many of our readers will be pained to learn of the death of Charles Lee Crowley, an able young electrician, at his home at Hamilton, Ohio, on the 28th of May, in his thirty-fourth year. He was first connected with an electrical firm in Cincinnati when he showed rare ability, and later on became associated with the Denver (Col.) Traction Company, where he remained till 1895. He left Denver in that year to accept a position as engineer for the firm of John T. McRoy, the conduit manufacturer. He was singularly popular. He was a man of extensive travel, and his mind was stored with the fruits of exhaustive reading. In Mr. McRoy's service he visited the principal cities of the country, and made electrical friends wherever he went. The Hamilton papers on the occasion of his death spoke in the highest terms of the many good qualities that Mr. Crowley possessed.

PERSONAL

DR. W. E. GEYER, of the Stevens Institute of Technology, lectured before the department of physics of the Brooklyn Institute on May 25 on the subject of Self-Induction.

MR. CHARLES E. PATTISON, for the past six years in charge of the construction and operating of the stations of the Edison Electric Illuminating Company, of Boston, has made arrangements to give up his position and to again take an active part in the business of Pattison Brothers, consulting and supervising engineers of this city. He will continue until January 1st to give part of his time to finishing up the construction work now in progress for the Boston Edison Company, but is at liberty from the present time to act as engineer for other concerns who may desire his services.

MR. LEMUEL E. BANNISTER, of the Westinghouse Electric Manufacturing Company, has gone abroad for a vacation of a few weeks.

THE STOCK MARKET

SECURITIES STEADY OR ADVANCING.

The results of the week go to show that conditions are steady and that in general the country is in a far more hopeful attitude of mind than it has been for a long time past. The cheering views expressed by Mr. Gage, the Secretary of the Treasury, have attracted much attention, the more because of the promise associated with them to give the country legislation looking to a sound currency as soon as the tariff is settled. Meanwhile, the tariff is moving through Congress at a good rate of speed.

Current quotations for Western Union are 79¼ to ¾, General Electric, 31½; American Bell, 229. Electric Storage Battery is reported from Philadelphia as strong and active and in ready demand.

COPPER.—There has been an active market for copper. Lake Superior was quoted at 11 cents up to 11¼. Other grades sold at 10⅝ to 10¾ for electrolytic, and 10⅜ to 10⅝ for casting stock.

MR. W. S. BARSTOW, the general superintendent of the Brooklyn Edison Company, writes: "I have always found The Electrical Engineer up to date in all recent developments of central station work. As we all know, a central station manager's time is not his own, and it is very comforting to know that there is a paper to which he can go for all his information, at the same time feeling sure that this information is correct in every detail."

MR. E. E. CUNNINGHAM, the electrician of the Valley Improvement Company, Elkins, W. Va., says: "I have been a reader of your journal for some time, and I am well pleased with it. Any electrical or steam engineer who wants to keep posted, cannot afford to do without it."

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 1, 1897.

Alarms and Signals:—

ELECTRIC BURGLAR AND FIRE ALARM. J. R. Fraser, Jr., Chicago, Ill., 583,644. Filed February 20, 1897.

A combined burglar and fire alarm system in which the burglar alarm may be rendered inoperative without affecting the fire alarm.

Batteries, Secondary:

SECONDARY BATTERY. J. H. May and F. King, London, Eng., 583,810. Filed January 26, 1897.

Method of applying a coating of India rubber to a cover for secondary batteries. Consists in first treating with a solvent of the material composing it, and applying to it while in soft condition a coating of India rubber.

Conductors, Conduits and Insulators:—

ELECTRIC CONNECTOR. F. E. Austin, Hanover, N. H., 583,589. Filed January 7, 1897.

An insulating casing having elastic closing plugs provided with pin hole apertures for the insertion of the ends of the conducting wires, and a conducting amalgam in the casing adapted to establish an electrical connection between the wires.

CONDUIT. A. L. Daniels, North East, Pa., 583,672. Filed February 10, 1896.

Consists of an inner clay tube composed of short lengths, an outer wrapping of wire, and a coat of waterproof material between the wire and the clay tube.

INSULATOR. E. Renault, Waldo, Fla., 583,692. Filed January 20, 1897.

Comprises a pin having clamping members formed integral therewith, an insulating bulb, formed with a circumferential groove in which the members fit, the bulb being provided with an interiorly toothed sleeve through which the wire passes and is held by the teeth, and set-screws located above and below the bulb for securing the clamping members together.

ELECTRIC INSULATOR. W. Christie, San Francisco, Cal., 583,787. Filed February 16, 1897.

Insulated hanger for electric wires, and comprises an insulator enclosed within a metallic casing.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. P. M. Heldt, Chicago, Ill., 583,622. Filed November 16, 1896.

Comprises a source of polyphase current, with a plurality of primary coils in circuit therewith, and a plurality of secondary coils being disposed in substantially equal inductive relation to each of the primary coils.

Miscellaneous:—

ELECTRIC GAS LIGHTER. J. Y. Parke, Philadelphia, Pa., 583,630. Filed January 2, 1897.

Details of construction.

ELECTRIC WATER FILTER. W. L. Teter, Philadelphia, Pa., 583,718. Filed June 19, 1896.

Consists in forcing the liquid in minute jets against a positive metallic electrode, filtering it and at the same time passing a current of electricity through it, and in its divided state subjecting each jet to the action of a current of electricity, then forcing the water up through a filtering medium and at the same time passing a current of electricity through the water.

VACUUM ELECTRIC ARC FURNACE. H. Eldridge, G. H. Wright and D. J. Clark, Galveston, Tex., 583,618. Filed February 24, 1896.

An upright furnace casing, a carbon lined pot-cathode and a hollow cylindrical anode supported within the cathode and forming a receptacle for the material to be used.

ELECTROLYSIS OF WATERY SALT SOLUTIONS. W. Spilker, Berlin, Germany, 583,513. Filed August 15, 1891.

A process for the production of diaphragms for use in electrolytic processes by the electrolytic process itself with the preliminary aid of an endosmotic vegetable, animal, or mineral membrane—such as parchment, asbestos, etc.

MANUFACTURE OF CARBID OF CALCIUM. J. T. Morehead, Spray, N. C., 583,498. Filed February 20, 1896.

Consists in building up the furnace wall as the formation of the carbid progresses, adding fresh charges of the material to be treated as the wall is built up, and keeping the lower end of the upper electrode at all times near the upper edge of the furnace wall.

Railways and Appliances:—

UNDERGROUND RAILWAY CONDUIT. A. G. Wheeler, New York, 583,524. Filed March 5, 1896.

A slotted conduit comprising slot-rails, supports to which they are bolted and guide rails which are secured to the slot-rail supports being inserted between the slot-rails and their supports.

ELECTRIC RAILWAY. A. G. Wheeler, New York, 583,525. Filed March 5, 1896.

Comprises a supporting bar attached to the car and carrying at its lower end a traveling contact device.

COLLECTOR FOR ELECTRIC RAILWAYS. L. J. Hirt, Brookline, Mass., 583,575. Filed September 6, 1895.

Consists of a plow having a series of contact-points on the supply conductors, and provided with appliances for cleaning and brightening the conductors.

TROLLEY FINDER. G. E. Johnson, Los Angeles, Cal., 583,868. Filed August 21, 1896.

Two arms pivoted and arranged to drop by gravity from each other in a plane transverse to the trolley wire, and means for raising the arms to cause them to straddle the trolley wire.

SELF-ADJUSTING TROLLEY. C. S. McIntire, Allegheny, Pa., 583,881. Filed February 19, 1895.

Comprises a trolley arm and wheel of lateral inclined guard fingers and a wire replacing slide adapted to raise the wire from the guard fingers and replace it in the groove of the trolley wheel.

ELECTRIC BRAKE. R. M. Hunter, Philadelphia, Pa., 583,880. Filed July 14, 1895.

Comprises a longitudinal sliding core encircling the axle and having conical friction-head, a spring acting to press the core in one direction to remove the braking action, and a solenoid having a stationary frame with a conical socket formed to receive the conical head of the core.

Switches, Cut-Outs, Etc.:—

ELECTRIC SWITCH. T. H. Brady, New Britain, Conn., 583,452. Filed February 1, 1897.

Knife switch for heavy currents.

FUSIBLE SOCKET FOR ELECTRIC LAMPS. S. H. Russell, Watsonville, Cal., 583,820. Filed December 7, 1896.

Details of construction.

LEGAL NOTES

TROLLEY FREIGHT CARS ENJOINED ON LONG ISLAND.

A temporary injunction has been granted by Justice Gaynor restraining the Long Island Electric Railroad and the National Express Company from running freight cars of the express company over the tracks of the Long Island Electric Road between Jamaica and Far Rockaway. The suit is brought by Aaron N. De Graw, property owner in Jamaica on the line of the trolley road. He claims the electric road company was organized for passenger service, and that the contract with the express company is in violation of law.

REPORTS OF COMPANIES

ADAMS-BAGNALL ELECTRIC CO.

The Adams-Bagnall Electric Company have, as already announced in these pages, recently closed a deal by which they will confine themselves exclusively to the manufacture of arc lamps, having sold their incandescent business and factory. Their late manager, Mr. Rogers, and Mr. Arnold, of their engineering corps, have gone with the incandescent business. The Adams-Bagnall Company have moved into much larger quarters, which gives them nearly double their previous capacity and the manufacturing facilities which their previous experience showed them would be desirable.

INTERNATIONAL BELL TELEPHONE COMPANY (LIMITED).—The directors elected for this company are Samuel D. Babcock, Gardiner G. Hubbard, Louis A. Von Hoffman, Richard A. McCurdy, Charlton T. Lewis, Elisha S. Converse, Ferdinand C. Thierot, Howard S. Randall, and Louis A. Thébaud.

NATIONAL AUTOMATIC FIRE ALARM COMPANY OF LOUISIANA, New Orleans, office 618 Gravier street, is going into the general electrical supply business, handling electric light, telephone and house goods supplies, putting in a complete line of these goods. Mr. E. H. McFall, general manager, writes us that he will be glad to receive catalogues and communications from manufacturers.

PROVO, UTAH.—Mr. L. L. Nunn has filed notice for a big dam to furnish water for a 10-000-horse-power electrical transmission scheme.

WINDSOR LOCKS, CONN.—It is proposed to have the electric light company pump water for the water company by motor, shutting down the expensive steam plant at the reservoir.

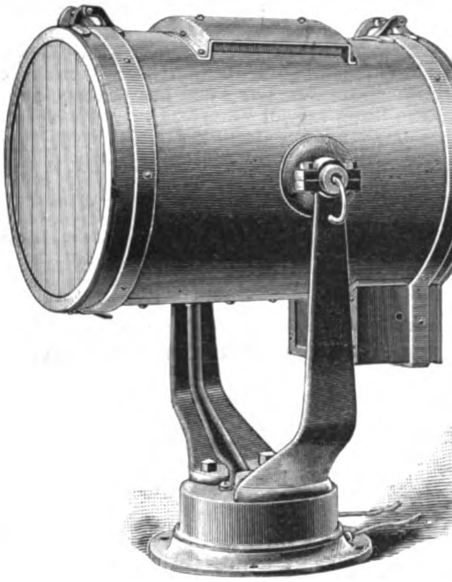
NO CHEWING.—Orders have been given forbidding the practice of chewing tobacco on the part of the operators in the larger telegraph offices of the country, and the men will have to fall back on "gum."

OLD COLONY ROAD.—It is stated that on the Providence Division of the Old Colony Road, from Forest Hills to Readville, the laying of two additional tracks later to be used in connection with the electrical equipment of this line, has been completed, and the stations moved back the necessary distance to clear the way.

TRADE NOTES & NOVELTIES

CARLISLE & FINCH SEARCH LIGHTS.

It is rapidly becoming a necessity for all steamers, whether for ocean, river or lake service to be equipped with the best modern search lights, to assist them make landings with safety and in loading and unloading freight, etc. A lamp that is coming into favor for this purpose in the West is the one manufactured by the Carlisle & Finch Company, of Cincinnati, O. The general appearance of their lamp is shown in the accompanying engraving, which is what is known as "Form 1," or lamp without pilot house steering gear. This lamp embodies all the latest and best features of search light construction.



Carlisle & Finch Search Light.

The feeding apparatus is so accurate that a variation of two volts across the arc is impossible. The lamp will start and burn perfectly when pointed in any direction, and will work as well when pointing up vertically as when in a horizontal position. Either silvered copper reflectors or ground glass lens mirrors are furnished as desired. By means of a small hand wheel in a convenient place, the relative position of reflector and arc may be changed so as to make the ray of light straight or divergent at will. The lamps are made of iron, brass or aluminum. The bases are broad and heavy, and of such width that the whole appearance is extremely symmetrical. The entire weight of the lamp is supported on hardened steel balls and the friction is thus reduced to a minimum.

It is a noteworthy fact that wherever these lamps have been installed they have invariably brought duplicate orders, which is a most flattering recommendation. The firm will be glad to send their full descriptive pamphlet, with prices, on application.

THE STANDARD ELECTRIC COMPANY'S PRODUCTS.

No electrical man, engineer or contractor, with the advances made in the use of high tension circuits, needs to be told the importance of a reliable switch, releasing the contact blades quickly and positively. The Standard Electric Co., of Reading, Pa., have placed a line of switches on the market that are particularly adapted for controlling circuits conveying high tension currents, in which class of switches breaking of the arc is the vital point. Their advertisement appearing on page xxx of this issue illustrates the device. The circuit is broken by the release of the switch blades from engagement with the pole pieces by the expansive force of a compression spring, when the lever releases the cam. The switch lever or arm in its open position, it will be noticed, shows a wedge-shaped protrusion, which, when the lever is closed, engages itself with the rounded bearing faces of steel, permanently attached to the blades. This engagement by the wedge as an auxiliary, makes the contact rigid and perfect in meeting the contacts on terminals. In a recent test for quickness in rupturing the arc, a 15 ampere double pole switch on an 80-light circuit of 220 volts, openea the line with a barely perceptible arc. The company will be glad to respond to any inquiries in regard to these meritorious appliances, and prompt shipment of all orders is promised.

THE HEINTZ STEAM TRAP.

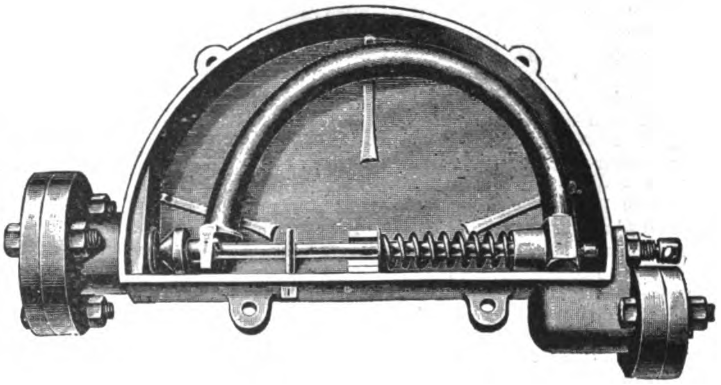
A STEAM saving device recently introduced into this country has attracted attention among steam users. The inventor of this trap, A. Heintz, a native of Alsace, was one of the first to conceive the idea that an expansion trap was, theoretically, and should be practically, the best form of this apparatus, and some twenty-five years ago began experiments on this line. After two years steady work he succeeded in producing a device that met with a fair amount of success but did not realize the inventor's ideas, and it was not until five years later, after constant, energetic application, that he finally succeeded in producing the article that he now places on the market in very nearly the same form that it now possesses.

The Heintz apparatus illustrated in the accompanying engraving consists of a tube spring which is practically the trap, and in the manufacture of this, twenty-one processes are involved, and for each individual spring three weeks' time is consumed. This is so adjusted that at a temperature of 212 degs. it holds the valve closed tight against any pressure and variation of pressure up to 200 lbs., but at 211 dgs. it is slightly open, and by the time the temperature of passing condensation has fallen to 197 dgs., it is wide open, closing again when the temperature reaches 212 degs.

The peculiar merit and economy of the Heintz system lies in the fact that it utilizes all the heat in the steam, but the instant this steam is converted into water, it is passed off and discharged into any convenient receptacle which may be placed either below or above the trap, as the latter will elevate this condensation to any height, limited only by the pressure of steam behind it.

William S. Haines, of 126 South Fourth street, Philadelphia, the sole manufacturer in the United States, claims that he can effect a saving in the fuel used of not less than ten per cent., and cites cases where the saving has been as high as thirty-three per cent.

Mr. Haines states that one single order for twenty thousand No. 1 traps was received last month from a railroad company after exhaustive tests. Inquiries addressed to Mr. Haines at 126 South Fourth street, Philadelphia, will be promptly taken care of.



Figs. 1 and 2.—The Heintz Steam Trap.

FORT WAYNE ELECTRIC CORPORATION.

The continued dull times have exerted no ill effect on the business of the Fort Wayne Electric Corporation. They have experienced a brisk inquiry and sale for all their specialties, which now range through the entire field of electric light and power. The installations of Fort Wayne lighting apparatus have been very numerous of late. The company acquired recently, as already noted in these columns, the full control of the Adams-Bagnall incandescent lamp, which has an entirely smooth bulb, without nipple, and it is understood that this will be very energetically pushed. Mr. C. S. Knight, the active manager of the company, will be present at the Niagara Falls convention.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., make steel boxes of every kind and description for electrical work.

P. & B. SPECIALTIES.

Mr. Frank S. De Ronde, general sales agent of the Standard Paint Company, 81-83 John street, New York, reports that during the past six months the increase of sales of their P. & B. insulating compounds and other electrical goods, particularly in the West, has been most gratifying. People who used these goods ten years ago are using them to-day, preferring not to change. The Standard Paint Company are now making a specialty of tape for re-insulating cable, preservative paints for poles and cross arms, acid proof paints for battery rooms, etc. They are also offering an excellent white and color water paint which is especially adapted for use on walls, etc. Color card and price list of this material will be gladly sent anywhere on application, and should be kept handy in electric lighting, power and railway plants.

ADVERTISERS' HINTS

HUGO REISINGER, 38 Beaver street, New York, claims the "Electra" Nuernberg carbons are the most economical and efficient manufactured.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., illustrate an installation of 600 kilowatt 10,000 volts water-jacketed transformers at Riverside, Cal. They also set forth the merits of their 1897 induction ceiling fan motors for 16,000 or 7,200 alternations.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., show the "Compound" 35 to 2,000 horse-power, "Standard" 5 to 250 horse-power, and "Junior" 5 to 75 horse-power styles of their engine. Their system of permitting prospective buyers to test any engine in the shops before purchasing is a distinct inducement this company extends.

THE DAYTON GLOBE IRON WORKS, Dayton, O., advertise water wheels for power transmission. They present views of a pair installed for the plant of the Boston and Montana Consolidated Copper and Silver Mining Company, at Great Falls, Mont. 3,945 horse-power is developed under a head of 50 feet.

HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., have lately brought out several new designs in their well known switches. Some of these are illustrated and briefly described in this issue, but full information may be obtained by requesting their catalogue "C."

ABENDROTH & ROOT MANUFACTURING COMPANY, 28 Cliff street, New York, claim that the Root boiler is the best adapted to lighting and railway station work.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., advertise their new combination of American-Ball engine and new six-pole generators, and publish a long list of direct-connected plants they are now installing.

JACOB CLOOS, consulting engineer, Milwaukee, Wis., draws attention to his junction box for high potential alternating and direct currents, which was fully described in the February 17th issue of The Electrical Engineer, and will furnish catalogues and price lists on application.

THE OKONITE COMPANY simply state that Okonite is the best insulation for lighting and power.

THE BRUSH ELECTRIC COMPANY show their arc dynamo as it was twenty years ago, and as it is to-day. They offer reduced prices on supply parts when ordered direct.

THE OHIO STORAGE BATTERY COMPANY, Wade Building, Cleveland, Ohio, set forth the manifold advantages incident to the use of storage batteries. This company manufacture a special type for motor-cycle work.

THE STANDARD THERMOMETER AND ELECTRIC COMPANY, Peabody, Mass., advertise the Upton "Midget" enclosed arc lamp as being the shortest, cheapest and most efficient on the market.

THE FARRACUTE MACHINE COMPANY, Bridgeton, N. J., build presses and dies for cutting and notching armature discs and other electrical work.

H. M. UNDERWOOD & COMPANY, Marquette Building, Chicago, Ill., say their "Duplex" lamp guard has made "a great hit." A card dropped to them will elicit full information.

CARLISLE & FINCH COMPANY, 830 North Sixth street, Cincinnati, Ohio, are offering a hand dynamo which generates direct current, 10 volts, 2 amperes or more according to the power applied. It weighs 16 pounds, is twelve inches high and costs $6.50.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., show a type of their iron clad motor adapted to be fastened to ceiling beams, wall beams or wherever most convenient.

THE PRATT & WHITNEY COMPANY, Hartford, Conn., build an endless variety of milling machines and machine tools. This week they illustrate their No. 2 column miller and No. 3 die sinker.

E. H. KELLOGG & COMPANY, 243 South street, New York, established in 1858, are experts in the manufacture of oils for lubricating purposes.

EMIL GREINER, 146-148 William street, New York, is supplying X-ray focus tubes, for which he claims the highest efficiency.

THE BEACON LAMP COMPANY, New Brunswick, N. J., state that they are not in the trust, but are ready to furnish in any quantity every variety of incandescent lamps and X-ray tubes as well.

THE WARD LEONARD ELECTRIC COMPANY, Hoboken, N. J., present a cut of their 1,000-light interlocking dimmer. Their recovery from the disastrous fire which destroyed their works has been exceedingly rapid.

THE GIBBS ELECTRIC MANUFACTURING COMPANY, Hartford, Conn., guarantee absolute protection to the trade in buying the Hartford switches. They say the base never breaks.

THE WALKER COMPANY, Cleveland, Ohio, illustrate the new Walker inductor alternator and cite some of its many excellent features.

THE STANDARD ELECTRIC COMPANY, Reading, Pa., advertise quick break switches and automatic time cut-outs. Both switches and cut-outs are made to suit the conditions of any circuit.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, advertise arc lamps in every variety.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, are manufacturing cored and solid carbons, carbon brushes and a large variety of carbon specialties.

THE BOSTON MOTOR COMPANY, Boston, Mass., furnish X-ray apparatus, experimental supplies, motors, etc. They will send a catalogue on receipt of stamp.

HAMMACHER, SCHLEMMER & COMPANY, 209 Bowery, New York, make telephone box locks one of their specialties.

CHAS. BESELER'S SON, 218 Centre street, New York, is advertising high grade stereopticons, magic lanterns and accessories.

THE PRENTISS CLOCK IMPROVEMENT COMPANY, 49 Dey street, New York, are prepared to furnish anything electrical in connection with clocks. Their catalogue 5697 contains full information.

HENRY W. BULKLEY, the sole manufacturer of the Bulkley "injector" condenser, illustrates the apparatus similar to that installed in the Paterson (N. J.) Edison Company's station described in The Electrical Engineer of December 9, 1896. This condenser requires no air pump, "safety" floats, vacuum valves, exhaust check valves, etc.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY, Syracuse, N. Y., carry at all times a full line of sockets, switches, cut-outs, wall boxes, junction boxes, switchboards, etc.

THE NON-POLARIZING DRY BATTERY COMPANY, 347 West Broadway, New York, advocate the use of the "O. K." dry battery and publish a list of dimensions and output of several types of cells.

THE IRON CLAD RHEOSTAT COMPANY, Westfield, N.J., state that there are 2,500 of their theatre dimmers in use.

R. B. COREY, 711 Havemeyer Building, New York, is the New York agent for the "Columbia" incandescent lamp, "Simplex" wires and cables, "T Z R' weather-proof and rubber covered wires, and underground cables.

THE ELECTRICAL EXCHANGE, 166 South Clinton street, Chicago, are offering some bargains in alternating generators, direct current dynamos and motors, arc lamps, instruments, etc.

THE AMERICAN CARBON CO.'S carbons are carried in stock by the Chicago Edison Co., Chicago, Ill.; the Peck Electrical Co., New York City, and the Brooks Follis Electric Co., San Francisco.

WILLIAM S. HAINES, 122 South Fourth street, Philadelphia, Pa., is the sole manufacturer for the United States and Canada of the Heintz Steam Saver. It is fully described elsewhere in this issue.

AMERICAN RHEOSTAT CO., Milwaukee, Wis., advertise an electric controller that "is not built for the repair man and does not make you think it's the fourth of July when it operates."

THE CENTRAL ELECTRIC CO., 173 Adams street, Chicago, give a couple of pointers to probable purchasers.

OTIS BROS. & CO., New York, illustrate one of their electric passenger elevators and give several reasons why it is one of the most desirable.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, Ill., are headquarters for porcelain goods, carrying a full line in stock. They are ready to fill orders with despatch.

DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., have brought out several new designs in their famous fans this season.

FORT WAYNE ELECTRIC CORP., Fort Wayne, Ind., advertise the "Wood" station instruments in the construction of which no springs or permanent magnets are used.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 527 West Thirty-fourth street, New York, claim their system of interior wiring to be the standard.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, say that by the use of their lamps, 20 per cent. is saved in economy and 30 per cent. in life. They are now in a position to fill all orders promptly.

THE STANDARD THERMOMETER AND ELECTRIC COMPANY, Peabody, Mass., who have met with so much success in introducing their latest lamp, the "Midget" enclosed arc, which they claim to be the shortest on the market, are represented in New York by J. H. Bunnell & Co.; Chicago, The Electric Appliance Company; Philadelphia, Etherington & Co.; San Francisco, Dunham, Carrigan & Hayden Co.

J. JONES & SON, 67 Cortlandt street, New York, advertise switches, switchboards and panel boards, as well as electrical supplies.

THE BERNSTEIN ELECTRIC COMPANY, Boston, Mass., continue to sell their well known incandescent lamps.

THE AMERICAN ENDOSCOPIC COMPANY make it a specialty to supply miniature lamps for decorative purposes.

S. F. B. MORSE & COMPANY, Chicago, carry a stock including wires and cables, arc lamps, incandescent lamps, rheostats and theatre dimmers, and general electrical supplies.

THE ELECTRIC PROTECTION COMPANY, Philadelphia, Pa., advertise the Hunter push buttons as the best thing in that line.

THE EDDY ELECTRIC MANUFACTURING COMPANY, Windsor, Conn., state that it is now sixteen years since their apparatus was first put on the market. Their direct-connected generators and motors are recognized as standard the world over.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., remind the public that to make and sell switches and switchboards is their business, and that they are doing both.

THE ELWELL-PARKER ELECTRIC COMPANY, Cleveland, Ohio, carry a full line of belted and direct-connected motors for all conditions of service, direct connection to machines being one of them.

QUEEN & COMPANY, Philadelphia, Pa., note the advantages of their adjustable vacuum X-ray tubes.

AHLM-EDWARDS ELECTRIC COMPANY, who recently moved to larger quarters in Cleveland, are building an excellent line of dynamos and motors. They will cheerfully reply to any requests for detail information.

McLEOD, WARD & COMPANY, New York City, advertise ceiling fans, ventilating fans, desk lamps and spark arresters.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, Mass., have made "a hit" with their Universal field rheostat and will introduce an automatic motor starter in thirty days.

A. K. WARREN & COMPANY, New York, illustrate their dynamo brushes, which they claim to be the most economical on the market, as by means of the holder every part of the brush is utilized.

NEWTON APPLIANCE COMPANY, New York, illustrate and describe some of their specialties in switches, fuse "bugs," etc.

THE INTERNATIONAL ARC LAMP COMPANY, New York, call attention to something new in that line.

ANCHOR ELECTRIC COMPANY, Boston, advertise switches of all kinds.

KEYSTONE ELECTRIC INSTRUMENT COMPANY, Philadelphia, Pa., will have their headquarters in Parlor E of the Cataract House during the convention, where they will give all information regarding their high grade instruments.

F. N. ROEHRICH & CO., the specialists in machinery designing, have removed to more commodious quarters at 102 Fulton street, New York.

EDWARDS & CO., 144th street and Fourth avenue, New York, advertise a great variety of specialties, including door openers, self-fastening desk pushes and lock gravity drop burglar alarms.

THE THRESHER ELECTRIC COMPANY, 26 North Main street, Dayton, Ohio, show one of their motors direct connected to a web printing press. The slow speed at which these motors operate and their general construction render them well adapted for power work.

THE D. & W. FUSE COMPANY, 53 Ahorn street, Providence, R. I., are doing a large business in their non-arcing fuse and safety devices for alternating, motor, railway, lighting, telephone and fire-alarm circuits, and claim them to be absolute protection from short-circuit or overload.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., who commend the Holly system of heating in utilizing waste steam, quote a letter from one of their customers who says that their receipts from this source enable them to pay eight per cent. dividends on an investment of $100,000, which includes their electric lighting plant and steam heating apparatus.

THE STANDARD PAINT COMPANY, 81 and 83 John street New York, invite those interested to write for prices on the P. & B. specialties. These have long been recognized as standard, and the excellence of their quality is indisputable.

W. R. BRIXEY, 203 Broadway, New York, continues to sell "Kerite" wire and cables. Kerite has a thirty-one years' record and is still holding its own, becoming more popular every year.

THE IDEAL ELECTRIC CORP., Thirteenth and Hudson streets, New York, illustrate their alternating long-burning arc lamp. A card to them will obtain full details as to what this lamp will and will not do.

THE WHITE THERMOSTAT COMPANY, Providence, R. I., have an insulating wire support that is really worth considering. Its simplicity and efficiency are hard to excel.

THOS. MUIR & SON, Detroit, Mich., have met with much success in introducing their new motor starter, combining simplicity, durability and efficiency and made for 110, 220 and 500-volt currents.

THE GENERAL ELECTRIC COMPANY will be largely represented at the convention and will respond to any inquiries regarding their several systems of complete central station equipment.

NEW ENGLAND NOTES

AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., are very busy on orders for their surgical, dental and bicycle lamps. They are specialists in all high-grade miniature lamps.

C. H. McEVOY, Lowell, Mass., reports a satisfactory business in telephone cords. Mr. McEvoy has been manufacturing telephone cords almost from the time the telephone was invented, also switchboard cords, medical battery and bell cords. They are of superior make and widely used throughout the country. Mr. McEvoy will take pleasure in mailing catalogue and prices to any address on application.

L. E. KNOTT APPARATUS COMPANY, 14 Ashburton Place, Boston, Mass., are filling good orders for physical and electrical apparatus. They are manufacturers and dealers in these goods.

GLOBE ELECTRIC LAMP COMPANY, Malden, Mass., have enlarged their plant and put in new machinery to increase their output.

JOHN BECKER MANUFACTURING COMPANY, Fitchburg, Mass., are receiving large export orders for their milling machines.

BOSTON MOTOR COMPANY, 17 Batterymarch street, Boston, Mass., have issued a very interesting 1897 catalogue, which contains several tables and other valuable information, and shows also a full line of motors for battery alternating and direct current purposes. It includes also Röntgen ray apparatus, and a variety of experimental electrical supplies. A copy will be sent to anyone interested on receipt of two cents for postage, and prompt attention will be paid to any orders or requests for information. Requests for catalogues should mention the 1897 edition.

WESTERN NOTES

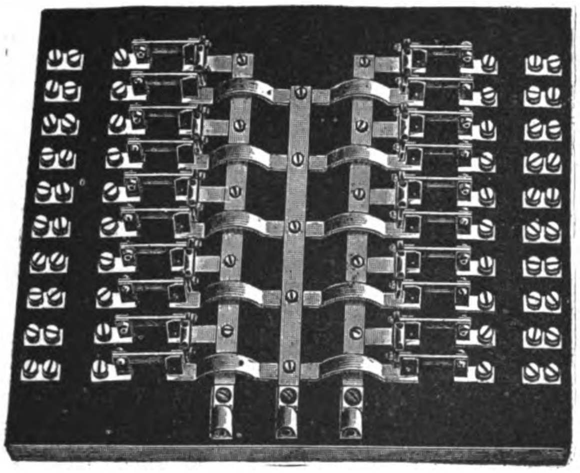
A. M. MORSE has removed from 1249 Marquette Building, Chicago, to suite No. 1108 and 1109 same building. He will make a specialty of high grade engines for electrical service, both Corliss and high speed type. Mr. Morse has had a wide experience in steam engineering work, and has equipped many of the representative power plants in the southwest. For the past five years he has been the selling agent of the Buckeye Engine Company, but severed his connection with that company June 1st.

ELECTRIC APPLIANCE COMPANY.—The protection of electrical machinery from damage by electrical storms is al-

THE JONES PANEL BOARDS.

THE latest thing in panel boards is the unique idea embodied in the boards built by Messrs. J. Jones & Son, of 67 Cortlandt street, New York.

As shown in the accompanying engraving, instead of raising up the mains, as has been done in the past, the mains are "jumped" by the branches by means of a half-loop in the same strip. The main bars thus rest directly on the branch bars, reducing the number of joints to a minimum, lessening thereby the resistance at the contacts and at the same time reducing the cost. The engraving shows a 3-wire main with 2-wire branches.



JONES & SON PANEL BOARD.

NEW YORK NOTES.

KIELY & MUELLER, 7 to 17 West Thirteenth street, New York, are the inventors and manufacturers of the Champion return steam trap, Eureka pressure regulator, and positive-acting pump governor. They handle a great many other steam specialties and have recently installed their goods in the new "Astoria" Hotel, Delmonico Building and Sherry Building.

PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren street, have just issued a very tasteful circular, literally in all the colors of the rainbow, devoted to an illustrated description of their leading specialties, Rainbow, Honest John, Hercules and Peerless packings, as well as the Eclipse Sectional Rainbow Gaskets. Our readers should get a copy of this circular.

MR. A. D. FRENCH, the New York agent of the Williamsport Wooden Pipe Company, has been obliged to remove to larger quarters in the Edison Building, 44 Broad street, in order to handle his increasing trade. Besides handling conduit, he has a large trade in octagonal poles, and keeps a stock in New York ready for quick delivery. He also controls the output of two mills in the South, and has a large stock of poles on hand for shipment.

ROOT BOILERS.—One may depend upon the Root boiler for safety and economy and efficient service. It has been upon the market for thirty years and its merit is unquestioned. There is an attractive advertisement of the manufacturers, the Abendroth & Root Manufacturing Company, in this number, and our readers are advised to give it their attention.

NEW JERSEY now has in force a law compelling trolley companies to vestibule their cars in winter.

HARRISON SAFETY BOILER WORKS, Philadelphia, have recently shipped a 1,000-horse-power heater to the Central Electric Company, Lexington, Ky., and a 500-horse-power heater to the Memphis Light and Power Company, Memphis, Tenn.

MR. A. L. REINMANN, for many years general superintendent of the Sawyer-Man lamp factory, is now general superintendent of De Laval's Svea lamp factory at Stockholm, Sweden. It is one of the largest establishments of this class, having a capacity of 10,000 lamps a day. They own their own gas works and glass house, and use some Berrenberg metallic pumps.

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Electrical Engineer.

A WEEKLY REVIEW OF THEORETICAL AND APPLIED ELECTRICITY.

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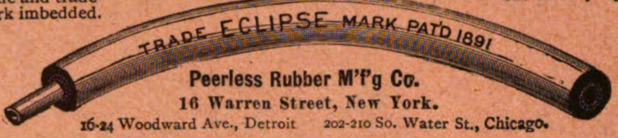

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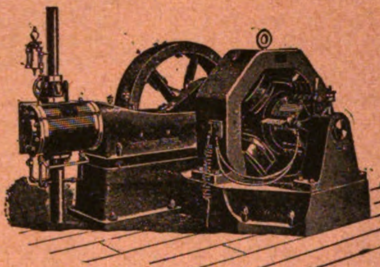

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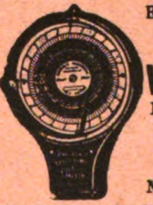

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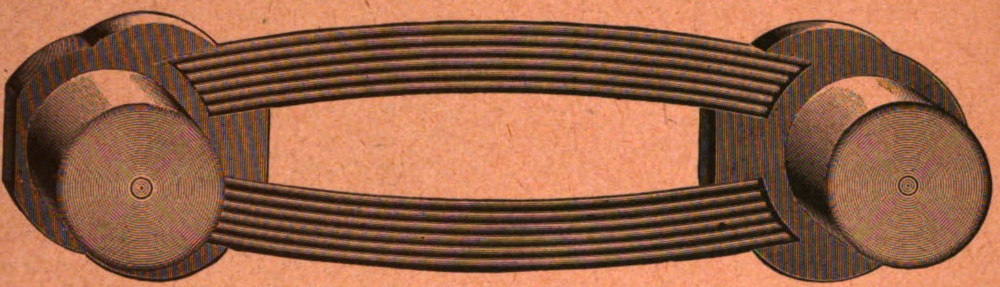

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The Electrical Engineer.

Vol. XXIII. JUNE 16, 1897. No. 476.

ELECTRIC LIGHTING

MUNICIPAL LIGHTING.[1]

BY W. WORTH BEAN.

THE subject to which I would respectfully invite your attention is one of the most vital questions, and of the most momentous importance—not only to the profession to which we have the honor to belong, but also to various commonwealths of which it is our pride to be citizens—that has ever arisen in this advanced electrical era. Municipal ownership of electric lighting plants, the most discussed of all the questions of municipal polity, is the more insidious that it comes dressed in the sheep's woolly garb of a philanthropist, which to the uninitiated and ignorant has an alluring and plausible aspect, but to the experienced are plainly visible the wolf's deadly fangs, which have, in every instance, sooner or later lacerated the taxpayer. The authors and promoters of this alluring scheme are either visionary theorists, who have no practical knowledge of its manipulation, or unscrupulous politicians who, desiring to pose as benefactors to the municipality, hope to ingratiate themselves in the hearts of the voter and thus secure political plums for themselves and their henchmen. That there are many honest supporters of this political fad who, having been deceived by beautiful but false reports from cities which are experimenting with this question, are misled by political demagogues, is undeniable.

The tidal wave is sweeping over our land, and certain municipalities are now on the crest, but it will not need the average period of depreciation in a plant for the wave to subside and leave the wrecks stranded with increased burdens and depleted treasuries. Already cities have sold their plants, paying dearly for their experience, and others are looking for buyers, in order to unload their "white elephants." Municipal ownership is contrary to the spirit of republican institutions.

Government, whether national, State or municipal, was instituted for the purpose of protection and not production. It would be just as reasonable for the city to enter any pursuit, such as farming, or as a grocer, or keep a sawmill to saw its own material for sidewalks or paving, or manufacture shoes for its citizens, or run a saloon for the profit there is in it, as for it to enter the field of lighting. Just as sure as a nation becomes a commercial producer, competing against its own citizens, just so sure will the seeds of its own disintegration be sown.

Municipal ownership is a source of danger to the commonwealth, in that it affords a great opportunity for fraud. Municipal corruption is so common and so well known that it needs no argument to prove the danger of opening a new avenue of power in the hands of unprincipled public officials. In this business there are a number of important, and ought to be well salaried, offices, which can be used to great advantage by political manipulators to further their own ends to the detriment of the city. In the State of Michigan one political party had been in power for thirty-four years until 1891. A member of the old party was elected to the Senate and introduced a bill to benefit Coldwater, Mich., and this has been the Mecca of the municipal advocates ever since. It has been the oasis in the desert where they could get sweet morsels to roll under their tongues to advocate the scheme of municipal ownership. I venture to say that more than a score of towns and cities have charged up expenses for the examination of this delectable plant, and from their own printed statements I am willing to qualify that the figures are not as they should be made. Reports come from Grand Haven, Mich., that through political influence a competent electrical corps has been discharged to make room for inexperienced friends of the "powers that be." "To the victor belong the spoils" is a policy followed with unswerving fidelity by a great many city officials. Scandals from our great cities in regard to employés, inspectors, officials and boodle aldermen, should teach us to avoid throwing this enterprise, involving hundreds of thousands of dollars, and positions of the utmost importance to the city, into the maelstrom of municipal politics.

Municipal ownership is unjust to the electrical plant now in the field. The central station man has, through his industry, ingenuity and executive ability, built up a large enterprise. The city has invited him to invest thousands of dollars, not only of his own money, but also the money of its own citizens, with no immediate show of dividends, and, in some cases, barely sufficient income to pay the running expenses and interest on the bonds during a period that will amount from one-half to the whole of the average amount of time allowed for depreciation of the plant. The central station man during this time has been harassed with the anxiety of meeting the fixed charges, maintaining the credit, providing a reserve fund to meet loss by fire, wind storms and burned-up apparatus, and cheering up despondent stockholders who have nothing to show for their money but the rosy-hued prospect that, at some time in the near future, there will be an adequate dividend to compensate them for their risk, and now, when these hopes are about to be realized, in a modest degree, they are confronted by municipal ownership. He must either compete with the city—which, through ignorance, will furnish lights below cost—or sell out. The latter proposition is impossible, for he cannot hope to dispose of a plant that has depreciated 50 or 75 per cent. without great loss, therefore he is compelled to continue in business with his former heaviest consumer, now his strongest competitor, with the prospect of having to renew his plant within a very short time, at a heavy expense, and knowing full well that there is room for but one paying plant in a city of that size. Such conduct on the part of the city amounts to the indirect confiscation of property; obtaining a competent and effective service for years without profit, holding out the alluring representations of a future gain.

Municipal ownership is unjust to the taxpayer. That through ignorance or willful errors in keeping accounts it is certainly true, in most cases, that lights are furnished to the city and private patrons at a loss, and the deficits charged to some other accounts. Very few of its citizens are able to take the lights at the reduced price, for the great majority of its citizens are day laborers, who are paying for their homes, and cannot afford to take the lights even at any price, but who eventually must help to carry the burden of the ever-increasing loss, thus making the many help pay for the luxuries of the few. Municipal ownership has cost the city of Hamilton, Ohio, $575,000. It is reported that an order has been made to discontinue the electric lights, on account of lack of funds. This has been a very expensive experience for Hamilton, and the taxpayer who has burned nothing but an oil lamp now helps to pay the bill.

The result, in most cases, will be less efficient service than under the competitive system. Central station men who have been in the business for a long time, and who have had years of experience, are, without doubt, the most competent to give the best service of the times. He surrounds himself with expert electricians and a corps of able assistants who have been educated in the business and retain their position by the strictest attention to duty. He is continually devising means for improving his service, not only in employés, but also in the latest improved machinery. On the other hand, municipalities change their officials frequently, and new men take control. Councilmen who oftentimes are not even good business men, and have no knowledge of apparatus and electrical affairs, pass on the purchasing of supplies and the competency of electricians and engineers, deposing experienced incumbents and apportioning political plums to friends of but ordinary ability. The men now in control attempt to compete with electrical experts and competent engineers of long experience, and about the time when they are beginning to understand their plant and how to save loss—in a year, or possibly two—the Council changes, and they must step down to make way for those of even less ability. Again, in smaller cities councilmen are often elected on the single issue of economy, and in order to fulfill the expectations of their constituents, they must cut expenses. The first attack is made on the official salaries, which results in filling responsible positions with inefficient men. Experts cannot afford to educate themselves for positions commanding low salaries and subject to the vicissitudes of municipal politics, and we all know too well the cheap men in this business are the most expensive. Then, again, the economical councilmen will object to improving the plant, which will require vast sums in replacing that which has but lately cost so much, and for which they have not as yet finished paying. This is especially so if the improvements are demanded in a time of financial depression, and when taxes are already too high.

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[1] Abstract of paper read before the National Electric Light Association, Niagara Falls, N. Y., June 8–10, 1897.

The glowing reports from cities that are experimenting with this question are unreliable and misleading, except to the electrical profession. In some cases, where the plant is new and there is no perceptible depreciation, and where they have providentially escaped accident or disaster, no doubt these statistics are honestly, though ignorantly, compiled, deceiving the taxpayer into the belief that their venture is a glorious success. The engineer's salary and the coal bill are often charged to the water department, and the water consumer helps pay the electric light bill.

In most instances the item of interest on the outstanding bonds is charged instead of interest on the entire plant, and 4 per cent. depreciation is charged, whereas from 10 to 15 per cent, should be the rate. In some cases losses by fire are not accounted for; in others accidents are never charged. The loss to the city of the taxes that would be paid in by a private corporation is not computed, and in a great many cases the accounts are so mingled with other departments that it is impossible for even the officials themselves to tell how much the lights for street purposes cost the city.

I have personally visited Niles, Kalamazoo and South Haven, Mich., and I know that these cities are paying more for their lights than their official reports show what they cost, and yet they are considered among the list of those who are successful with municipal lighting. The city of Detroit has probably the finest equipped plant in the State of Michigan, and operated under the most advantageous circumstances, and yet she pays $100 in round numbers per lamp for 1,483 lamps, under municipal ownership, while St. Joseph and Benton Harbor, under the relentless pressure of a private corporation, only pay $90 on an average, for sixty-two lamps. Tipton, Ohio, and Marquette, Mich., had serious accidents, and the deluded taxpayer, with his eyes partly open, refuses to vote more money for such a hazardous enterprise.

At this present writing municipal lighting has not passed through its most dangerous period, and its is difficult to predict its final result. It is now but at the dawn of its existence, but a December day will be long in comparison with the life it has to run, for when bonds are to be redeemed, accidents befall the plant, and a depreciated plant is to be renewed, then comes the trying ordeal, and woe be to the city that has not provided against that day, but has wasted its substance in riotous living, for then it will be found to have nothing left for its existence but the husks of "Municipal Lighting."

PROFITABLE EXTENSIONS OF ELECTRICITY SUPPLY STATIONS.[1]

BY ARTHUR WRIGHT, BRIGHTON, ENG.

THERE are many central stations which, very soon after starting the supply, have to face extensions of plant and mains, and generally such necessity for extensions has been regarded as an unmistakable proof of commercial success. That this is not necessarily so, many of us have found, as it is obvious that no extensions are warrantable unless a definite profit can be assured from them.

No company should be called upon to supply electricity to any one at a loss, notwithstanding the common impression that it is necessary in electricity supply business to take the bad customers with the good, and the author shows in this paper that it is quite possible to devise a simple and equitable tariff by which a profit to the supply company, as nearly as is commercially practicable, is assured from every consumer; and, moreover, that only by adopting such a tariff of approximately equal rates of profit from all consumers can central station managers hope to get the use of electricity generally adopted for all the many purposes it naturally lends itself to.

Owing to the enormous development of the business of electricity supply for power transmission, for traction and other purposes, many central station managers have lately devoted most of their energies to the supply of electricity for those uses. The author, on the contrary, firmly believes that there exists even a larger and more profitable field for electricity supply ready at hand in every town, waiting only to be tapped, and refers to the supply of light to the thousands of domestic lamps required by the middle classes in their homes. This profitable domestic supply, which is largely used after business hours, need in no way interfere with the much-catered-for power supply, the value of which the author fully appreciates. Another enormous field for profitable extensions is to be found in the smaller and lower classes of stores, saloons and business houses that trade until late in the evening.

The author doubts the possibility of much financial success attending the efforts of central station managers until they dismiss from their minds the idea that large consumers' bills necessarily mean large profits, as very frequently the reverse is the case. His contention is that, if an equal rate of profit be charged to all consumers of every class and size, the field for profitable extension is practically boundless.

It may be argued that if the principle of equal rates of profit from all consumers be carried into effect, it might result in a serious loss of revenue to the supply stations, owing to the large but short-hour consumers objecting to the higher rates thereby necessarily charged to them.

A perfect answer to the short-hour consumers, who object to pay a higher rate than their long-hour neighbors, is that under no circumstances whatever ought their supply to involve a loss to the supply company or increase the charge on the more profitable classes, as it is obviously very sound commercial practice in every business, without exception, to encourage the profitable, even at the risk of losing some of the profitless, business.

If the principle of a sliding scale based upon the more or less prolonged use of the maximum demand is correct, then, on every consideration of practice and of policy, it should be applied to each consumer without distinction. Uniform rates mean that, if high, they discourage the only class of business yielding profit; and if low, mean a heavy loss on supplying short-hour consumers, which they directly encourage. Moreover, a uniform rate can never be so low for the supply of electricity to long-hour consumers as charges on an equitable sliding-scale system.

It may be said that many managers have long ago introduced the system of giving discounts in proportion to the number of lamp hours consumed per lamp installed per annum. The author maintains that, for anything else than street lighting, this system must have a very pernicious effect on the development and extension of the supply business, for the following reasons:

First, as the discount given is frequently inversely as the connected load (a strange method surely of encouraging the public to give a whole-hearted support to electric lighting), a consumer usually installs only those lamps he can use very freely, and, under this scale, the longer he runs them the larger will be his "bounty" in the shape of discounts; as he knows very well that if he installs any less frequently used lights, his consumption per lamp, and, consequently, the discount given him, will decrease, so he stops short of the number he would like to use, and electric lighting remains for him a luxury strictly confined between the limits of certain business or social requirements. The economic disadvantage of this method of charging, then, is that it tends to contract the load curve and drive up the peak, which seem to the author fatal to this system. By this method of discounts, hotels and private residences, which afford probably the most profitable field for electricity supply, would be charged at a rate so high as to prohibit the general wiring of them, although, by their being generally wired, their load curves would be so spread out as to make them highly desirable consumers. This method of giving rebates must also prevent large business establishments from wiring their entire premises, although, probably, the lights would be used in the upper residential parts when those on the lower floors have been extinguished.

The second objection is that in practice the author maintains it is impossible, in a large business, to ascertain with sufficient accuracy throughout the year the wired capacity of all the consumers' premises. The third great objection is the inexpediency and great expense of insisting upon the necessary domiciliary visits in all parts of private houses, hotels, etc., which this system requires.

Fortunately, there is a much cheaper way of determining the consumers' true demand on the station for supply, consequently the true basis on which the charges should be made—viz., by measuring the greatest rate at which they usually require to be supplied with electricity. Another system now very much in vogue, but having equally bad effects in preventing the profitable development of supply stations, is the unsound practice of charging a higher price for electricity consumed in lamps than in motors or other current-consuming apparatus. The author maintains that the isolated plant question can also, by a judicious tariff, be turned into a blessing, instead of a curse, and his experience leads him to believe that there should be little difficulty in obtaining practically the whole of the profitable part of this business as regular consumers, instead of irregular worries. By no other method than that of an equitable sliding scale can this particular and generally very profitable business be obtained. It is well known that isolated plants are generally only installed where the demand for electricity is of a lengthy nature, consequently they would form a most desirable class of consumers if their permanent supply could only be obtained. That the result of an equitable sliding scale is to get this class of consumer on a central station supply, is shown in Brighton, England, where, since the sliding scale has been adopted, several valuable isolated plants have been secured to the supply station mains, and not a single new one has been installed in that town.

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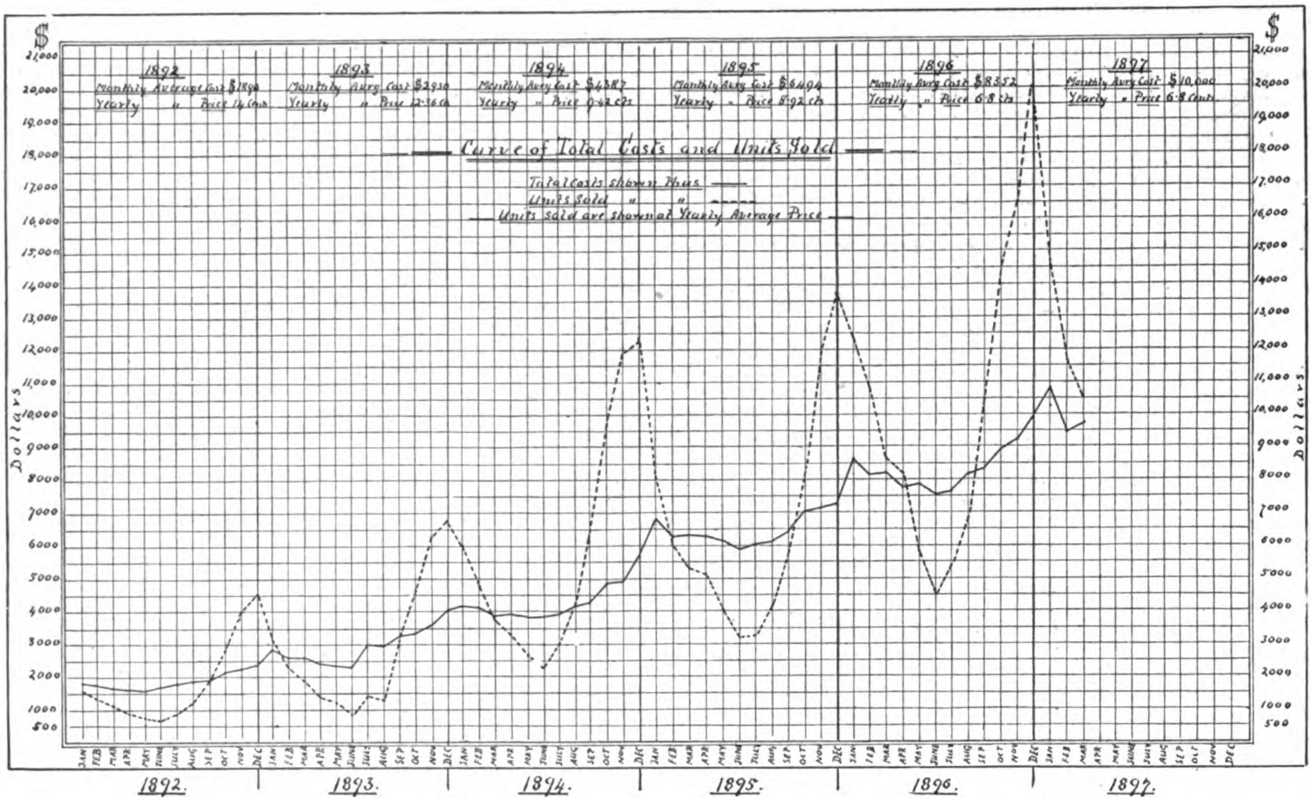
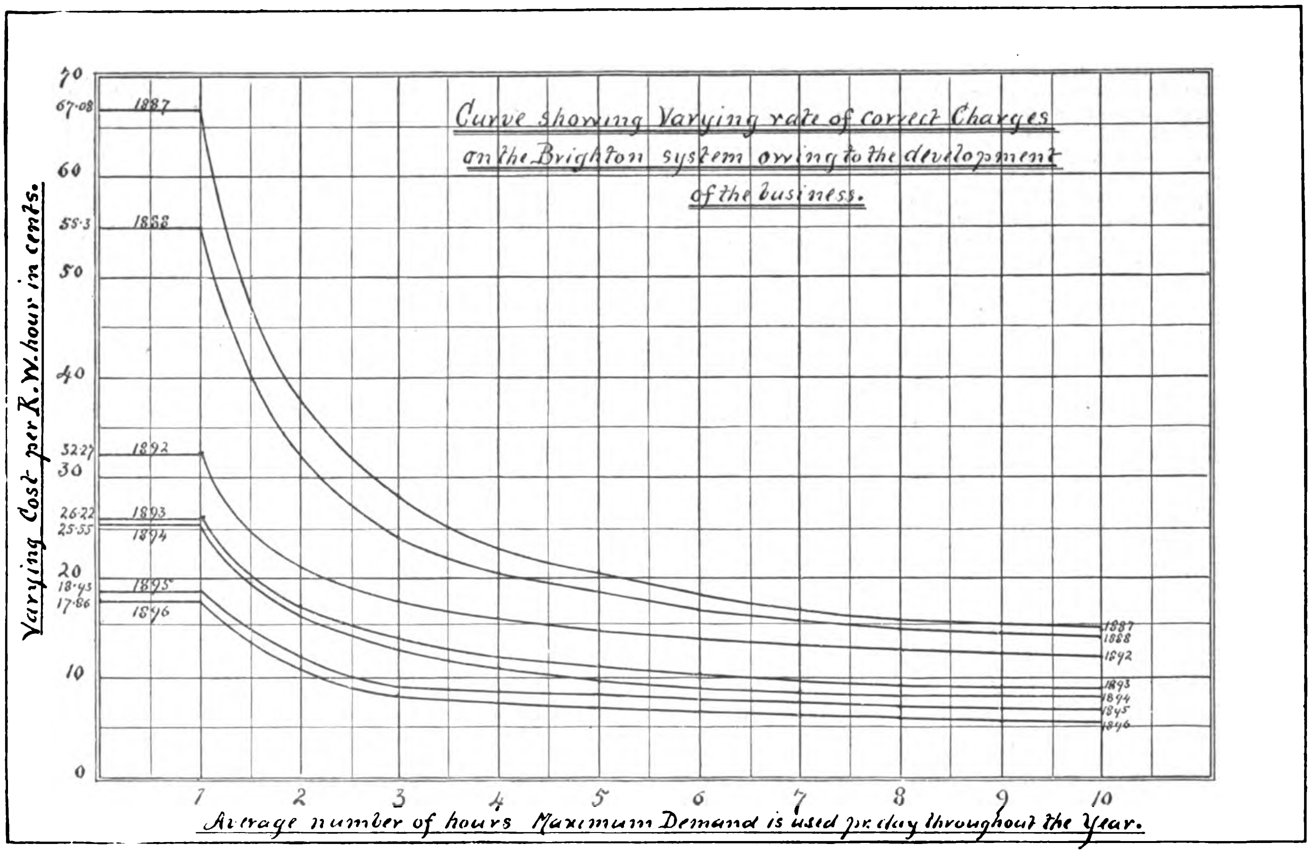
[1] Read before the N. E. L. A. Abstract.



at varying hours, and on the same principle encouraging consumers to install lamps that will be used at different times of the day and night. This diverse supply in a town obviously means a much less plant capacity than would be the case were all the lamps required for the same purpose and at the same time. In the town of Brighton, where the actual demands of all the consumers are accurately known, and where the use of electricity is very evenly divided between residences and stores, this diversity factor is now no less than



Another excellent method of profitably extending the business of central supply stations, is catering for, as much as possible, different classes of consumers requiring electricity one and one-half; or, in other words, if all the Brighton consumers were to require, simultaneously, their ordinary maximum supply (not their wired capacity), the generating plant of the station would have to be increased very nearly 50 per cent.

In the author's opinion, it is very much more important to run, very soon after the starting of the station, mains in all districts of the town in which artificial light is used late in the evening, although this may be in the districts of the poorer classes of consumers, than it is to spend it on coal-saving refinements, or in running large mains in districts occupied by immense early-closing stores or by the mansions of the wealthy; both classes being very expensive to supply, because of the short daily use made of the plant by the former, and the latter's frequent and lengthy absences from home, or the erratic nature of their demand.

The author would specially point out the true economy of a liberal supply of distributing mains, which can be made to serve the double purpose of supplying the street lamps as well as the general public. In this connection he questions very seriously the wisdom of the practice, resorted to by many central station managers, of running special mains and systems for the sole supply of the public street lamps, as by so doing they needlessly increase the total cost of supplying the whole of the requirements of the district.

The author thinks that insisting on a high initial rate of charge per kilowatt hour, or lamp hour, being maintained to each consumer until the annual cost of getting the plant in readiness to supply his maximum wants has been covered, and then substantially reducing the charge for the subsequent consumption, forms the basis of a perfectly equitable tariff, applicable to all stations and conditions of supply.

As the knowledge of the profit-earning capacity of any electricity supply station so obviously depends upon the correct method of determining the cost of supplying electricity, the author thinks that the accompanying tables, relating to the development of a supply station in the fairly representative English town of Brighton, will be found interesting. The consumption per inhabitant at Brighton is far and away ahead of that in any other town in the United Kingdom; viz., seventeen kilowatt hours consumed per inhabitant this year. The columns of the tables have been arranged in a form which will enable company managers to compare their results with the figures given.

The first small station was built on the usual pioneering lines adopted by many companies before security of franchise could be sufficiently assured to tempt capitalists to put much money in the concern, and the second on the modern lines of a permanent station possessing an absolutely secure franchise. As both concerns, in their respective years, were quite free from any promoters' paper capital, and always gave a supply whenever and wherever called upon to do so, the author sees no reason why the figures given should not form a basis for estimating the cost of supplying electricity under the most diverse conditions, by the necessary alterations being made in the cost of capital, coal, etc., and thereby enable any manager to find out the proper basis upon which to construct an equitable tariff for any particular town or condition of supply.

Columns have been inserted in the tables giving equitable charges that should have been made to the consumers during the different years on the two systems of charging advocated by the author, the first being based on the principle of charging the amount shown in Column 9, of Table I., per annum per maximum kilowatt demanded by each individual consumer, and then charging all the electricity consumed, quite irrespective of the purpose for which it has been used, at the rates given in Column 10 of the same table; and the other tariff, which is commonly known as the Brighton system, of charging a sufficiently high price per kilowatt hour consumed, until all the costs the company are put to in standing-by have been covered; these figures being given in Columns 11, 12 and 13, respectively, of same table. The fact of this system having been adopted in about thirty English towns will convince the members of its commercial practicability.

On this tariff it is advisable to make the difference between the initial price and the reduced price as marked as possible.

In the preparation of the tables, the author has employed the method of cost analysis by differences, explained at length in his paper before the London convention of the Municipal Electrical Association in 1896. In arriving at the total charges against the revenue accounts for the respective years, he has assumed that all stockholders would be quite willing to invest their money if 5½ per cent. on it were put aside out of revenue for the purposes of redemption and depreciation, and at the same time there was a reasonable chance of their getting another 5 per cent., at least, for the use of their money. He regards this as sufficiently liberal, as, so far as his knowledge goes, very few electricity companies set aside so large a percentage as 5½ per cent. on the whole of the capital for depreciation and repayment of capital, exclusive of dividends. With this provision the author has prepared the columns already referred to, showing what the tariff should have been to have produced this satisfactory result.

In a perfectly equitable system of charging, which, in the author's opinion, will generally be found synonymous with the soundest commercial tariff, it is obviously correct to make every one, whether using electricity for power or lighting purposes, pay the cost the company is put to in preparing the plant to supply the individual consumer's demand. Column 9, on Table I., is therefore given, showing the cost of so doing during the various years, and it is obviously inadvisable to look for a profit on this expenditure, or on the service rentals, but to make the whole of the net profit for dividend-paying purposes on the amount of the electricity actually consumed.

It must be understood that these tables have been prepared without making any arbitrary assumptions, and that the various amounts for running, standing-by, and service rentals have been ascertained by the aforesaid method of differences and by a close analysis of the stations' costs sheets.

It will be seen from Column 5, Table III., that, at Brighton, where coal on the average costs about $5 a ton, delivered in front of the boilers, the cost of producing the electricity has always been very small compared with the cost of getting everything ready to supply.

The author need hardly remind company managers that where coal is relatively cheaper, or water power is the source of energy, this proportionately large amount of standing-by costs will be still further increased.

It may be thought that all this great cost of putting the station in a position to run, compared with the cost of actually running the machinery, will practically disappear with a large extension of the motor supply business. This, in the author's opinion, is a complete fallacy, as the lighting load in any town will be very similar, however general the supply may become, and whether a constant day load is added to this or not makes no difference at all in the relative cost of supplying lamps one hour or, say, four hours. Until storage batteries become much cheaper than steam generating plants, the ratio of the standing costs to the running cost for lighting purposes will remain high.

As the standing charges of late years at Brighton have been found to rise nearly in proportion to the maximum annual load on the station, the author, in estimating the cost of supplying any consumer, debits him with an amount of the standing charges in proportion to his maximum call for current.

The author calls particular attention to Column 4, Table V., showing the enormous increase in the sales per maximum kilowatt load on the station that has occurred since the sliding scale of charging was adopted, at the beginning of the year 1893. From the column it will be noticed that this prolongation of the use of the plant has been no less than 54 per cent. in four years, and it is perhaps needless for the author to point out what a great effect this has had in reducing the cost of production, as, with coal costing even the high price it does at Brighton, an improvement of the load factor of only 3 per cent. has the same effect in reducing the total cost of producing electricity as if the coal bill had been reduced 15 per cent.

Table V.—Showing lamps connected, maximum load,, diversity factor, and length of distributing mains.

Date.	Year of operation.	Equivalent No. of 16-C.-P. lamps connected at end of year as applied for. 1	Diversity factor of the consumers as a whole. 2	Mean of the two-years' station maximum loads in K. watts. 3	K. W. hours sold in the year per mean maximum K. watts. 4	Length of streets with distributing mains at end of year. 5
						miles.
1887	2	5,614	1	42	1,260	....
1888	3	8,880	1.11	73	1,025	....
1892	1	5,614	1.25	160	913	4.25
1893	2	9,880	1.36	287	1,000	9.5
1894	3	19,243	1.54	508	1,150	17.5
1895	4	25,032	1.54	740	1,170	19.75
1896	5	33,319	1.46	9[illegible]	1,405	22.05

It will be noticed from the tables that the only items that were found to vary with the amount of electricity actually sold from a given plant, were coal stores, water and repairs. Should any managers find that their wages or other costs vary also on this account, it is easy to separate these into stand-

TABLE I.—Showing development of business, proper charges for service rentals, standing-by, and for current consumption.

Type of station. 1	System 2	Date 3	Year of operation. 4	Annual sales of electricity: In K. W. hours. 5	Annual sales of electricity: In 50-watt lamp hours. 6	No. of house services at end of year. 7	Correct annual charge per service. 8	Correct annual charge for standing-by per consumers' maximum demand in K. W. 9	Correct charge per K. W. hour to pay cost of running and to produce additional 5% on investment 10	Inclusive charge per K. W hour consumed on the average in one hour per day throughout the year 11	Inclusive charge for supplying one 50-watt lamp one hour daily on average throughout the year. 12	Subsequent charge per lamp hour (including renewals). 13	Ratio of charge for first lamp hour to subsequent lamp hours (exclusive of lamp renewals). 14
							$	$	cents.	cents.	cents.	cents.	times.
Pioneer...	Overhead wires, multiple series, H. T. continuous ...	1887	2	53,000	1,060,000	57	23.40	214	8.58	67.08	3.394	.469	7.8
Do.	H. T. alternating, house transformer system........	1888	3	75,000	1,500,000	86	14.86	170	6.8	55.3	2.805	.48	6.3
Permanent	Buried conductors, two-wire L. T. storage battery, 1,500 amp.-hrs. capacity.	1892	1	156,041	3,120,820	212	14	82.1	9.775	32 27	1.664	.539	3.3
Do.	Ditto, three-wire L. T. sliding scale..........	1893	2	286,895	5,737,900	420	10.26	69.5	7.17	26.22	1.3505	.398	3.65
Do.	Ditto, with H. T. alternating sub-stations and L. T. distributors....	1894	3	583,701	11,674,020	853	7.28	46	5.9	25.55	.9675	.335	4.34
Do.	Ditto..........	1895	4	867,494	17,349,880	1,065	8.60	49 8	5.28	18.93	.9865	.304	3 58
Do.	Ditto.......	1896	5	1,388,821	27,776,420	1,366	7.68	50.4	4.06	17 86	.933	243	4.4

TABLE II.—Comparative effects of the correct charges during the various years of development.

Date.	Year of operation.	Inclusive daily charge per K. W hour consumed in one hour. 1	Inclusive daily charge per K. W. hour consumed in four hours. 2	Ratio charges bear per K. W. hour if consumed in one hour and four hours respectively. 3	Ratio of charge for first lamp hour to subsequent lamp hours (including lamp renewals). 4	Inclusive charge for supplying one 50-watt lamp one hour daily on average throughout the year. 5	Inclusive total charge for supplying one lamp for *four* hours daily (including lamp renewals). 6	Inclusive total charge for supplying one lamp for *ten* hours daily (including lamp renewals). 7	Equivalent cost of gas giving same C. P. with ordinary burners per 1,000 feet, according as the lamps are burned.: 1 hour daily. 8	4 hours daily. 9	10 hours daily. 10	Annual cost of current for 500-watt arc lamp burning ten hours daily 11	Inclusive annual cost of 500-watt arc-lamp, with attendance and carbons, but exclusive of interest on lamp and post 12	Correct charges for motors of 75% efficiency: Annual charge per maximum B. H. P. 13	Cost of current per K W hour 14
		cents.	cents.			cents.	cents.	cents.	$	$	$	$	$	$	cents.
1887	2	67.08	23.23	2.89	7.2	3.394	4.8	7.615	4.24	1.5	.95	264	307	214	8.6
1888	3	55.3	20.45	2.71	5.83	2.805	4.245	7.125	3.5	1.325	.89	245	286	170	9
1892	1	32.27	15.4	2.10	3.1	1.664	3.28	6.515	2.08	1.025	.813	219	262	82	9.7
1893	2	26.22	11.93	2.2	3.38	1.3505	2.5425	4.9325	1.67	.792	.615	165	208	69	7.17
1894	3	25.55	9.06	2.82	2.87	.9675	1.9725	3.9825	1.21	.613	.498	131	174	46	6
1895	4	18.93	8.7	2.18	3.25	.9865	1.8975	3.7225	1.235	.59	.465	121	164	50	5.28
1896	5	17.86	7.51	2.37	3.85	.933	1.6200	3.12	1.165	.505	.39	100	143	50	4

TABLE III.—Data for determining the correct charges.

Date.	Year of operation.	Total annual standing-by charges per maximum K. W at station 1	Running costs per K. W. hour: Coal. 2	Stores and water. 3	Half repairs to machinery and plant. 4	Total. 5	Amount of profit to equal 5% additional interest on capital invested 6	Daily cost per 50-watt lamp of standing-by. 7	Correct charge per lamp hour for continuing to supply (including lamp renewals) 8
		$	cents	cents.	cents.	cents	$	cents.	cents.
1887	2	214	3	1.8	.48	5.3	1 735	2.925	.469
1888	3	189	3.3	1.32	.68	5.3	2.615	2.325	.48
1892	1	103	2 42	.09	.0368	2 546	11.265	1 125	.539
1893	2	94.25	1.416	.214	.0302	1.66	15.775	.9525	.398
1894	3	70.80	1.32	.324	.176	1.82	23.700	.6325	335
1895	4	76.60	1.27	.162	.104	1.54	32.500	6825	.304
1896	5	73.70	1.016	.118	.077	1.21	39.125	.690	.243

TABLE IV.—Showing total investment and annual charges to revenue account.

Date.	Year of operation.	Capital sunk in undertaking at end of year. 1	Capital sunk in mains and services, exclusive of meters, etc. 2	Plant investment. 3	Total charges to revenue account, including service costs, and 5½% on capital. 4	Total annual service cost. 5	Total running costs for K. W. hours sold. 6	Ratio of standing-by charges to actual running costs of year. 7	Cost per mile of street for mains and services. 8	Cost of mains per service connected. 9	Plant investment per service. 10	Plant investment per K. W. of maximum demand on station. 11
		$	$	$	$	$	$		$	$	$	$
1887	2	44,800	.....	......	12,720	936	2,810	3.19	... ..	...	...	...
1888	3	59,750	......	......	18,830	1,070	3,980	3.46	,... .	.	. .	...
1892	1	255,000	101,000	72,300	22,450	2,060	3,975	4.16	23,700	480	341	452
1893	2	375,000	175,500	89,400	35,000	3,240	4,765	5.67	19,500	419	213	312
1894	3	574,000	266,000	132,500	51,200	4,630	10,650	3.38	15,200	312	155	262
1895	4	728,000	326,500	165,200	78,250	8,250	13,330	4 25	16,600	306	155	210
1896	5	857,500	384,000	194,000	99,000	9,350	16,800	4.34	17,500	281	142	196

ing-by and running costs by the above simple method of differences. Perhaps it may be well to remind those members who did not read the author's paper on the "Cost of Electricity Supply," in England. last year, that this method of analysis by differences is a means for determining the cost the station is put to in having to supply every additional kilowatt hour from its plant, and it consists in dividing the difference between the amounts debited in the six winter and six summer months, respectively, to the special account required to be so analyzed by the difference in the number of kilowatt hours sold in these two respective periods, the result giving a very correct estimate of the running cost per kilowatt hour during that year.

In the comparison of the cost of an electric lamp with that of gas, it has been assumed that the gas is of a quality known as sixteen candles, which, burnt with ordinary burners, generally gives two candle-power per cubic foot.

In order to make the comparison, in Columns 8, 9, 10, of Table II., between the charges for electricity and gas, applicable to other towns, it seems to the author fair to assume that the ratio of the cost of producing gas and electricity in any one town bears generally a constant ratio, as the items which affect this, such as the cost of capital, coal, labor, etc., would generally vary in similar proportions.

From Table II. it will be seen that, even in the year 1893, when something under 300,000 kilowatt hours were sold, the charges for a sixteen-candle-power lamp, burning four hours a day throughout the year, would have been less than gas at 80 cents per 1,000 feet, and that last year, when the supply was under 1,500,000 kilowatt hours, electricity burnt under these circumstances could compete with gas at 50 cents; while for street lamps, or lamps used in basements all day long, electricity was cheaper than gas at $1 per 1,000 feet, in 1887, supplied from the small pioneering station.

Columns 11 and 12, of Table II., giving the charges for current and total inclusive cost for a 500-watt arc lamp, may be of interest, as also may be the proper tariff for motive power, shown in Columns 13 and 14 of the same table.

To illustrate how impossible it is for electricity to be supplied on a uniform tariff at so low a price to the lamps used in the average house of the middle classes as it can be profitably done on an equitable sliding scale, it is only necessary to note that to have produced the same amount of profit in 1896 the uniform charge per kilowatt hour would have been to this four-hour class of consumer 9.3 cents against the equivalent charge of 7.5 cents, or at an increased charge of 25 per cent.

If we take the case of saloons and clubs, which keep open late throughout the year, and burn, on the average, their lamps six hours a day, the necessary uniform charge would have been 46 per cent. higher, and, in the case of basement users, using their lamps ten hours a day, on the average, throughout the year, a uniform charge would have to have been 70 per cent. dearer than it could have been supplied on the system of equal profits, whereas the one-hour consumer, on the uniform system, would have been charged 9.3 cents against the proper charge of 17.86 cents per kilowatt hour, and, as 15 cents would have been the actual cost to the supply station in giving him this kilowatt hour, the company would have lost no less than six cents for every kilowatt hour so sold.

It may be thought that the amount of the service rentals shown in Column 8, of Table I., to be equitable in the different years, may prevent the classes the author so strongly suggests should be catered for from being able to benefit in point of economy by a supply; but it is easy to show from the tables that even in the year 1894, with a sale of 583,701 kilowatt hours in any ordinary residence where at least four lamps are generally used till 10 p. m., any householder should have been able to get electricity cheaper than gas. Moreover, directly cheaper forms of electricity meters are put on the market, and meter readings can be taken once a quarter instead of once a month, as hitherto, these service rentals will very much diminish.

In case any of the members should be inclined to think that there is no necessity to depart from the ordinary method of charging a uniform price per lamp hour, the author has prepared the curves showing how very slightly the total costs of a central supply company vary in the different months of the year, notwithstanding the enormous variation in the number of kilowatt hours sold. These curves, Fig. 1, in the author's opinion, are the most speaking condemnation any manager can possibly have of the commercial unsoundness of the uniform method of charging.

In order to demonstrate very clearly the effect of the gradual development of the business on an equitable sliding scale of charges, the author has prepared the curves, Fig. 2, showing how the varying charge per kilowatt hour, according to the number of hours the demand is used, has diminished in the various years, as many managers have suggested that this necessity for a high initial rate will disappear on electricity being more generally used.

THE DAYLIGHT WORK OF CENTRAL STATIONS.[1]

BY T. C. MARTIN.

THE development of the central station industry has been in some respects, a disappointment. We have now had nearly twenty years of central station work in this country, and have witnessed an enormous growth in that period within the field of work covered by this organization, but it is apparently as true to-day as when the association was formed, that the companies restrict themselves injuriously in their natural and logical advance by remaining mere lighting corporations. What would happen to us all if some new lighting medium came into vogue that deprived us of our illuminating business entirely? If we had to fall back on daylight work, might we not be better off?

A brief retrospect will not be out of place, if followed by a study of the present situation. It is as well not to go back further than 1886, for, although arc lighting is a full decade older than that, the industry ten years ago took its great leap forward. A careful investigation shows that, in 1886, there were about 410 central stations in this country. Of these, only 300 furnish available statistics, and it would appear that 226 of the companies were then only doing a night arc lighting business. It is safe to assume that all the companies which did not report were in the same category as the 226; so that, out of the 410 local companies, some 325 were doing business only between dusk and daylight, and were standing idle all the rest of the time. In other words, taking the year through, they were idle nearly two-thirds of the day, if the average running be taken at 3,000 hours a year.

To what degree have these conditions been improved in the ten years? This is an extremely difficult question to answer, but a few tentative figures may be acceptable as a basis for study and discussion. At the close of 1896 there were about 2,400 central stations in operation in this country, so that in ten years the number had increased sixfold, a gain that is simply stupendous. Of these 2,400, however, 975 had, from the figures obtainable, no day circuits, and 220 others had only arc apparatus, so that 1,195 local companies, by their own admission, were limited to night work. The case is not, however, so encouraging as might be implied from these figures. Of the remaining 1,200 companies, only 327 report day circuits, and if it is safe to assume that half of the 900 companies and plants not giving these details were without day circuits, it would appear that, out of 2,400 local plants, at least 1,500 are limited to the night hours for their earning capacity. It must be noted, however, that nearly all the 900 companies not specifying day circuits are operating incandescent circuits, very largely with the alternating current, so that the means for day operation are generally there under more or less favorable conditions.

It is obvious at once that an immense amount of capital and machinery is standing idle that might otherwise be productive of profit and dividends. Of the 1,200 companies confessing that they have no day circuits, only some 780 give their figures of capital and generating capacity in steam or water. It would appear that these plants, with a moderate capitalization of $46,908,000, and with an engine and water wheel capacity of 164,000 horse-power, are standing idle two-thirds of the day and often a great deal longer.

Such figures are given broadly, and may be a little inaccurate in precise detail, but it is the mere fact that is so striking. It is obvious that these figures apply to the great bulk of small stations. And yet some of them are certainly not small. At least sixty-five or seventy of them have each a capacity of 500 horse-power and upward, and several of them are legitimately capitalized at above a million dollars each. A company of such size ten years ago was rare and exceptional, and would have been difficult to start, except on the general hypothesis that its business would include something beyond simple street illumination, with a little house lighting thrown in. It may be doubted whether capital of any magnitude could be enlisted to-day for a company that had no ideas beyond ordinary lighting work.

If the stationary motor work, whose claims I ventured to urge on this association eleven years ago, had been left to the local lighting companies, I fear it would not have made much headway. The 327 and other companies with day circuits do an enormous amount of power work, but a careful analysis of somewhat incomplete data would lead one to believe that the isolated plants are the real backbone of the electric power industry to-day. Why this should be so, it is difficult to explain, except on the hypothesis that station current, when obtainable, often costs too much, and is generally not obtainable. It will, I trust, be understood that this paper is not offered in any wise as a criticism of central station management, but simply a presentation of the puzzling facts that confront students of the situation. No one can know the inwardness of the problem so well as the central station manager himself, and no one can be more deeply interested than he in dealing with it wisely and well.

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[1] Abstract of paper read before the National Electric Light Association, Niagara Falls, N. Y., June, 1897.

It might be said that, in a general survey, four new factors have presented themselves in the last ten years for the consideration and approval of the central station manager. These are motors, alternating-current supply, storage batteries and electric heating. The alternating current is, for most stations, still restricted to night work; and will be, probably, until more single-phase motors of successful character are on the market. This form of current has given such a tremendous stimulus to lighting that it deserves a wider range of usefulness, so that, in time, alternating-current stations may compete with direct-current stations as earners of dividend.

Allusion has already been made incidentally to motor work. What is possible in this direction is best judged from what the large stations do. Of course, this is in some respects an erroneous guide, but in the same manner as great men are exemplars for those of less heroic bulk, so the large stations indicate the actual possibilities, even for a lower plane of execution. The following are figures of a large western central station, showing the horse-power of motors connected to the circuits, and the percentage that the power consumption bears to the total output. The data come down to March 31, 1897.

Low Tension.

Power connected April 24, 1897...........	6,962	horse-power
Power p. c. of the total switchboard output	22.8	per cent.

High Tension.

500-volt power connected April 24, 1897....	1,566	horse-power
Power per cent. of high tension output....	21.4	per cent.

All Systems.

Power connected April 24, 1897	6,962	horse-power
Power p. c .of the total switchboard output	22.8	per cent.

Another example is to be found nearer home, in the work of the New York Edison Company. The motors to which that company supplied current from its distributing mains represented, on January 1, 1896, a total installation of 11,640 horse-power. On January 1, 1897, the motors connected were the equivalent of 15,930 horse-power, an increase of motors connected in a single year of 4,290 horse-power, or 36 per cent. This does not include an installation equivalent to 1,142 horse-power in motors, to which current is supplied from the New York Edison stations during minimum hours, or for emergency and breakdown connections. It will be seen that this brings the total horse-power in motors connected to the company's mains up to 17,072 horse-power. The average size of these motors is from three and one-half to four horse-power. Of the total motors connected it is estimated that about 5,000 horse-power, equivalent, is installed in connection with direct electric elevators and grip hoists.

In order that the idea should not go abroad that the big companies are monopolizing the power business, but that it is open to all, I would mention that in Massachusetts, where there is only one large city, no fewer than eight companies out of fifty-eight are supplying power from their arc circuits; eighteen from incandescent circuits, and twenty-nine from independent power circuits; the total being about 14,000 horse-power of motors on the circuits. The asking rate for kilowatt hour averages about 20 cents, but runs down as low as 10 cents.

Turning next to storage batteries, it is not my intention to agitate old discussions, but simply to give a few figures, which would go to show that the batteries may do more than perform the Alpine feat of taking care of the peak of the load. There are at the present time in America—I blush to give the figures—only fifteen central stations using batteries, with a total capacity of 25,000 horse-power hours' output. Four other stations are being equipped. I hope devoutly that some future chronicler will be able to report that 1,500 stations are equipped with batteries, and that by their reservoir capacity they have answered in the affirmative the question whether their life was worth living. What batteries can do is best exemplified by the Duane street station of the New York Edison Company, one of the biggest stations in the world, with an engine and generator capacity of 20,000 horse-power. The load during minimum hours, I am told by Mr. J. W. Lieb, Jr., the general manager of the company, is such that it can be supplied in that period from the storage battery annex at the Bowling Green Building in the southern tip of the tongue of Manhattan Island; or from the storage battery plant at the Twelfth street station, either alone or in conjunction with current supplied from the Twenty-sixth street station over the feeder tie lines. The supply of stored current from the batteries in the annex stations during the minimum hours enables the big Duane street station to be shut down every night from 10:30 p. m. to 5 a. m.—nearly seven hours; and on Sunday the operation of the generating machinery at Duane street is limited to one watch. I do not hold a brief for storage batteries, but in view of such facts it is hardly possible to do other than press their claims on the attention of central station managers.

A word in conclusion as to electric heating. It is said that, with current sold on the basis of 20 cents a kilowatt hour, no business can be done in heating, and that, even if the price be cut in two, the inducement to possible customers is not great. If this were true, the matter of price of current might forbid the operation of a single fan motor from central stations. Making a rough calculation of 1 cent per hour for the ordinary fan motor;that is, 10 cents a day for ten hours steady running, or, say, $3 per month, or $36 a year. Allowing twelve such motors to the horse-power, the local companies are selling current to thousands of willing customers in the summer time at the rate of $430 a year per horse-power, for a working day of only ten hours. Other quotations can be made showing the high price got readily for current in small quantities from purchasers who are perfectly satisfied with the bargain, and find it pays them also very handsomely in some element of comfort, pleasure, convenience or even economy.

A test taken three years ago, for twelve weeks of current consumed in cooking a dinner of several dishes daily for a large number of persons, showed that for ninety-seven persons the current fell as low as 307 watt hours per person. This would make 29,779 watt hours, or, in round figures, thirty kilowatt hours. At 10 cents per kilowatt hour, that means an expense of $3 per day, or, say, $90 per month. It will, of course, be objected that, in a great many isolated plants, the current made on the spot does not cost to exceed 5 cents per kilowatt hour, which would, in the building where the test was made, have brought the sum down to $45. I have tried to get some basis of comparison between this and an equal amount of work on a gas stove or range, for an equal number of persons, but it is not easy to obtain. In one family I know, which consists of six persons, they have been cooking by gas for some five years. It costs, with gas at $1.25 per 1,000 cubic feet, on an average, $5 to $6 per month, or from 16 to 20 cents per day, or about 3½ cents per head per day, if all are at home to every one of the three daily meals, which is far from being the case. If the same expense averaged for the ninety-seven persons for three meals daily, the outlay for gas in cooking would be between $90 and $100 a month, or about as much, if my figures are approximately right, as electricity would cost, if the current were supplied at 5 cents per kilowatt hour. This is certainly a very encouraging showing for electricity, but we must not forget that central stations do not exhibit much anxiety to sell their current at 5 cents per kilowatt hour, or even per horse-power hour, and this is one reason why isolated plants have multiplied so tremendously in our cities. I might add, as one point of interest, that, when the family I mention began to cook with gas, it bought a gas range for $25 and paid $2 or $3 more to get it set. The range has worn out, and the family is now hiring a good one from the local gas company for $3 a year.

From these crude remarks of mine, it will be seen how sadly tentative and experimental the art of electric cooking is for most of us; but is it not the duty of the local lighting companies to go into this matter and see how far they can foster the new art, by introducing the apparatus and furnishing current for it cheaply? Even if the price falls short of $430 per horse-power per year, for ten hours a day only, they should not feel discouraged.

I have spoken of cooking, but this is but one of many fields of usefulness for electric current heating supply. Our esteemed ex-president, Mr. J. I. Ayer, who has placed at my disposal much interesting data that I cannot produce here, for lack of time, gives me also a variety of information as to work that has lately fallen within his sphere of practical attention as representative of a large electric heating company. Their work includes a wide extent of shoemaking machinery, heated silk-finishing rolls, leather-working machinery, 387 curling-iron sets in the dressing rooms of the combined Waldorf and Astoria hotels, in New York City, seventy-two sets in the Parker House, Boston, and apparatus in the Plankinton and Pfister hotels, Milwaukee, as well as on the American line steamers across the Atlantic. It would not be fair to omit the 14,000 car heaters installed, of one make alone, in the past year and a half. A blankbook manufacturer has had in use since 1894 from thirty-five to forty electric glue pots, and Duryea & Co., the starch makers, are also users of electric heat apparatus. In Knabe & Co.'s piano factory, at Baltimore, twenty electric heaters have recently been placed; and there is a long list of clothing houses throughout the country that use electric irons. The same is true of vulcanizers for bicycle tire agencies and factories, while irons in large numbers have been supplied to State asylums in Indiana, Michigan, Wisconsin, Illinois, New York, Massachusetts, Maine and Maryland. It is simply impossible that all this apparatus should have been put in, unless it was economically or practically worth while; and this being so, is not the electric heat field one in which the local companies can now begin to work with advantage? Surely, here lies opportunity of the largest kind, to help the introduction of apparatus that must serve as a large customer for current at all seasons of the year.

RECENT PROGRESS IN ARC LIGHTING.*—I.

BY PROF. ELIHU THOMSON.

We have, to-day, in actual commercial use arc lamps running under quite a variety of conditions as to nature of current, regulation of the current, and conditions concerning the arc itself as a source of light.

According to the manner in which the arc lights are worked on an electric circuit, we are enabled to make several general divisions, about as follows:

Series arcs on
- Constant, continuous-current circuits.
- Constant, pulsating-current circuits.
- Constant-potential, continuous-current circuits.
- Constant, alternating-current circuits.

Single arcs on
- Branch of constant-potential, continuous-current circuit.
- Branch of constant-potential, alternating-current circuit.
- Compensators with alternating current.
- Constant-current transformers.

It will, at this time, be scarcely necessary to dwell upon the main features of several of the cases above enumerated, as they are too well known to call for comment here. Thus, the case of arcs in series upon a continuous, constant-current circuit is the oldest and best known. It has the peculiar merit of permitting economical transmission by currents of potentials of several thousand volts; gives ease of regulation and great simplicity of circuits and connections, and does not demand the highest grades of carbons for the open arcs. On account of the relatively higher potential demanded by an inclosed arc, or a partially inclosed arc, and the consequent restriction of the number of lights in a series with a given permissible voltage, there has naturally resulted thus far very little real commercial use of series inclosed arcs, and where they have been on trial use they have, in most cases, so far as the writer is aware, been discontinued.

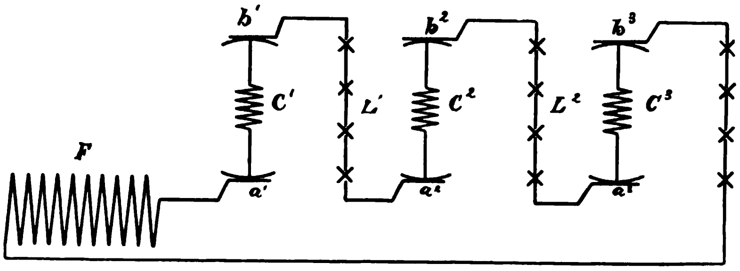

FIG. 1.

In recent years the tendency in series arc lighting with constant current has been to increase of voltage of the dynamo, and machines capable of working 125 to 150 arc lights in a series have been developed successfully. But the potential between terminals in such a case may be 7,000 volts—often too high for security, and in some places forbidden by special legislation. An ingenious method of employing such machines when, as is the case with the Brush machine, several commutators are present in series relation, has been devised by Mr. Green, of the Brush Company. This plan demands that separate pairs of wires be run from the machine to the switchboard for each circuit, but the unquestionable effect of the new connections is to limit the difference of potential which is possible to be manifested between any two parts of the circuit through the machine and lamps. A simple diagram, like Fig. 1, will make the connection and its general effect on the distribution of potentials clear to those who may not have given attention to the subject. Let F be the field circuit of the dynamo; we may for simplicity, neglect its resistance and that of the wire of the circuit. If C^1, C^4 and C^3 represent the sections of armature conductor, and L^1, L^2, L^3 the series of lights connected between the commutators of the machine, it will be seen that each armature section, C^1, C^2, C^3, with its appropriate commutator, acts to produce a difference of potential, which may be represented by the vertical a^1, $b^1 = a^2$, b^2, and a^3 b^3, while the fall of potential through each series of lights, L^1, L^2, L^3, results in bringing the line potential down, as it were, for another raising. In such a system, evenly loaded, the highest difference of potential anywhere to be found will evidently be that required to run a series of lights looped between two successive commutators. If lights are cut off from any set or loop, the potential difference between the terminals of that loop falls accordingly without any corresponding or proportional rise between any other parts of the circuit. If, however, lights are cut off one set and added to another, so as to keep the machine in full work with unbalanced loads, then the potential distribution is, of course, disturbed, and the system approaches the condition of all commutators connected directly in series, and the lights all in one series—the old plan.

The immediate future of the series arc lighting system appears to be in the development of large dynamos, up to, say, 300 arc lights each, running at such speeds that one or a pair may be easily coupled directly to the shaft of a moderately high speed engine.

While it is true that in the open coil types of dynamos—such as the Brush and Thomson-Houston—the current, as set up by the armature, must necessarily be wavy, still it must be borne in mind that the field magnet coils, the line and the series lamp magnets have, together, a considerable inductance, the effect of which is to smooth out the minor fluctuations, so that the current becomes fairly uniform. A slight tremor in the current, with differential magnet lamps, is an assistance in preventing tardy feeding. In the pure shunt type of lamp, this is of less effect on the feed.

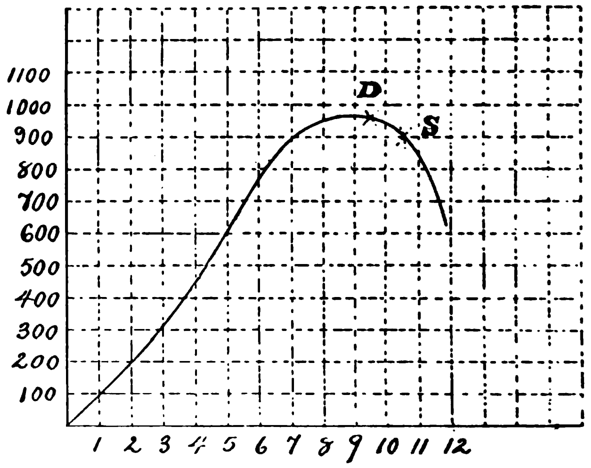

FIG. 2.

It has been thought by many that arc lamps are interchangeable (if made or adjusted for the same current) from the circuit of one type of series arc dynamo to that of another, without difficulty. In a general way this is true, but not by any means necessarily true. Also, it may happen that a dynamo which will take a certain load of differential lamps at a certain strength of line current, can only work with satisfaction on pure shunt lamps with a 10 per cent. to 20 per cent. increase of line current, and fewer lamps in series. In this case the differentials secure a stable current when working on a part of the characteristic curve back of that were the heavy droop occurs, D, Fig. 2, while the shunt lamps are only given stable current at S. Instability or quick rise and fall with flashing and possible intermittent extinguishment otherwise result.

On the other hand, any circuit of pure shunt-feed lamps will take differentials adjusted for the same current without difficulty. But in such case, if the current fluctuates in value and there be but few differential lamps on the circuit, with a large proportion of the shunt-feeding type, the differentials are the ones to suffer and not the others. The former are sensitive to current variations, the latter indifferent thereto.

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*Read before the N. E. L. A. Abstract.

There is neither time nor space to devote to the details of arc lamp mechanism for constant-current circuits, though much might be said in regard to the proportions that should be given to the parts, the character of pull to be secured in the magnets controlling the lamp, the securing in clutch lamps of a slow or "sneak" feed (as it is sometimes expressively, if not elegantly, termed) for the carbons, the cut-out switch, etc., in both differential and shunt-magnet-control mechanism. There are two points, however, which may be touched upon in this connection, as tending to secure the best results. First, the variation of pull for a given variation of current in the magnets controlling the lamp should be as great as possible. Second, there should be as little as possible variation in the force required to feed or recover from feeding. The force required to be imparted to the mechanism to release the clutch, detent or escapement should be as little as possible, and but a very small fraction of the total magnetic force in a differential or shunt-feeding system. Otherwise, the lamp will not be a sensitive feeder. Lamps are frequently found which form their arcs well enough, but hang up or delay at the feeding point, the action of feeding being preceded by quite a rise of potential between the carbons at the arc. This is owing to too much force being required to unclutch or release the mechanism. A good lamp should feed on a variation of three to five volts, and, with certain constructions, a feeding action within one-half to three-quarters of a volt variation for a 45-volt arc can be readily attained.

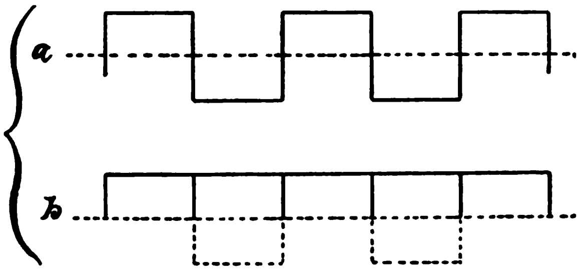

Fig. 3.

Passing now to the consideration of the use of pulsating currents in arc lighting, it may be said that at present little or nothing has been done commercially in the United States in the use of such currents. The subject becomes one of importance in connection with what are known as rectifiers. These are machines that take an alternating current and commute the waves, or rectify them, so that the flow of current is in the same direction always, though rising from zero to a maximum for every alternation in an alternating current. The more or less near approach to continuity of current will depend upon the shape of the wave rectified. A rectangular wave, properly rectified, would, as in Fig. 3, give a true continuous current. Other forms of wave give less continuity, depending on the sharpness of the individual wave peaks, c, d, Fig. 4. The character of arc produced by the rectified current resembles closely that of the continuous-current arc, in that the crater in the positive carbon is present, and the negative tends to point itself. There is, however, a strong note or sound evolved from the arc, depending for its pitch upon the periodicity or frequency of the alternating current. The inductional effects of the pulsating currents in lines upon neighboring lines will, of course, resemble those of alternating currents, though less musical than the latter when a sound results, as in a telephone. In order to make it easy to commute or rectify such a high potential of alternating current as would be needed to feed, say, a series of forty to fifty arc lamps with pulsating current, certain conditions are very desirable. One of these is that the current to be rectified should be of constant value, though alternating. The writer showed, nearly ten years ago, how a constant-current transformer could be made, using primary current at constant potential to obtain secondary constant current. When such a current is rectified, the same characters are preserved, and the regulation is all that could be desired for all loads within the capacity of the apparatus. The efficiency of transformation is also quite high, and the apparatus is not of excessive size for a given output.

The above relates to the rectification of a single-phase current. When, however, two-phase or three-phase currents are to be rectified, there will be at last two or three constant-current transformers, one for each phase, and the secondary current may be combined through commutators resembling those of the Brush arc dynamo for the two-phase, and the Thomson-Houston for the three-phase. In such cases the resulting rectified current is much more nearly a steady or smooth current, and not so much of a pulsating character. This is, of course, owing to the relation of the phases being such as to cover each other's zeros or to overlap. Under proper working conditions there should be a certain field for the use of rectifiers in the United States, as well as in England, where Ferranti has for some time past had some of them in use. It is difficult to adapt a rectifier to periodicities of as high as 125 per second, but with sixty periods the problem is comparatively easy. The use of rectifiers has the one great advantage of permitting the generation of current in a station to be by means of large direct-connected dynamos, a portion of the output of which is used in the ordinary way to feed lights, etc., through the usual constant-potential transformers, while another portion, feeding rectifiers, supplies the arc lamps of the system instead of special arc dynamos, while, if needed, the whole capacity of the generator may be utilized for one or other kind of load, as desired.

The arc lamps worked by rectifiers are like continuous-current arcs in giving the downward distribution of light from the positive crater, a feature of great value in street lighting. There is also complete regulation—such that lights may be cut out ad libitum by shunting, while the other lights remain unaffected. Furthermore, the efficiency of the rectifier is high, and may easily be made over 90 per cent.

The inevitable use of a choking resistance in series, with arc lamps run from constant-potential lines, is now pretty generally understood. Without it the current in the lamp branch is unstable, owing to the fact that the resistance of an arc is not a definite quantity, but varies for a definite length of arc in inverse ratio to the current flowing, or even falls more rapidly than the current increases, or vice versa.

Much was said, and some considerable amount written, a few years ago about lamps in series on constant potential robbing each other, so that when one was bright the other was dim, and the reverse. This phenomenon does not occur with properly constructed lamps, which are sufficiently sensitive feeders.

The distribution of current for arc lighting at constant potentials has undoubted advantages, one of which is the relatively low tension and absence of danger. Another is the facility of installation along with incandescent lights, and ease in metering the supply. The loss of energy in the distribution may, at full load of lines and moderate distances from the supply station, be, say, 10 per cent. or more, chargeable chiefly to feeder drop, and about 15 to 20 per cent. in dead resistance in the lamp branch. We may take, then, 25 per cent. as an average loss in reaching the lamps. This loss, which is much greater than the percentage of loss on the series system, is yet largely, if not wholly, made up by the superior efficiency of the constant-potential, low-pressure generators of large capacity over that of arc machines of relatively smaller output, and by the higher engine efficiency which may readily be attained in driving large generators, especially when working with economical loads. It must not be forgotten, however, that for equally good results a better and more expensive carbon will be required for constant-potential work than for plain series arc lighting. These observations relate, of course, to ordinary open arcs with full supply of air reaching the hot ends of the carbons. The conditions existing with long-burning lamps or inclosed arcs will be alluded to later.

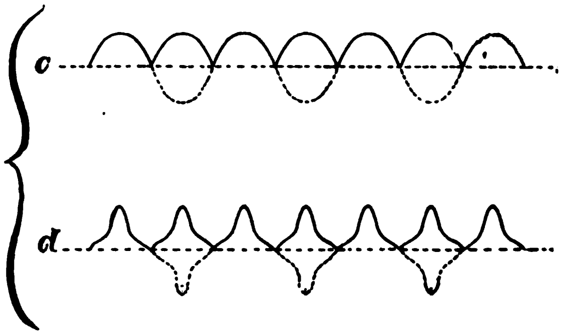

Fig. 4.

One serious objection to the arrangement of lamps in series between constant-potential mains, especially those of 220 to 500 volts, is the inflexibility, or inability, to cut off some lamps in a branch without substitution of equivalent resistance, which substitution, of course, means that the same watts are consumed whether the lights burn or not. With alternating current at constant potential there is greater flexibility, but, unfortunately, no alternating-current arc lamp is likely to equal in its effects lamps making use of continuous currents or unidirectional currents.

REPORT OF COMMITTEE ON DATA.[1]

BY F. R. LOW.

In your last report you submitted returns from eighty-one electric light stations using coal as fuel, showing the following results obtained in actual practice:

	Watt hours per lb. coal.	Lbs. coal per kw. hour.
Maximum	237	4.22
Minimum	33	30.3
Average	108	9.26

In your conclusions you called attention to the fact that, at the Chestnut Hill pumping station at Boston, an effective horse-power had been developed on 1.34 pounds of coal per hour. If a steam dynamo can be constructed and operated as efficiently as was this steam pump, it will deliver 746 ÷ 1.34 = 557 watt hours per pound of coal and require only 1,000 ÷ 557 = 1.8 pounds of coal per kilowatt hour.

I am asked to account for this difference between the actual efficiency attained in the every-day practice of electrical stations and the efficiency apparently attainable in other applications of power.

In the first place, the standard which you have set is, purposely, no doubt, extremely high. The Chestnut Hill engine holds the world's record for steam efficiency, having developed an indicated horse-power on a consumption of 11.22 pounds of steam per hour, and embodies all the refinements of modern engineering. There is no reason why an equally efficient engine cannot be built and attached to a dynamo, should it appear advisable to incur the expense of all this refinement for the attainable difference in expense of maintenance.

There are steam dynamos now running on thirteen pounds of steam per indicated horse-power, which, with a difference of fifteen per cent. between the indicated and electrical horse-power, and an evaporation of ten pounds of water per pound of coal, would require $\frac{13 \times 1{,}000}{.85 \times 746 \times 10} = 2$ (prox.) pounds of coal per kilowatt hour, and deliver 500 watt hours per pound of coal; and these figures, actually attainable with existing steam dynamos for short periods under test conditions, are what should be compared with the record-making test of the pumping engine in your report.

Steam per horse-power hour.		Equivalent§ Coal per kilo-watt hours.	Equivalent Watt hours per lb. coal.
Indicated.	Effective.		
11.22	13.4*	1.8	557
13.	15.3†	2	500

*Calculated from water pumped against pressure.
†Electrical horse-power, 746 watts.
§Calculated on evaporation of 10 lbs. water per lb. coal.

Thus reduced, the question becomes one of accounting for the difference between results obtained by a high-class engine, running under test conditions, and those obtained by an entire station, under running conditions involving not only the decreased efficiency of the units under unfavorable load conditions, but all the standing losses of the station, inferior fuel, etc. The difference will be made up mainly from the following items: 1. Decreased boiler efficiency. 2. Lesser normal efficiency of engine. 3. Impaired conditions of engines. 4. Unfavorable engine load. 5. Leakage. 6. Condensation. 7. Auxiliaries. 8. Heating.

Much has been said of the disadvantage under which electric light stations labor on account of the wide difference between the minimum and the maximum loads, and thermal storage has been suggested as a means of evading this loss of efficiency. It is quite possible that this loss has been overestimated, so far as the boilers are concerned.

The capacity of a boiler is determined by the amount of water which it will evaporate in a given time; its efficiency by the combustible required to evaporate a pound of water from and at 212°. To determine how the efficiency varied with the rate at which the boiler was run, within limits, I have plotted on Fig. 1 in the horizontal direction the water evaporated per hour per square foot of heating surface, and in the vertical direction the pounds of water evaporated from and at 212° per pound of combustible, as determined by 30 different tests on Babcock & Wilcox boilers. If there were any decided tendency for the efficiency to follow the rate of evaporation within the range there covered, it might be expected to show itself here, but it will be seen that practically as good results are obtained at over five pounds per square foot of heating surface as at 1.75 pounds, and the intermediate tests show no dependence on the rate of evaporation. In Fig. 2 I have plotted in the same way all the tests of which I could find a record, and in this wide range still no evidence is apparent of any dependence of the boilers represented on the rate of evaporation within the range covered. This means that the variation of efficiency of boilers within the range here comprised is less than the variations due to different firing, etc.

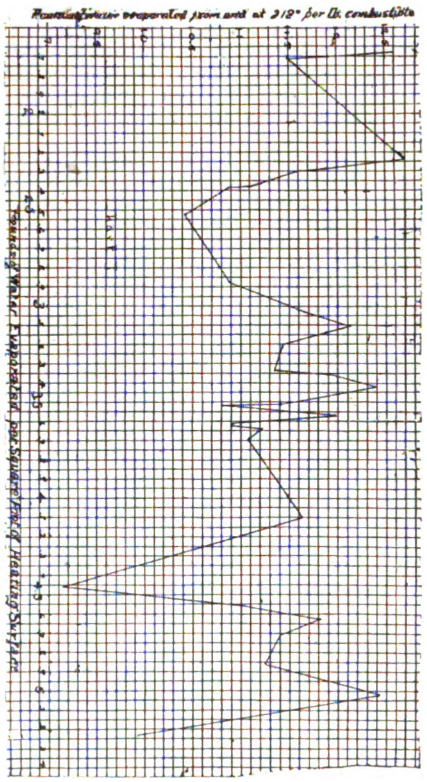

FIG. 1.

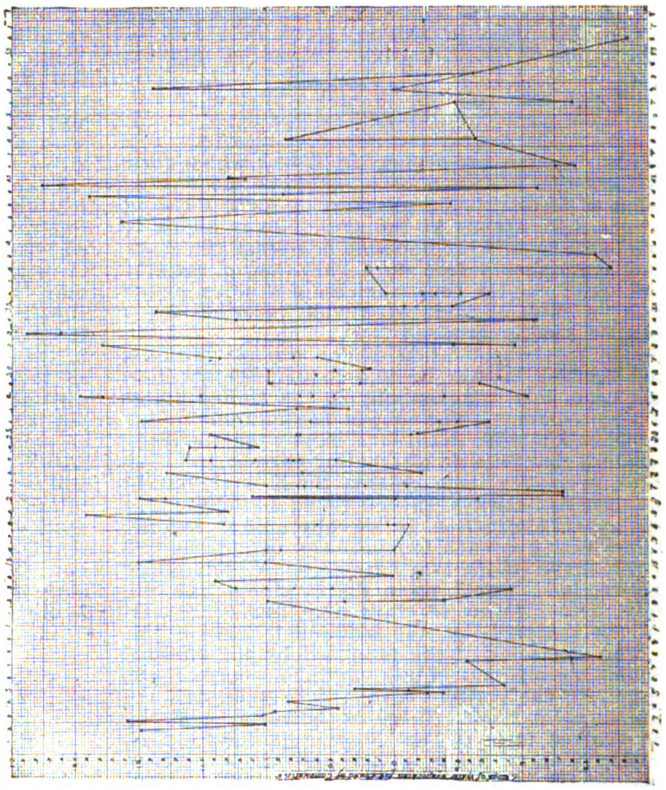

Fig. 2.

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[1] Presented at the Niagara Meeting of the N. E. L. A.

Wm. H. Bryan, in a paper read before the Engineers' Club, of St. Louis, gives the data and tests on a battery of horizontal tubular boilers which were forced to nearly double their rated capacity with a decrease of only six per cent. in their efficiency, and which could, doubtless, have been diminished to one-third of their rated capacity with a less impairment still. In other words, with good management and an adaptation to condition, these boilers would have taken care of a maximum load six times the minimum without suffering extremely.

If a boiler runs sixteen hours a day at an average rate of twelve pounds of coal per square foot of grate per hour, and stands the other eight with a consumption of .5 of a pound per square foot of grate per hour, the coal used, while idle, will be 2.04 per cent. of the whole. If it runs half the time, the expense in coal, while standing, will be four per cent. of the total amount. The following table gives the percentages for different lengths of running and different rates of combustion:

Hours Running.	Hours Standing.	Percentage of Total Coal Used in Idle Boilers at .5 of a Pound per Square Foot of Grate While Idle. Average Rate Combustion per Square Foot Grate While Running.				
		12	15	18	20	24
23	1	.18	.15	.12	.11	.10
22	2	.38	.30	.25	.23	.19
21	3	.59	.47	.40	.36	.28
20	4	.83	.66	.55	.50	.41
19	5	1.08	.87	.66	.65	.55
18	6	1.37	1.10	.92	.83	.69
17	7	1.69	1.35	1.13	1.02	.85
16	8	2.04	1.63	1.37	1.23	1.03
15	9	2.44	1.92	1.64	1.48	1.23
14	10	2.89	2.33	1.99	1.75	1.44
13	11	3.40	2.73	2.30	2.07	1.70
12	12	4.00	3.23	2.70	2.44	2.04
11	13	4.69	3.79	3.18	2.87	2.40
10	14	5.51	4.46	3.75	3.38	2.83
9	15	6.50	5.26	4.42	4.00	3.35
8	16	7.69	6.25	5.26	4.76	3.85
7	17	9.19	7.41	5.96	5.79	4.87
6	18	11.11	9.09	7.69	6.98	5.88

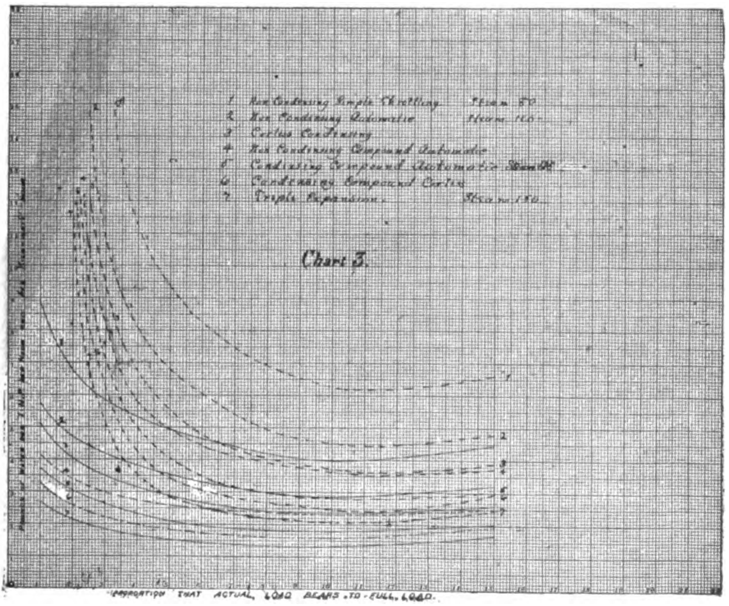

FIG. 3.

It has been a matter of surprise, in following out this investigation, to find so moderate a difference between the performance of the boilers reported for long periods under widely varying capacities, and charged with all the coal used for banking, etc., and their normal efficiency under test conditions. The ratio in 14 cases varied 84 and 97 per cent. comparing the actual with the best duty demands special consideration, for it affects directly the whole efficiency. Inefficiency in an engine affects only the steam which it uses, but inefficiency in a boiler affects the cost of all the steam produced for all purposes.

Engine Losses Due to Unfavorable Load.—The performance that we have taken as a standard was accomplished at the load for which the engine was particularly adapted. The performance that we are comparing with it was accomplished under all sorts of conditions of over and under-loading. Fig. 3 is given by Prof. R. C. Carpenter[3] as showing the rate of steam consumption that may be expected with engines of different types, and the method of variation of that rate with change of load.

These curves are based upon the steam consumption per indicated horse-power, but what we wish to know, not only for the purpose of comparison, but in order to handle the units of a station intelligently, is the rate of variation per kilowatt hour.

That the curve will be different from the indicated horse-power curve, is shown by Fig. 4. The lower curve is the first curve of Fig. 3 re-drawn to a higher vertical scale. Assuming a difference at the best efficiency of fifteen per cent. between the indicated and electrical horse-power, I have laid out the upper curve, showing the rate of variation on the same engine per kilowatt hour. At one hundred horse-power the engine takes forty pounds of steam per hour per indicated horse-power, or 40 x 100 = 4,000 pounds per hour. But we only get eighty-five electrical horse-power out of it, so the cost per electrical horse-power is

$$\frac{40 \times 1{,}000}{85} = 47 \text{ pounds,}$$

and the cost per kilowatt hour,

$$\frac{40 \times 100 \times 1{,}000}{85 \times 746} = 63 \text{ pounds.}$$

Calculating the other loads in the same way, the points for the upper curve were located. This curve is brought down to its dotted position for ready comparison with the other. Owing to the increasing proportion of the frictional and electrical losses, the curve rises very rapidly with an under-load, while, as the load is increased, the diminishing ratio of these losses carries the point of minimum consumption further out, and it is seen that, while the steam rate per indicated horse-power is least at one hundred, the steam rate per kilowatt hour is least when the indicated horse-power is ten per cent. greater, and the line rises less abruptly as the overload increases. It would seem as though every station manager would know the most efficient rate of output for each of his units, and how badly they suffered from a departure from this rate, but I found this to be in no wise the case.

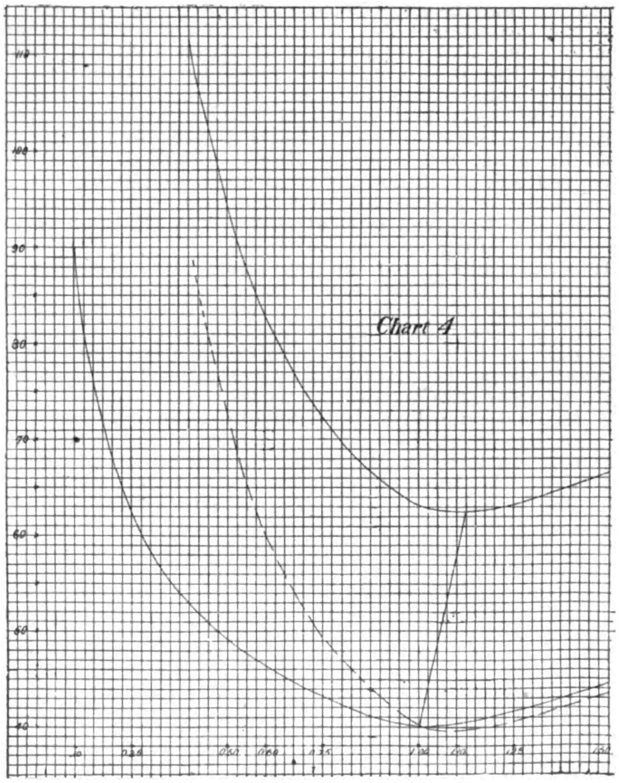

FIG. 4.

The station that has a constantly changing load is at the worst disadvantage from inadaptability of units. The "load factor" proposed by Crompton, expressed by the ratio of the area within the load-line to the area of the containing rectangle, is not a fair expression for this disadvantage; for of two stations, each having a "load factor" of sixty, for example, and one running six-tenths of the time on uniform load, as in Fig. 5, and the other all the time on a constantly changing load, as in Fig. 6, the first will be at a decided advantage in this respect. Its units, if adapted to their output, can be run at their maximum efficiency, and the station is better off even than a cotton mill, or other factory with a steady load, for it has a long run without interruption. It is to the fact that its load-line approximates more nearly this condition that the exceptional efficiency of the Brooklyn Edison No. 2 Station is due, and that an arc station is able to run at a less coal cost per unit of output. With a changing load like Fig. 6, however, the units are at their maximum efficiency only momentarily, as at A, B, C, D. By plotting the engine blocks into the actual load-line as they are plotted into this conventional line, and as they have been in the actual load-line submitted from the Brooklyn station, it can be determined how much and for what proportion of the time they were under or overloaded, and from one of the consumption curves for the given type of engine, the effect of such unfavorable loading may be estimated.

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[3] The Variation in Economy of the Steam Engine Due to Variation in Load. Proceedings Amercan Institute Electrical Engineers, Volume X, 1893.

No.	Hours' Run.	Results.		Efficiency per cent.	Percentage of Coal Used for						
		Lbs. coal per kilo-watt hour.	Watt hr's per lb. coal.		Engines.	Conversion.	Leakage.	Radiati'n.	Auxiliaries.	Boilers.	Unassigned.
1	24	8.30	120.5	24.09	20.95	.24	....	....	....	19.91	34.79
2	6-12	6.24	160.3	32.05	27.30	3.63	....	....	....	26.98	10.04
3	24	3.71	269.5	53.91	9.03	....	11.63	....	....	19.98	5.45
4	24	4.56	219.7	43.86	5.88	2.13	<—12	—>	....	25.00	23.11
5	23	8.69	115.1	23.01	24.97	6.95	....	....	....	.4	32.66
6	24	3.82	262.	52.10	8.80	5.03	....	4.00	....	....	30.07
7	24	8.91	112.2	22.45	22.56	5.50	....	....	....	38.60	10.89
8	14-20 Av 17	8.67	115.3	23.07	....	....	....	....	6.04	39.60	31.28
9	24	6.64	150.6	30.12	30.12	21.50	....	....	....	1.70	17.56
10	24	8.62	116.	23.20	24.12	7.50	....	....	....	1.50	43.67
11	24	10.13	98.7	19.74	9.27	....	....	....	....	42.50	28.49
12	24	7.45	134.3	26.85	38.22	....	....	....	....	13.60	48.53
13	12	7.33	136.5	27.29	11.45	....	....	....	....	25.00	36.26
14	24	5.68	176.2	35.21	10.64	1.07	....	....	5.30	10.00	37.77

It is quite likely that the importance of the impairment of efficiency from this cause has been overestimated. Even on the steep kilowatt curve of the least efficient engine in Fig. 4 it will be seen that if all the engines in the station run all the time at half load, the impairment would be less than thirty-three per cent., and if they ran all the time at fifty per cent. overload, the impairment would be only eight per cent.

A. G. Pierce and R. S. Hale, who have made a careful study of the Boston stations of the Edison companies, say: "In our test we have finally found the variation due to causes which we first thought negligible, to be more than the variation due to change in load. As a matter of fact, the steam per indicated horse-power in our two 200 units holds within twelve per cent. over a range from one-quarter up to full output."

Leakage.—It is probable that the loss by leakage is greater than is generally supposed, and when the steam supposed to have been consumed is determined by the water meter, leakage, either in the form of water or steam, counts against the engine. In a surface condensing plant, if there were no loss by blowing off or leakage, no water would have to be supplied to the system after it was once charged. As a matter of fact, a constant supply is necessary. At one of the stations visited the leaks were about 2,000 pounds per hour in the winter time, and in the summer, with one-half the engines, two-thirds the boilers and all the heaters shut off, they were about 500 pounds per hour; in another they were 3,500 pounds per hour.

Condensation.—All the water evaporated by the boilers does not reach the engine in the form of steam, considerable being condensed in the conducting pipe. In a test this is allowed for and only the dry steam charged to the engine. Recent experiments have shown that each square foot of bare pipe exposed under average conditions will condense .85 of a pound of steam per hour. It would take at this rate only fifteen square feet to consume a horse-power (i. e., thirteen pounds of steam).

Auxiliaries.—A large amount of steam is used by the auxiliary engines about a station. While it is true that the boiler feed pumps, for instance, develop little power as compared with that of the main engines which they supply, they are, as a rule, very extravagant in the use of steam. The same thing is true of the ordinary independent air and circulating-pump. There are also in many stations small engines used for operating automatic stokers, fans for artificial draft, coal-handling machinery, etc., the aggregate steam consumption reaching a very considerable figure. There is a movement in the direction of replacing steam-operated auxiliaries by those operated by electric motors, reducing the piping system to the utmost simplicity. At a cost of, say, twenty pounds of steam per indicated horse-power, and a loss of fifty per cent. in its electrical transmission and re-development, one would have, at the point of application, only forty pounds of steam per effective horse-power, against the seventy-five or 200 pounds required by the steam motors, displaced, to say nothing of the reduction to be expected in the radiation and leakage losses.

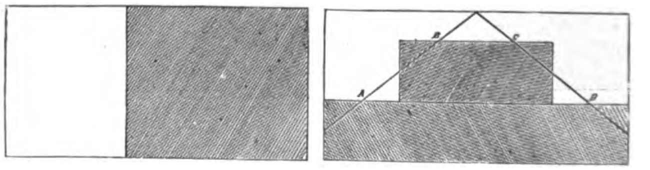
Heating.—The heating of the station usually follows from the unavoidable radiation, but the offices, and often considerable other space, are heated by exhaust steam at the expense of back pressure upon the engines, or by live steam from the boilers direct. Either of these, while necessary, is a drag on the efficiency of the station in kilowatt hours per pound of coal.

Starting Engines.—No inconsiderable amount of steam is used in getting a large engine ready to put to work and allowing it to "turn over" slowly for some time, as is often done before it gets its load. One manager assures me that a careful computation showed the cost of starting up a large engine, including the labor, oil, etc., as well as the steam required, to be over three dollars.

In the accompanying table, I have undertaken to show, for the few stations from which reliable data have been procurable, the proportions which the various demands upon the coal pile bear to each other and to the whole. The column headed "efficiency" shows the percentage of the coal actually used that would have been used by the standard equipment (10 pounds of steam per hour and the electrical horse-power .85 of the indicated). Under "engines" is the percentage of the total coal consumed by reason of the lesser efficiency of the engines; under "conversion," the percentage of the coal consumed by reason of the conversion losses exceeding the standard. The next three columns give the percentage of the total coal used to supply leakage, condensation and auxiliaries. The column under "boilers" gives the percentage by which the consumption was affected, by reason of the fact that the boilers evaporated more or less than ten pounds of water per pound of coal, while the column of "unassigned" gives the aggregate of all the losses not separately reported.

Station No. 1.—Incandescent, run 24 hours per day; average daily output, 13,600 kilowatt hours; coal per kilowatt hour, 8.3 pounds; watt hours per pound of coal, 120.5; boilers: water-tube; average evaporation per pound of coal, 8 pounds; average feed-water temperature, 212 degrees; average boiler pressure, 125 pounds; coal: buckwheat; engines: vertical, compound non-condensing, four-valve, direct-connected; water per hour per indicated horse-power, at best efficiency, 25.8 pounds; water per kilowatt hour, at best efficiency, 37.5 pounds; generators: General Electric.

Station No. 2.—Incandescent, run 6 to 12 hours per day; average daily output, 1,400 kilowatt hours; coal per kilowatt hours, 6.24 pounds; watt hours per pound of coal, 160.4; boilers: water-tube; average evaporation per pound of coal, 7.3; average feed-water temperature, 212; average boiler pressure, 125 pounds; coal: buckwheat; engines: horizontal, cross-compound condensing, high-speed, single-valve, automatic, belted to generators; water per hour per indicated horse-power, at best efficiency, 25.7; water per kilowatt hour, at best efficiency, 39.3; generators: General Electric.



Figs. 5 and 6.

Station No. 3.—Incandescent, run 24 hours per day; coal per kilowatt hour, 3.71; watt hours per pound of coal, 269.5; boilers, water-tube; average evaporation per pound of coal, 8 pounds; engines, vertical, compound condensing, four-valve direct-connected; water per hour per indicated horse-power, at best efficiency, 15.5; generators, General Electric.

Station No. 4.—Incandescent, run 24 hours per day; average daily output, 200,000 kilowatt hours; coal per kilowatt hour, 4.56 pounds; watt hours per pound of coal, 219.7; boilers, water-tube; average evaporation per pound of coal, 7.5 pounds; average boiler pressure, 160 pounds; coal, New River and hard screenings; engines, vertical, triple-expansion, four-valve, direct-connected; water per hour per indicated horse-power, at best efficiency, 15; water per kilowatt hour, at best efficiency, 23.5; generators, General Electric.

Station No. 5.—Arc and incandescent, run 24 hours per day; average daily output, 15,600 kilowatt hours; coal per kilowatt hour, 8.69 pounds; watt hours per pound of coal, 115.1; boilers; return tubular; average evaporation per pound of coal, 9.96; average feed-water temperature, 208; average boiler pressure, 125 pounds; coal, Bituminous, 2 parts; screenings, 1 part; engines, simple non-condensing, belted to generators; compound non-condensing, belted to generators; water per hour per indicated horse-power, at best efficiency, 29.1; water per kilowatt hour, at best efficiency, 47.7; generators, General Electric, Thomson-Houston.

Station No. 6.—Incandescent, run 24 hours per day; average daily output, 6,500 kilowatt hours; coal per kilowatt hour, 3.82 pounds; watt hours per pound of coal, 262; boilers, return tubular; engines, compound condensing, four-valve, belted to countershaft; water per kilowatt hour, per indicated horse-power, 15.5.

Station No. 7.—Incandescent, run 24 hours per day; average daily output, 13,000 kilowatt hours; coal per kilowatt hour, 8.91 pounds; watt hours per pound of coal, 112.2; boilers, water-tube; average evaporation per pound of coal, 6.1; average feed-water temperature, 180; average boiler pressure, 135 pounds; coal, Anthracite pea; engines, simple non-condensing, belted to generators; compound non-condensing, belted to generators; water per hour per indicated horse-power, at best efficiency, 28; water per kilowatt hour, at best efficiency, 45; generators, bi-polar.

Station No. 8.—Arc and incandescent, run 14 to 20 hours per day, averaging 17; average daily out-put, 12,400 kilowatt hours; coal per kilowatt hour, 8.67; watt hours per pound of coal, 115.3; boilers, water-tube; average evaporation per pound of coal, 6 pounds; average boiler pressure, 160 pounds; coal, Kentucky slack; engines, cross-compound condensing, direct-connected; tandem compound, belted to generators; water per hour per indicated horse-power, at best efficiency, 28; water per kilowatt hour, at best efficiency, 45; generators, Westinghouse, General Electric and Wood.

Station No. 9.—Arc and incandescent, run 24 hours per day; average daily output, 2,700 kilowatt hours; coal per kilowatt hour, 6.64 pounds; watt hours per pound of coal, 150.6; boilers, horizontal, tubular and water-tube; average evaporation per pound of coal, 9.83; average feed-water temperature, 140; average boiler pressure, 120 pounds; coal, Clearfield and coal dust, one-half each; engines, single-acting, compound condensing, belted to generators; simple, automatic, high-speed, non-condensing, belted to generators; water per hour per indicated horse-power, at best efficiency, 28; water per kilowatt hour, at best efficiency, 53.27; generators, Westinghouse, Thomson-Houston and General Electric.

Station No. 10.—Arc and incandescent, run 24 hours per day; average daily output, 3,400 kilowatt hours; coal per kilowatt hour, 8.62 pounds; watt hours per pound of coal, 116; boilers, horizontal, tubular and water-tube; average evaporation per pound of coal, 9.85; average boiler pressure, 112 pounds; coal, bituminous, 4 parts; Yars screenings, 1 part; engines, compound condensing and simple non-condensing, belted to generators; water per hour per indicated horse-power, at best efficiency, 28.5 pounds; water per kilowatt hour, at best efficiency, 38.1.

Station No. 11.—Arc and incandescent, run 24 hours per day; average daily output, 4,000 kilowatt hours; coal per kilowatt hour, 10.13 pounds; watt hours per pound of coal, 98.7; boilers, horizontal, tubular and water-tube; average evaporation per pound of coal, 5.75 pounds; average feed water temperature, 212; average boiler pressure, 115; coal, screenings; engines, compound condensing, belted to generators; compound condensing, belted to countershaft; water per hour per indicated horse-power, at best efficiency, 22 pounds; water per kilowatt hour, at best efficiency.

Station No. 12.—Incandescent, run 24 hours per day; average daily output, 4,300 kilowatt hours; coal per kilowatt hour, 7.45 pounds; watt hours per pound of coal, 134.3; boilers, horizontal, tubular; average evaporation per pound of coal, 11.36 pounds; engines, four-valve, simple; single-acting, compound; single-acting, simple; water per hour per indicated horse-power, at best efficiency, 34.3 pounds.

Station No. 13.—Incandescent, run 12 hours per day; average daily output, 5,000 kilowatt hours; coal per kilowatt hour, 7.33 pounds; watt hours per pound of coal, 136.5; boilers, horizontal, tubular; engines, tandem compound, four-valve, condensing; water per hour per indicated horse-power, at best efficiency, 20 pounds.

Station No. 14.—Arc and incandescent, run 24 hours per day; average daily output, 124,000 kilowatt hours; coal per kilowatt hour, 5.68 pounds; watt hours per pound of coal, 176.2; boilers, horizontal, tubular; average evaporation per pound of coal, 9 pounds; average feed-water temperature, 120; average boiler pressure, 115 pounds; coal, Tennessee, run of mine; engines, Tandem compound condensing, belted to jackshaft; double tandem compound, non-condensing, belted to jackshaft; cross-compound, belted to generators; water per hour per indicated horse-power, at best efficiency, 17.5 pounds; water per kilowatt hour, at best efficiency, 26.65 pounds; generators, Thomson-Houston, Eddy, Wood and Detroit.

THE INDUCTION FACTOR, A NEW BASIS OF DYNAMO CALCULATION AND CLASSIFICATION.[1]—I.

BY PROFESSOR CHAS. A. CARUS-WILSON.

SECTION I.

If a dynamo has A conductors on the surface of the armature, N lines of force per pole and p pairs of poles connected in series, the torque in inch-pounds for C amperes passing through the dynamo can be written

$$t = 1.41\, p\, C\, A\, N\, 10^{-8} \qquad (1)$$

When N is a constant quantity, the only variable in this equation is C; so we can write

$$t = 1.41\, C\, M \qquad (2)$$

where M depends simply upon the number of conductors on the surface of the armature, the number of lines of force per pole and the number of pairs of poles connected in series, and can be expressed thus:

$$M = p\, A\, N\, 10^{-8} \qquad (3)$$

If the armature rotates uniformly at n revolutions per second, the induced volts can be written

$$e = p\, A\, N\, n\, 10^{-8} \qquad (4)$$

Thus $M = \frac{e}{n}$ and may be defined as the induced volts divided by the number of revolutions per second; we may call M the induction factor of the dynamo.

We must not suppose that, because M can be defined as the induced volts divided by the revolutions per second, it necessarily depends in any sense on the motion of the armature. Equation (3) shows that M depends only upon the number of conductors, the lines per pole and the number of pairs of poles connected in series, and this equation holds true if the armature is at rest, and does not in any way involve the speed.

The induction factor can be determined experimentally, either by observing the torque for a measured current, or the induced volts at a measured speed; the latter method is the most useful, as the necessary observations are so easily made.

Example 1. We wish to know the torque on the shaft of a direct-coupled generator when delivering a current of 300 amperes. We see by the tachometer that the speed is 400 revolutions per minute, while the voltmeter reads 120 volts on open circuit; dividing the volts by the revolutions per second, we at once find the induction factor to be 18, and the required torque 1.41 × 300 × 18, or 7,610 inch-pounds. Thus, by simple inspection of the tachometer and voltmeter, we can ascertain the forces acting in the machine for any given current in the armature.

If the voltmeter can be read only when a current is passing in the armature, we must, of course, make an allowance for the internal drop, since the value of e used in determining the induction factor is the true induced volts.

Example 2. We have to find the pull on the belt driving a railway generator, the pulley having a diameter of forty inches. The tachometer reads 440 revolutions per minute, while the voltmeter indicates 550 volts, the ammeter reading 400 amperes. Neglecting the internal drop, the induction factor appears to be seventy-five, so that the pull on the belt is given by 1.41 × 400 × 75 ÷ 20, or 2,110 pounds. If now the internal resistance were 0.0375 ohm, there would be an internal drop of fifteen volts, so that the true value of the induction factor would be seventy-seven, and the actual pull on the belt fifty-six pounds more than we had estimated. The pull thus calculated is, of course, that due to the current in the armature, and does not include that required to make up the core and friction losses.

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[1] Read before the N. E. L. A.

SECTION II.

If for t we put T, where T is the force at the rim of a pulley of diameter d, equation (2) can be written

$$T = \frac{1}{\pi d} M C 10^7 \text{ dynes} \qquad (5)$$

where d is expressed in centimeters, T in terms of C. G. S. unit of force and C in amperes. If, now, the circumference of the pulley be 10^7 centimeters, i. e., if $\pi d = 10^7$ centimeters, we can express the force of the dynamo thus:

$$T = M\ C \text{ dynes} \qquad (6)$$

The force of a dynamo may thus be defined as a force of M C dynes at the rim of a pulley 10^7 centimeters in circumference. We may call M C the force factor of the dynamo.

Since M is the induced volts divided by the revolutions per second, it follows that $C\ M = \frac{C e}{n}$; but C e is the rate of doing mechanical work; i. e., the work done per second measured in watts, hence C M is the work done per revolution of the motor at any speed. If, then, we are given C and M, we can find the work per second, i. e., the rate of working, or the power, by simply multiplying the product C M by the revolutions per second.

Example 3. If the induction factor of a dynamo is five, and the maximum current one hundred amperes, C M = 500, and the rate of working at twenty-five revolutions per second is seen at once to be 12.5 kilowatts.

Many manufacturing firms have used the ratio of the watts to the revolutions per second as a basis of comparison of dynamos without perceiving its true significance, and have called this ratio the mass factor.

The fact seems to have been overlooked that the ratio of the induced volts to the revolutions per second is a constant, so long as the useful lines per pole remain unaltered, being, in fact, what we have termed the induction factor.

While the force factor and the so-called mass factor are one and the same thing, the latter is expressed in a way involving the idea of power and, consequently, of speed, while the former indicates the real nature of this ratio, showing that it is quite independent of speed, and, therefore, not a power unit at all, much less a mass unit, but a force unit.

Example 4. A four-pole railway generator, with the armature parallel connected (giving P = 1), has 440 conductors on the armature, with 16.1×10^6 lines per pole; the induction factor is seventy-seven, and the force factor for 600 amperes is $77 \times 600 = 46.2$ kilodynes; the output at 450 revolutions per minute is $46.2 \times 7.5 = 346$ kilowatts; the dynamo is a General Electric Company's M. P. 4, 300 multipolar railway generator.

Example 5. A ten-pole generator, armature parallel connected with 1,440 conductors and 28.6×10^6 lines per pole, will have an induction factor of 412.

The force factor for 1,500 amperes is $412 \times 1{,}500 = 618$ kilodynes, and the output at eighty revolutions per minute is 825 kilowatts. The dynamo is a Westinghouse ten-pole railway generator.

USE OF THE INDUCTION FACTOR IN DYNAMO CALCULATION.

SECTION III.

The induction factor forms a connecting link between the calculation for and the construction of a motor, and since it is the true basis of the dynamical action of the motor, it can be made the subject of calculation and enter into equations of any complexity.

Example 6. We have to design a motor that will draw a car at thirteen miles an hour, with a tractive effort of 680 pounds on thirty-three-inch wheels, with gear ratio 4.78 on a 500-volt line, the resistance of the motor being 1.3 ohms. If the mechanical efficiency is eighty-five per cent., the total tractive effort T must be 800 pounds.

If E be the tension of the line, d the wheel diameter, v the gear ratio, S the speed in miles per hour, R the resistance of the motor, the induction factor is given by the following equation:

$$M = \frac{E d}{11.2 v S}\left\{1 + \sqrt{\left(1 - \frac{8 R T S}{E^2}\right)}\right\} \qquad (7)$$

Inserting the given values in this equation, we find M to be 41.7. We also see from the equation

$$T d = 2.82 v M C \qquad (8)$$

that the current, when running with the given load, will be forty-seven amperes.

So that the motor must have an induction factor of 41.7 and carry safely 47 amperes; i. e., the force factor must be 1,960 dynes.

The induction factor may be made up in any way that is most convenient. If there are 720 conductors on the armature, and four poles, the armature, being series-connected, giving p = 2, we see from Equation 3 that we must have 2.89×10^6 lines per pole. Further, if the motor is series-wound, it must have the specified induction factor for forty-seven amperes in the field winding.

Equation 7 may be written in the form

$$M = 7.85 \frac{E d}{v s}\left\{1 + \sqrt{\left(1 - \frac{R T s}{11 E^2}\right)}\right\} \qquad (9)$$

where s is the velocity measured in feet per second, and d is the diameter of the rope drum of a crane or elevator.

Example 7. We have to design a motor for an elevator where the unbalanced weight to be raised is 2,000 pounds, the velocity 200 feet per minute, the tension of the line 125 volts, the gear ratio seventy-five, the friction equal to 1,400 pounds at the rim of the rope drum, which is thirty-six inches diameter, and the resistance of the motor 0.05 ohm; inserting these values in the equation, we find the induction factor to be 4.45, and the running current 130 amperes; the force factor is therefore 578 dynes. If p = 1, and A = 200, there must be 2.22×10^6 lines per pole. Since the pull at the rim of the rope drum is 3,400 pounds, when running at 200 feet per second, this motor would develop about twenty horse-power; and if the elevator had to act always at this speed, it would be sufficient to describe the motor as a twenty-horse-power motor; but this would give no information as to the ability of the motor to accelerate, since, at the moment of starting, the horse-power is nothing.

SECTION IV.

The current required for any given acceleration is given by the equation

$$a = 405 \times 10^{-4} \times \frac{v\ M}{d\ W} \times C_a \qquad (10)$$

where C_a is the current required (over and above the frictional or running current) to produce an acceleration of a feet per second in a mass of W tons[2].

Example 8. We have to start up the elevator car of Example 7 in two seconds; i. e., to get up a speed of 200 feet per minute in two seconds; a is then 1.67, and if we suppose the total mass to be moved to be five tons, the required current is twenty-two amperes, making a total current, at the start, of 152 amperes. The motor must therefore have a force factor of 676 dynes in order that it may start up in the given time.

If the distance from floor to floor were twelve feet, two seconds would thus be occupied in getting up speed, during which time the car would travel 3.3 feet, and the rest of the distance, 8.7 feet, would be covered in 2.6 seconds at 200 feet per minute, making a total time of 4.6 seconds for the whole distance. Nearly half the time is thus occupied in accelerating.

Suppose now that we had to reduce the time of starting by one-half; i. e., to start up in one second. One way of stating the case would be to say that we needed a "more powerful motor"; but so long as the frictional resistances and the final speed are to remain the same, the maximum horse-power of the motor remains constant, so that we do not need more power, but more force; i. e., we require a motor with a higher force factor.

We cannot alter M so long as the final speed is specified, so we must double the accelerating current, making the total current at the start 174 amperes. The motor would then be described as having an induction factor of 4.45, with an armature capable of carrying 174 amperes safely; i. e., the motor must have a force factor of 775 dynes.

Example 9. Take the case of the street railway motor of Example 6, with induction factor 41.7 and force factor 1,960 dynes.

The total available tractive effort was 800 pounds; allowing eighty-five per cent. mechanical efficiency left us with 680 pounds for useful effort. (The well known G. E. 800 street railway motor, made by the General Electric Company, has 800 pounds available for useful effort with forty amperes.)

If the track resistance for a car weighing ten tons be 200 pounds, this will leave us 580 pounds per motor, if there are two motors, for grades and starting, or we may say that of the maximum permissible current of forty-seven amperes, thirteen are used in overcoming gear and track friction, and thirty-four are available for grades or starting.

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[2] Tons of 2,240 pounds and so throughout this paper. If tons of 2,000 pounds are found more convenient, the numerical constant can be changed.

Now, 580 pounds are equivalent to a grade of five per cent. for a ten-ton car, so that the motor would run a car of this weight at the given speed—thirteen miles an hour—up a grade of five per cent. Taking 680 pounds as the useful effort at this rate, the useful watts can be written (to within one-half per cent. of accuracy) as 2 S T or 17.7 kilowatts or 23.7 horsepower. This is the maximum rate of working.

These motors, however, will not be able to start the car on this grade. They can run the car when once started, but if it should happen to stop on the grade, they cannot get it started again, since the whole available current is used up in track friction and on the grade. We must draw more current from the line if we are to start up on the grade.

Equation 10 tells us that we can make the acceleration at the start anything we please, by increasing the current above that required for the grade and for friction. Let us find how much current would be required to start up in twenty seconds on a five per cent. grade.

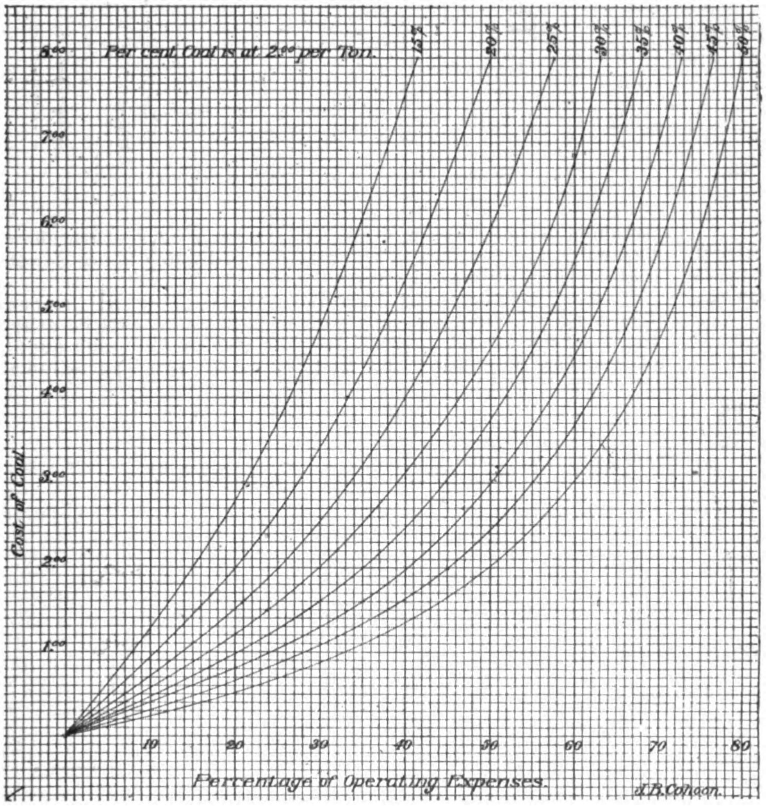
The final speed of thirteen miles an hour is equivalent to 19.1 feet per second; if we have to make up this speed in twenty seconds, the acceleration must be 1.91 feet per second, assuming uniform acceleration throughout. Inserting this value in Equation 10, remembering that each motor has to accelerate half the car, we find the required current to be twenty amperes, so that the total current from the line at the start would be sixty-seven amperes; namely, thirteen for friction, thirty-four for the grade and twenty for accelerating. The distance traveled in getting up speed would be about sixty-three yards.

The motors then would have to be capable of carrying sixty-seven amperes, and the force factor must be 2,790 dynes.

THE ESTABLISHMENT OF A BASE PRICE FOR CURRENT.[1]

BY J. B. CAHOON.

To bring incandescent lighting up to as profitable a basis as arc lighting is a serious problem, now that the people are accustomed to obtaining incandescent lights so cheaply, and certainly some stations are so situated that they cannot do it; others can by making a fight for it. Certain classes of stations are still giving flat rates in many instances, and the solution of the problem for them is to change over to meters and make the meter price one that will be equitable, both to the company and to the consumer. If it be decided that it is good policy to make a reduction to an equitable rate, then on what basis shall the company work? The thought has occurred to me, that it might be wise for the convention to adopt what may be called a standard rate, based on some factor or factors that will admit of application to every station in the country.



CURVE SHOWING RELATION OF COST OF COAL TO OPERATING EXPENSES.

A careful analysis of the prices paid per kilowatt hour for incandescent light in different sections of the country, seems to show that, in many instances, prices charged are based upon what somebody else has charged, rather than on what ought to be charged in view of the cost of the principal items entering into the operating expenses at each particular place. The two main factors that enter into operating expenses are wages and coal. If we separate wages into their natural subdivisions—administrative, distributive and productive—we find the amount expended directly for producing the current to be the dominating one in the matter of the cost of furnishing current to the consumer. Comparing the productive wages, we find that in different sections of the country there is very little variation in the amount paid to the engineer, to the fireman, to the coal-heaver and the auxiliary help in the machine room, so that, for practical purposes, it would not do to base the price of current on this factor alone. It is necessary, therefore, for us to look farther and seek some factor that shows a decided variation, and, at the same time, is one of the principal factors in the cost of producing current. The factor that seems to fulfill such conditions is coal. A glance over prices paid for coal in different sections of the country shows a very wide variation, and, at the same time, a consideration of the coal itself, as to its quality, shows a variation in evaporative power per pound of coal; which variations ought, strictly speaking, to enter as a factor in determining price, and, in order to get accurate results, should be so used: i. e., placing evaporative power of first quality coal at 12, then the price paid for coal should be multiplied by the ratio between 12 and the evaporative power of the coal used to determine the true value for comparison.

"E."

THE ELMIRA ILLUMINATING COMPANY

SUPERINTENDENT'S MONTHLY REPORT. MONTH OF 189

RECEIVED					CONSUMED	
ARTICLE	Amount	Cost			Amount	Cost
Coal						
Waste						
Water						
Arc Globes						
Dyn. Sund.						
Engine Sund.						
Station Sund.						
Cylinder Oil						
Engine Oil						
Grease						
CARBONS.						
7-16x12 c. c.						
7-16x12 Pl.						
7-16x7 c. c.						
7-16x7 Pl.						
5-8x12 c. c.						
5-8x12 Pl.						
LAMP RENEWALS.						
10 C. P.						
16 C. P.						
25 C. P.						
32 C. P.						
75 C. P.						
100 C. P.						
Total				Total		
Productive Wages						
Distributive Wages						
Wiring Wages						
Total Supplies and Wages						

Station output in Kilowatt Hours } Arc...
Power...
Railway...
Alt...

Total Kilowatt Hours

New Incd. Lps. Connected.................. ..New Arc Lps. Connected..................
New Motors in H.-P.............................New Fan Motors ....
Incd. Lamps Discontinued........................Arc Lamps Discontinued......................
H. P. of Motors Discontinued..................Fan Motors Discontinued ....
Net { Gain Loss | Incd. Lamps.......................Net { Gain Loss | Arc Lamps.......................
Net { Gain Loss | H.-P. in Motors.......................Net { Gain Loss | In Fan Motors.......................

Correct.

.... Supt.

SUPERINTENDENT'S MONTHLY REPORT.

In determining a base price which should be charged per kilowatt hour, it is necessary to start with some kind of coal at a certain price, and which enters as a certain per cent. into the operating expenses. For this purpose, bituminous coal, with evaporative power of 12 and price $2 per ton delivered at the bunkers, has been taken, and it is assumed that with this coal at the price mentioned, it enters as a factor at practically 25 per cent. of the total cost of operating expenses of the company, said operating expenses including every expense attendant upon the production and distribution of the current and the administration of the company, also including taxes and insurance, but not expenditures for wiring of buildings or fixed charges. For example:

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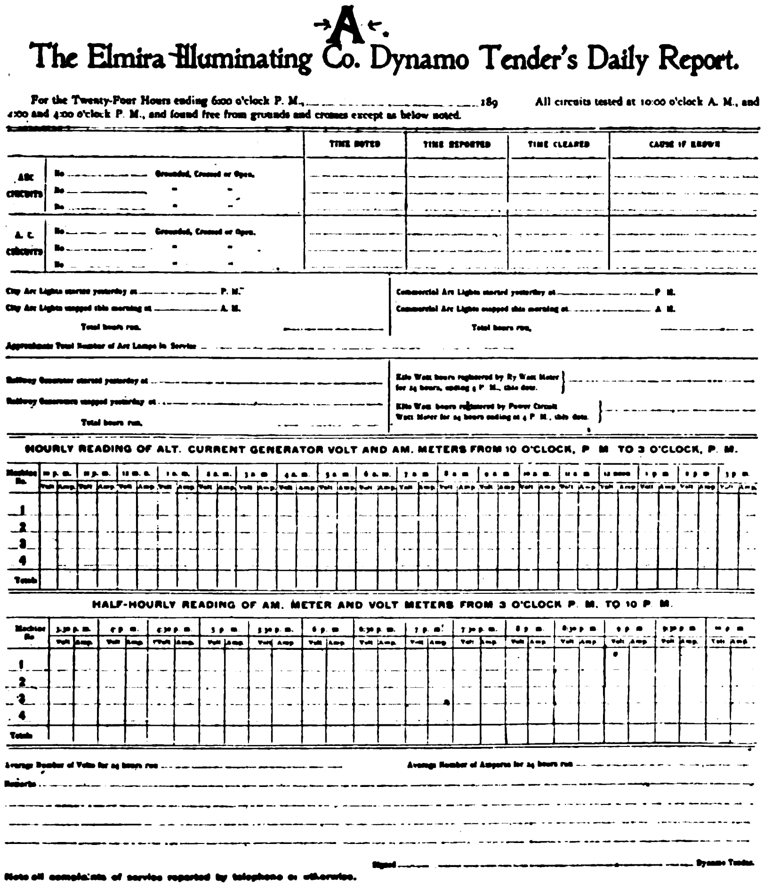
[1] Read before the N. E. L. A. Abstract.



→A←.

The Elmira Illuminating Co. Dynamo Tender's Daily Report.

For the Twenty-Four Hours ending 6:00 o'clock P. M., ... 189 All circuits tested at 10:00 o'clock A. M., and 4:00 and 4:00 o'clock P. M., and found free from grounds and crosses except as below noted.

		Time Noted	Time Reported	Time Cleared	Cause if Known
Arc Circuits	No. .... Grounded, Crossed or Open.				
	No. .... " "				
	No. .... " "				
A. C. Circuits	No. .... Grounded, Crossed or Open.				
	No. .... " "				
	No. .... " "				

City Arc Lights started yesterday at .... P. M.
City Arc Lights stopped this morning at .... A. M.
Total hours run. ....

Commercial Arc Lights started yesterday at .... P. M.
Commercial Arc Lights stopped this morning at .... A. M.
Total hours run. ....

Approximate Total Number of Arc Lamps in Service ....

Railway Generator started yesterday at ....
Railway Generators stopped yesterday at ....
Total hours run. ....

Kilo Watt hours registered by Ry Watt Meter for 24 hours, ending 4 P. M., this date. ....
Kilo Watt hours registered by Power Circuit Watt Meter for 24 hours ending at 4 P. M., this date. ....

HOURLY READING OF ALT. CURRENT GENERATOR VOLT AND AM. METERS FROM 10 O'CLOCK, P. M. TO 3 O'CLOCK, P. M.

Machine No.	10 p.m.		11 p.m.		12 m.n.		1 a.m.		2 a.m.		3 a.m.		4 a.m.		5 a.m.		6 a.m.		7 a.m.		8 a.m.		9 a.m.		10 a.m.		11 a.m.		12 noon		1 p.m.		2 p.m.		3 p.m.	
	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp
1																																				
2																																				
3																																				
4																																				
Totals																																				

HALF-HOURLY READING OF AM. METER AND VOLT METERS FROM 3 O'CLOCK P. M. TO 10 P. M.

Machine No.	3.30 p.m.		4 p.m.		4.30 p.m.		5 p.m.		5.30 p.m.		6 p.m.		6.30 p.m.		7 p.m.		7.30 p.m.		8 p.m.		8.30 p.m.		9 p.m.		9.30 p.m.		10 p.m.	
	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp	Volt	Amp
1																												
2																												
3																												
4																												
Totals																												

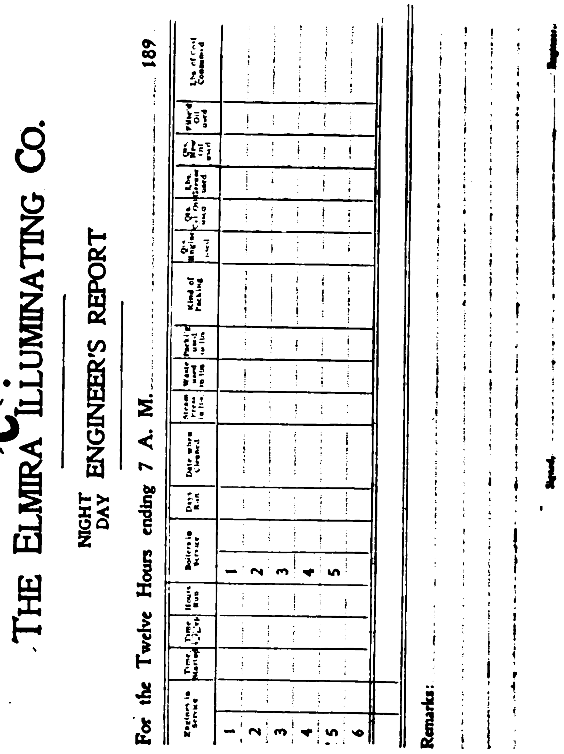
Average Number of Volts for 24 hours run .... Average Number of Amperes for 24 hours run ....

Remarks ....

Signed .... Dynamo Tender.

Note all complaints of service reported by telephone or otherwise.

Blank Form of Dynamo Tender's Daily Report for Small Stations.



→C←.

THE ELMIRA ILLUMINATING CO.

NIGHT
DAY ENGINEER'S REPORT

For the Twelve Hours ending 7 A. M. 189

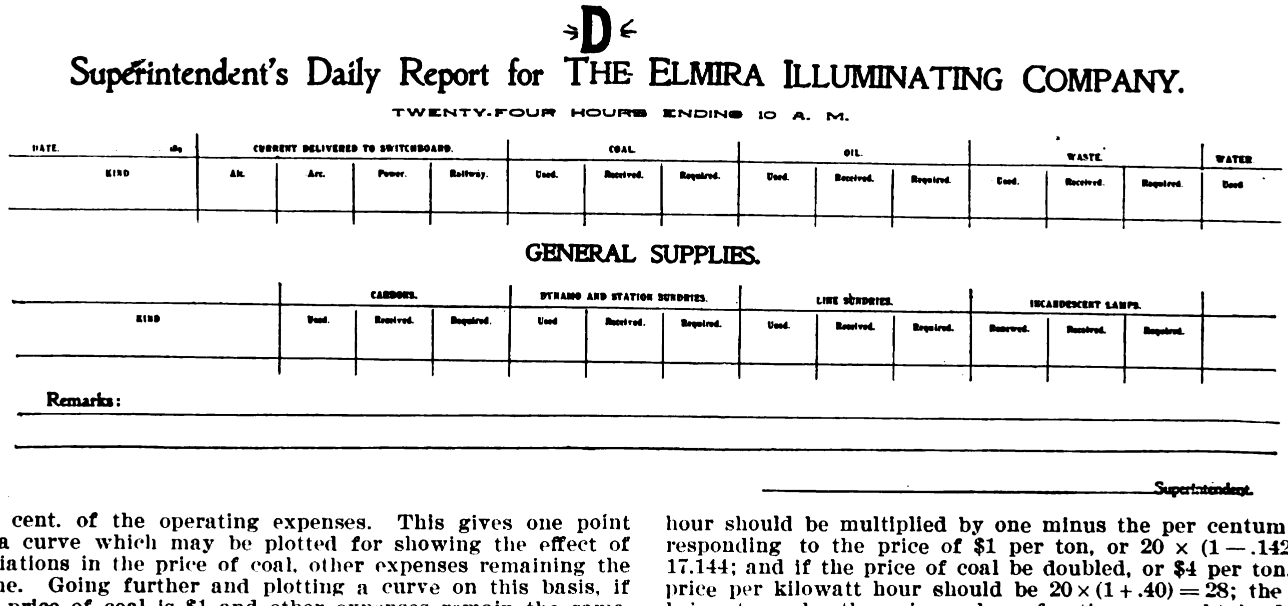
Engines in Service	Time Started	Time Stopped	Hours Run	Boilers in Service	Days Run	Date when Cleaned	Steam Press. in lbs.	Waste used in lbs	Packing used in lbs	Kind of Packing	Qts. Engine Oil used	Qts. Cyl. Oil used	Lbs. Grease used	Qts. New Oil used	Filter'd Oil used	Lbs. of Coal Consumed
1				1												
2				2												
3				3												
4				4												
5				5												
6																

Remarks: ....

Signed, ... Engineer.

Blank Form of Engineer's Report.

Assuming cost of operating expenses at $40,000, cost of coal as $10,000 at $2 per ton, we obtain the cost of coal as 25 per cent. of the operating expenses. This gives one point of a curve which may be plotted for showing the effect of variations in the price of coal, other expenses remaining the same. Going further and plotting a curve on this basis, if the price of coal is $1 and other expenses remain the same, we then have the total cost of operating expenses as $35,000, of which coal is $5,000, or 14.28 per cent. If coal is $4 per ton, the operating expenses are increased $10,000, and total operating expenses become $50,000, of which coal costs $20,000, or 40 per cent. In a similar manner, using other per cents, other points may be determined and curves drawn through these points, the curves partaking of the form of a parabola passing through the origin; such curves are shown herewith; the division of the scale of ordinates being dollars, and of the abscissa per cent.



→D←

Superintendent's Daily Report for THE ELMIRA ILLUMINATING COMPANY.

TWENTY-FOUR HOURS ENDING 10 A. M.

Date. 189	Current Delivered to Switchboard.				Coal.			Oil.			Waste.			Water.
Kind	Alt.	Arc.	Power.	Railway.	Used.	Received.	Required.	Used.	Received.	Required.	Used.	Received.	Required.	Used

GENERAL SUPPLIES.

	Carbons.			Dynamo and Station Sundries.			Line Sundries.			Incandescent Lamps.			
Kind	Used.	Received.	Required.	Used	Received.	Required.	Used.	Received.	Required.	Renewed.	Received.	Required.	

Remarks: ....

.... Superintendent.

If, now, we fix on 20 cents per kilowatt hour as the price which the consumer should pay on a basis of coal of evaporative power 12 and price $2 per ton, then if the same quality of coal can be obtained for $1 per ton, the price per kilowatt hour should be multiplied by one minus the per centum corresponding to the price of $1 per ton, or 20 × (1 — .1428) = 17.144; and if the price of coal be doubled, or $4 per ton, the price per kilowatt hour should be 20 × (1 + .40) = 28; the rule being to make the price, where fractions are obtained, the nearest whole number: thus, coal at $1 gives 17 cents per kilowatt hour. Similarly, the price that we should charge for arc lighting and power should be referred to the same standard. It should be clearly understood that the above assumption of coal at $2 per ton, and entering as 25 per cent. of the total operating expenses, is only made for the purpose of obtaining a starting point to present this idea to the members of the convention. In order to work on a satisfactory curve, and one that will fit the conditions of individual stations, each must figure out what per cent. of their operating expenses coal would be if they had to pay $2 per ton for standard coal, and start with this per centum as a basis on which to determine the proper curve for their own particular case.

Suppose each station were to make such a curve, and from it work out for itself the price which it should charge for current, and compare the price so obtained with the price that it is actually getting. This would then show whether the price should be advanced, in order to show a fair margin of profit. The purpose of bringing the subject up for discussion and for determining whether, in the opinion of the convention, it is advisable to establish such a basis, and, if it is wise to so establish a basis, whether it should recommend its adoption to the members.

B.

THE ELMIRA ILLUMINATING COMPANY.

DYNAMO TENDER'S DAILY REPORT.

For the Twenty-four Hours ending 6.00 o'clock P. M. ....189 . All circuits tested at 10.00 o'clock A. M., and 1.00 and 4.00 o'clock P. M., and found free from grounds and crosses except as below noted.

		TIME NOTED.	TIME REPORTED.	TIME CLEARED.	CAUSE IF KNOWN.
ARC CIRCUITS.	No........Grounded, Crossed or Open....				
	No.... " "				
	No.... " "				
A. C. CIRCUITS.	No. ......Grounded, Crossed or Open....				
	No.... " "				
	No.... " "				
RY. WAY CIRCUITS.	No........Grounded or Open..........				
	No.... " "				
	No.... " "				
MOTOR SYSTEM.	Grounded, Crossed or Open....				

City Arc Lights started yesterday at......P. M. — Number of City Lights in service..................
" " stopped this morning at......A. M — Estimated watt hours output ....
Total hours run ....

12 M. Arc Lights started yesterday at......P. M. — Number of 12 M. Lights in service..................
" " stopped this morning at ...... — Estimated watt hours output..................
Total hours run ....

10.15 P. M. Arc Lights started yesterday at ... P. M. — Number of 10.15 Lights in service..................
" " stopped yesterday at....P. M. — Estimated watt hours output ....
Total hours run..................

Watt hours registered by Railway Wattmeter for twenty-four hours ending 6.00 P. M., this date ....
" " Power " " " " " " ....
" " A. C. " " " " " " Mch. No. 1. ....
" " " " " " " " " Mch. No. 2. ....
" " " " " " " " " Mch. No. 3..................
" " " " " " " " " Mch. No. 4..................
Total station output for 24 hours ending 6.00 P. M., this date.................. Watt hours ....

Remarks..................

Note all complaints of service reported by telephone or otherwise. Signed.................. Dynamo Tender.

BLANK FORM OF DYNAMO TENDER'S REPORT FOR LARGE STATION.

The question of blanks for showing output of the station and its cost is one that may well be discussed by the members of the convention, and an effort should be made to secure a standard set of blanks that will show these points in such a clear way that the information may be available for comparison and discussion in the conventions. I present herewith specimen blanks which show the system designed for our station, and among them will be noticed two forms of dynamo tender's report, marked A and B, respectively. The former we used prior to putting recording wattmeters on the alternating circuits, and the other, which we are now using, since the introduction of the wattmeters. The first blank entailed a considerable amount of work, and necessarily gave only an approximate result, but it was better than having no record at all, and, in one sense, the second blank, marked B, gives an approximate result also, as no recording wattmeters are used on the arc circuits. You will note on blank marked A that hourly readings of the alternating-current volt and ammeters are taken from ten o'clock p. m. of one day to three o'clock p. m. the next day, this being during the light-load hours, when the variations are small; during the heavy-load hours, from 3 p. m. to 10 p. m., half-hourly readings are taken. Many of the smaller stations would not feel warranted in going to the expense of purchasing recording wattmeters for their incandescent circuits, and for this class of stations this form of blank is recommended. For the larger stations, which can afford to keep more accurate records, Blank B is recommended. Blank C, the engineer's daily report, is probably the same in substance, if not exactly so in form, as is in use by a majority of the stations at the present time, and will be found, it is thought, sufficiently complete to give the results sought for without going into too many details.

Blank D is the superintendent's daily report, and is intended for the larger stations having a general manager, and is designed to give the latter a general idea of what has been done, what has been used, what material has been received, what is required and for which requisitions in due form will be made out. Blank E is the superintendent's monthly report made to the general manger of large companies, but should be made out by superintendents of small companies also and filed in a book kept for this purpose, so that they may at any time turn to it and get any information that is desired, or make comparisons between the output and cost from month to month. The main feature of this blank is that in a comparatively small space it gives the total cost of operation of the station for the month, the total amount of supplies used, the output of the station, the number of new lamps, motors, etc., connected, and also the loss, if any, in either lamps or motors. From the office the manager will have the report of the amount billed out for the current used for incandescent and arc lamps and motors during the month, and, by comparing the two, can readily ascertain whether the business for the month, as a whole, has been conducted on a profitable basis or at a loss; whether there has been an increase in the business; whether too much has been expended in one direction and not enough in another, and, in fact, can, in a brief space of time, analyze the entire business for the month in such a way as to give him the information that he needs, in order that he may intelligently conduct the business to a successful issue.

ADDRESS OF PRESIDENT NICHOLLS.[1]

IN arriving at a decision as to the most suitable place at which to hold the twentieth convention of the National Electric Light Association, the Executive Committee and your president were guided largely by the desire to select a spot where our members could have some practical illustration of the most recent advances in electrical development as applied to everyday commercial use on an extended scale.

Niagara Falls, N. Y., appeared to offer superlative inducements as our place of meeting, judged by this standard, and was accordingly given the preference; and with a knowledge of the programme that has been prepared for the instruction of our members and the many interesting features for the entertainment of themselves and their friends, I am confident that before the close of the convention, those present will unanimously be of the opinion that our choice was wisely made.

When we consider that only five years since many of us were in attendance at the fifteenth convention of the association held in Buffalo, and were listening to the discussion which followed Dr. Carl Hering's paper on "Transmission of Power," even the most sanguine of us but little imagined that in half a decade we should be holding our twentieth convention at Niagara Falls, principally with the object of seeing and realizing the actual application of motive power derived from the Falls, to some of the most novel and most important industries of the country.

To "harness Niagara" had long been a dream but is now an actuality, and who can foretell the resultant progress and advancement that we may be destined to celebrate within the next few years.

There is no parallel in history for such rapid development of any industry as that of the manufacture of electrical apparatus and its application, or, to be strictly correct and quote ex-President of the Association Mr. M. J. Francisco, who is an authority on the subject, the only parallel was when the world was created in six days out of nothing. Five years ago we were discussing the possibilities of transmitting power in small units to moderate distances; to-day the problem is solved and innumerable installations are transmitting power in large quantities for long distances, and yet we have only crossed the threshold.

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[1] Presidential Address, N. E. L. A., Niagara Falls, June 8, 1897.

In this connection, I am of the opinion that the lecture to be given to-morrow evening by Mr. L. B. Stillwell will serve as a tidal mark. At the Buffalo convention we occupied ourselves in discussing the possibility or otherwise of transmitting Niagara power to Buffalo; Mr. Stillwell's paper will set forth the various actual applications of Niagara power at the present time, including transmission to Buffalo, and future presidents of this association will, in all probability, refer to his paper and draw comparisons when adverting to the strides which will be then have been made in the wider utilization of this mighty power, which for countless ages has been simply running to waste so far as any economic use is concerned and apart from its value as to the greatest scenic wonder of the world.

I fully appreciate the honor of presiding at this meeting, which, for the reasons I have just referred to, will be embodied in the annals of the association as marking an historic epoch in the advancement of the science of electricity as applied to industry, and it is, therefore, with more than ordinary satisfaction that I am authorized to state that at no previous period has this association been as prosperous, shown greater vitality or commanded such respect. It is now an acknowledged authority on matters electrical, its membership confers a privilege that has more than a sentimental value, and its gathering strength will offer a bar to use of powers municipal or corporate unjustly or arbitrarily directed for the purpose of destroying the capital investment of those who look to it for protection.

In union is strength, and to-day our membership numbers more active members than ever before, and the financial statement to be presented in due course by the chairman of the Finance Committee will show that after making provision for all expenditures necessary to maintain the usefulness of the association, an unusually large credit balance is at your disposal. It is certainly cause for congratulation that increasing prosperity has been followed by an access of dignity and influence and the more recent meetings have been remarkable for the greater interest that has been taken in the actual work of the association and the lesser attention that has been given to the merely social and entertainment features of the programme.

The desire to make the twentieth convention notably a business meeting has so far predominated that we have neither asked nor accepted any favors other than from the electric power companies, and several of the manufacturing establishments using electric power for the operation of their works.

Although several delightful and interesting excursions have been arranged for, the association has made, on behalf of its members a businesslike arrangement for the several trips and excursions set forth in the programme of the convention, preferring to pay our way rather than tax the courtesy of the transportation and other companies by accepting dead-head privileges.

In view of the fact that I have had occasion to communicate with our members from time to time during the past year by the issuance of printed "Interim Reports," referring to the work undertaken by your executive, it is unnecessary to give an account of my stewardship in this address, but I may say that many matters of urgent importance are pressing for settlement and which will doubtless receive the most careful attention at your hands during the next few days.

The list of papers to be read at this convention is an exceptionally good one, and the authors are of more than continental reputation, and I therefore trust that our members will show their appreciation of the care and study given to the preparation of these papers, by being present in force at every session, and taking an active part in the discussions that will ensue.

Notwithstanding the progress that has been made in the perfection of apparatus and the application of new principles, there never was a time when there was more to learn than now, and no more fitting occasion is likely to present itself to us to familiarize ourselves with the latest procedure in our chosen profession, and the papers to be read and the discussions thereon will find hundreds of thousands of readers and students, thanks to the electrical journals, of which we are all justly proud. No other art, science, industry or profession has been so well and faithfully served by an enlightened and progressive technical press as our own, and who can estimate the fair share of credit justly their due for the part they have taken in aiding and advancing the introduction of electromotive force in its many and varied applications.

As we have a lengthy programme before us and several important reports of committees to receive and discuss before we adjourn for midday recess, I now declare the twentieth convention of the National Electric Light Association opened and ready for the transaction of business.

REPORT OF THE N. E. L. A. COMMITTEE ON SAFE WIRING.[1]

CAPT. W. BROPHY, Chairman.

At the seventeenth convention of this association, held in New York City, a committee to be known as a Committee on Standard Electric Rules, consisting of five members, was appointed, with instructions to select one of its members or some other person to represent the National Electric Light Association in the National Conference on Standard Electric Rules.

This committee was the successor of the one that was appointed at the fourteenth convention of this association, known as the "Committee on Safe Wiring," and subsequently known as the "Committee on Standard Rules for Electrical Construction and Operation," which was discharged on its own recommendation at the same time. This last named committee has labored faithfully since its organization to bring about the much desired end, the establishment of a uniform standard set of electrical rules governing all electrical installations to be enforced by the fire insurance companies and municipal inspection bureaus. This task was no easy one for this committee. Its efforts met with fierce opposition from some and indifference on the part of others. It received some encouragement from the press at times, and no small amount of opposition at others. Some portions of the insurance interests looked upon it with favor, but a large portion opposed its aims and purposes. The principal obstacles to be overcome were:

First—Indifference on the part of those most deeply interested—those engaged in the electrical industries. They somehow believed that the fire underwriters of the country were more powerful than the municipal, State or even the United States Government; that any law, edict or rule issued by them, whether right or wrong, could be enforced and must be obeyed. For the benefit of this class, your committee must say, that such is not the case. The fire underwriters are receiving and disbursing agents of nearly the whole of the people of the country, receiving their money as a consideration for indemnity against total loss by fire. The larger proportion of the money they receive is returned as partial compensation for the losses sustained, the balance pays the expense of the business and a varying amount of profit to the holders of stock and the policy holders mutual insurance companies. The greater the care in selecting fire risks and the more careful the supervision of them while insured, the greater the profit.

The next obstacle to overcome was the prejudice of the average underwriter against electricity when introduced into the property he insured. To those who witnessed the methods adopted by those who installed the first electric light and know something of the losses sustained by the insurers and insured, this prejudice is excusable. Up to that time electricity had proved itself a useful and harmless servant, the only evidence of its ability to produce heat or flame was offered at the contact points of the telegraph relay and key, but when this very small spark was increased at the carbon points to such size and intensity as to rival in brilliancy the sun's rays, its power for good and evil was wonderfully increased. Those who could keep under perfect control the feeble battery current, did not possess the necessary appliances or knowledge to keep this new form of electrical energy under proper restraint, while the fire underwriters paid heavy tribute to it in the form of burnt offerings and in the shape of indemnity to the policy holders.

Under such circumstances who could blame these powerful bodies for taking alarm, and looking upon the new candidate for public approval with disfavor? They were between two fires as it were, those caused by electricity improperly harnessed, and that of enthusiastic admiration kindled in the breasts of their policy holders for the electric light; they would have it even if it did increase the fire hazard. How to get out of this dilemma was the burning question; they did not want to abandon a formerly profitable part of their business, but feared they must. Two remedies were tried: First, increased insurance rates was the penalty exacted for the introduction of electric lights. This plan proved ineffectual, because it did not prevent losses in excess of premium rates, and it opened up a new field for the illegitimate underwriter who preys on the insurer and insured alike in the end. The second remedy proved more effective. They called to their aid some of those who were supposed to know how to lead this new and unknown force along the straight and narrow path designed for it, and not permit it to wander into their domain and change fat dividends to heavy assessments. Such men were scarce, and most, if not all, of those engaged were obliged to learn by experience the best methods of procedure; the same can be said of those engaged in the electric business, the acquisition of such experience up to a few years ago proved very costly to the fire underwriters and others as well.

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[1] Presented at the Niagara Falls Meeting, June 8, 1897.

Gradually fire insurance associations appointed one or more inspectors to examine the electric light wires, lamps and fixtures installed in their territory, and enforce certain rules and requirements generally made by themselves. With the rapid advance of the electrical industries changes in these were inevitable, but lack of uniformity proved to be a crying evil. The best and most reasonable requirements were formulated in the sections of the country where the electric light had found a foothold earliest. Most of the inspectors instead of profiting by the experience of those longest in the business and adopting the rules formulated by them, insisted on issuing productions of their own, so that the so-called insurance rules differed as widely as the excise laws of Maine and New York. Some sections of the country were fortunate enough to have men who were empowered to make rules and enforce them, whose elevation to such position did not make them dizzy and cause them to issue impractical requirements, the enforcement of which did not always serve any good purpose, but made life a burden to those who were so unfortunate as to come under their jurisdiction, whether manufacturers, contractors or producers of electrical energy. But other sections were not so fortunate. Among all the burdens that those in the electrical business have had to bear in the past, the whims and caprices of the authors of insurance rules were not the least.

The loss of time and money caused by conflicting requirements became so great in time, a movement was inaugurated by this association for securing uniformity or rules—a codification of the best and repeal of the productions of cranks and impracticals. This task was accomplished by your former committee, the results of their labors approved and the first national code issued by this association. It was also adopted by the insurance associations who thus recognized the good work performed. After the issue of this national code it was thought that all the troubles here described were ended. Such however was not the case, for while the best representative men of the fire insurance associations agreed that the electrical engineer or electric light superintendents were the proper ones to formulate the rules and requirements, and the insurance associations should enforce them, there were others holding subordinate positions who could not bear to have this sentiment put in practice. As a result of such feeling an organization known as "The Underwriters' National Electric Association," which has claimed the sole right to issue new or amend the original rules first issued by this association, and has in the past insisted that the electric and allied interest should have no voice therein. As time rolled by, and the organization increased in numbers this sentiment has changed somewhat due to the influence of broad-minded practical men who are members of it, and to the efforts of your former and present committees and last, but not least to those of the National Conference on Standard Electrical Rules, which was organized through the untiring efforts of the chairman of the Committee on Standard Rules for Electrical Construction and Operation, Mr. W. J. Hammer and his associates.

As a result of our combined efforts the last codification of and amendments to the national code is the result of the combined efforts of the National Conference on Standard Electric Rules and The Underwriters' National Electric Association. The right to do this is what your committee have contended for in the past and have finally obtained. Your present committee on standard electric rules selected its chairman to represent you in the National Conference on Standard Electrical Rules, which was organized at a meeting held in the city of New York on March 18 and 19, 1896, of representatives of insurance, electrical and kindred interests, consisting of the following organizations: National Electric Light Association, American Institute of Electrical Engineers, American Street Railway Association, National Board of Fire Underwriters, American Institute of Architects, International Association of Fire Engineers, Underwriters' National Electric Association, Factory Mutual Insurance Association, American Society of Mechanical Engineers, Western Union Telegraph Company, Postal Telegraph Company, American Bell Telephone Company, General Electric Company, Westinghouse Electric Company; The complete list of official delegates, complimentary delegates and organizations to whom invitations were extended, can be found in the report of the committee presented at the last convention and published in the last volume of this association's proceedings. That body appointed a committee on code, consisting of seven members, one of whom was your representative; to this committee was assigned the task of amending and codifying Standard Electrical Rules. At the time of the last meeting of the National Conference upon Standard Electrical Rules, a large amount of work was done by representatives of the various electrical, insurance, architectural and allied interests, tending toward the adoption of The One Single Standard Code of Rules. A pamphlet had been prepared embracing the various codes used most extensively in this country and abroad; and after these had been in substance considered, and many changes, omissions and additions suggested, it was deemed desirable that the results of the two days' careful discussion should be handed over to a special committee of seven, with the president a member ex-officio, which committee should draft a code based upon the lines suggested, and then refer the same back to the conference for its approval.

Since the meeting of the conference, the committee has by meetings and correspondence, carefully taken up the work assigned to it. The most important meetings were held October 16 and 17, 1896; and December 11 and 12, 1896. Between these two dates, i. e., December 8 and 9, the annual meeting of the Underwriters' National Electric Association was held, and at the October meeting of the Code Committee, it was decided that the committee through one of its members (Mr. Merrill) should submit the draft already prepared by them, to the Underwriters' National Electric Association to secure the benefit of their criticisms and suggestions, and with a view of insuring a hearty co-operation upon their part. It was arranged that a joint meeting should be held of our Committee of the Code, and a committee from their association to facilitate the preparation of the final draft of the code. This meeting, held in December, 1896, was very successful, and it was jointly agreed by the two committees that the title of the new set of rules was to be: (1) "The National Electrical Code;" (2) "That the National Board of the Fire Underwriters in printing the code, would give on the inside of the cover, due credit to the National Conference for its work, and place upon the cover, the names of all the associations forming the National Conference, as fast as these bodies give their indorsements of the code;" (3) "That as far as possible the code should be left in the form as then presented, save that the classification as recommended by Mr. French, be tentatively adopted, and after being set up by the printer, be resubmitted in "dummy" form for final consideration by the members of both committees. The members of the Code Committee of the National Conference having met in New York May 19, 1897, passed the following resolutions:

"Resolved, That each delegate who attended the National Conference on Standard Electrical Rules, be sent a copy of the Standard Electrical Code, stating that said code had met with the approval of the Code Committee of the National Conference, and the Code Committee of the Underwriters' National Electric Association, and stating the belief of our committee, that there was no necessity for calling the conference together as a body again, entailing as it would, a very considerable sacrifice of time and money, and requesting their immediate reply, if they acquiesce in this recommendation, and approve of the report submitted by the committee, and by the president, secretary and treasurer of the conference itself. In the event of their objecting and desiring that the conference as a body be called together as a body to receive the committee's report, answer is to be made within ten days, or their opinion is to be considered as favorable, and the code and reports published through the press by the Code Committee, and each delegate represented at the conference requested to bring same formally before his association for approval." A meeting of the committee was held in Boston on the 5th inst., at which its previous action was ratified and the code as a whole unanimously adopted. The National Electric Light Association was the first to adopt and issue a national standard code of rules, and if it now adopts the new codification of them it will not only be indorsing the unanimous findings of its committee, but the unanimous action of the Code Committee of the National Conference on Electrical Rules, which conference was organized under the auspices of the association; but furthermore it will be the first body represented in the National Conference to do so, and your committee earnestly recommends that it gives its approval.

MR. JOHN J. COOPER, the manager of Las Animas Light and Power Company, Trinidad, Col., says: "We think a great deal of The Engineer and would not be without it."

MR. J. L. GUILE, engineer and electrician of the Oxford, N. Y., Electric Light Company, writes: "I am very much pleased with The Electrical Engineer and get a great deal of information and many points from it. It also gives us an insight into what other people's experiences are with electricity."

THE NIAGARA POWER TRANSMISSION LINE.[1]

BY J. G. WHITE.

MY first personal knowledge as to the then proposed transmission line between Niagara Falls and Buffalo dates from the autumn of 1894 when the White-Crosby Company was asked to prepare and submit detailed plans, specifications and proposals for its construction. It was then found that the engineers of the Westinghouse and General Electric companies had both recommended the construction of circuits of three wires, adapted to the three-phase system, each wire having an area of about 330,000 circular mils. Beyond this no definite plans had then been determined on. The engineers of the Cataract Construction Company at that time considered it advisable to have the line built entirely of iron poles and accordingly detailed drawings and specifications were prepared and submitted showing alternative plans. The first included two entirely independent lines of iron poles, not less than 40 feet long, weighing something over two thousand pounds each. The second consisted of lines of poles of about the same height, weighing one thousand pounds each, set in pairs and tied together by deep trusses, which served both as braces against the terrific wind storms which sometimes sweep across Lake Erie and as a means of carrying part of the wires. A steel truss fulfilling admirably this double function was designed, which weighed about six hundred pounds, the company's right of way being 30 feet wide, and the lines of poles located 15 feet between centers. Several wooden trusses were designed for the same purpose, but, while better from an electrical standpoint, these were all so clumsy in comparison to the iron poles that preference was given to the steel truss. Various designs of poles were considered, including several built up from "rolled shapes," final preference being given to plain tubular poles on account of their ability to withstand equally strains from all directions, their appearance and the ease with which they can be kept painted.

Numerous designs for cross arms were also considered, including those made from "rolled shapes," composite arms (part wood and part steel), and those made entirely of cast iron or of wood. The latter two were preferred on account of the ease with which they could be designed to accommodate either wood or iron pins.

In determining the details for these alternative plans it was assumed that poles would be set in concrete and spaced one hundred feet apart; that each wire would weigh one pound per lineal foot; that the three wires composing each circuit were to be placed at the corners of an equilateral triangle having sides at least three feet long; and that the lateral strength of the line was to be not less than three times the forces produced by wind acting with a pressure at right angles with the direction of the lines, equal to thirty pounds per square foot on the projected surface of the poles, arms, insulators and wires, when the latter were covered with a coating of ice one-half inch thick.

As a matter of fact the heat generated by the current passing through the wires, together with the static effect tending to repel all particles of moisture coming in contact with the wires, this effect being quite noticeable on a ten thousand volt line, would combine to prevent the formation of any such coat of ice unless at a time when current was off the line. Any error thus introduced was on the safe side and consequently not objectionable.

Full proposals with detailed plans and specifications for the construction above outlined were submitted October 11, 1894, and the amended proposition for carrying out the construction on the same general lines was submitted March 13, 1895. Nothing further developed in the matter until June, 1896, when new proposals were asked for the construction of the line on the assumption that white cedar instead of iron poles would be used throughout. Such proposal was submitted June 18 and accepted some days later. In working out the details of the line as built, the same general assumed data above given was used.

When the route for the line was finally determined on its length was found to exceed 27 miles instead of being 25 miles, as previously assumed, and consequently the area of the wire was increased from 330,000 to 350,000 circular mils. The wire actually erected is composed of 19 strands, having a combined area of full 350,000 circular mils, and weighs nearly 6,000 pounds per mile.

In designing a transmission line, the three most important factors probably are: 1. Its ability to carry its full load continuously and without interruption. 2. Cost. 3. Efficiency.

The first cost of power used to develop current for a transmission line is usually low, wherefore the efficiency of the line is not of primary, although of great, importance. Those of us familiar with the development of the street railway motors have seen in practice an illustration of the fact that efficiency is not always a controlling factor. There has probably never been in general use another street railway motor so efficient as the Sprague No. 6. With units of an ordinary size a short circuit on a line carrying ten thousand volts, even if through a defective insulator, a wooden cross arm and a wooden pole would make itself manifest at the power station by the opening of a circuit breaker, the blowing of a fuse, or some simliar method. With the huge generators which furnish power for the line the effects are different. During one night last fall, while an attempt was being made to operate the line on temporary insulators, the best obtainable at the time, the ends of no less than five of the large cross arms used on this line were burned entirely off; and this too without any manifestation having been made at the station that anything unusual had occurred. This naturally raises the questions whether it is possible to procure insulators which can be depended on to maintain the insulation on a circuit carrying 10,000 volts or over, and whether it is not good practice to have fewer poles, and consequently less weak spots in the form of insulators.

There are two sides to this question, and both deserve serious consideration in designing any transmission line. Let us assume that poles are set 100 feet apart and allow a sag in wires between supports of twenty inches, or one-sixtieth of the length of the span. We find that the area of the wire in use on this line is .267 of one square inch, and that its tensile strength, even assuming a high value for soft copper is about 10,000 pounds. Allowing the same deflection, one-sixtieth of the length of the span, this determines the maximum safe distance between poles as 178 feet, allowing a factor of safety of four, and shows that the cables might be expected to break if the span were lengthened to 712 feet, not allowing for wind pressure or extra load due to ice.

Assuming a tensile strength of 8,000 pounds per square inch for yellow pine, we find that the larger cross arms used on the line, which are twelve feet long and nearly five inches wide by six inches high, would support a load of 270 pounds on each end without bracing, and of 360 pounds on each end with the steel angle braces used, and this too with a factor of safety of ten, an unnecessary margin when we consider that the arms are all specially selected heart, long leaf Georgia pine. Similarly these cross arms would have the same factor of safety carrying three power cables on each side with spans 177 feet long if without braces, and 266 feet long with braces. Besides giving this added strength, the braces used on this line prevent such vibration and oscillation as usually takes place with the ordinary strap iron braces, such oscillation being the cause of many of the petty troubles on ordinary lines. These braces were each made from a single piece of steel angle 2 x 2 x ¼ inches bent to shape and forming when finished a truss 18 inches deep and five feet in extreme length, their weight being a little over 20 pounds each. Assuming again that poles are set 100 feet apart, we find that 12 wires with cross arms, insulators, etc., would present an area to the wind aggregating about 67 square feet, and that consequently each pole would be subjected to a side strain when wind pressure was 30 pounds per square foot, of about 2010 pounds. A sound 50-foot cedar pole, 8 inches diameter at top and 18 inches diameter at butt, 8 feet being held rigidly in the ground, would be capable of withstanding before breaking a side pressure near its top of only about 4,900 pounds and of only about 3,400 pounds when a layer 2 inches thick had decayed around its circumference.

With spans of 100 feet the pole would, therefore, have a factor of safety of only about 2½ when new, while the wires would have a factor of safety of about 7, and the cross arms of about 26. The advantages of having cross arms amply strong are so evident, and the possible reduction in cost such an insignificant part of any ordinary line carrying much copper, that it would seem foolish to reduce the strength size of these in order to bring their strength down to correspond with other parts of the line.

It is evident from the above that the weakest point of this line mechanically is the pole, in spite of the fact that as advised by one of the prominent members of your Executive Committee final decision was made in favor of spacing the poles 75 feet apart on straight, and proportionately closer on curved parts of the route. The only reasonably safe and practicable method of decreasing the number of weak spots furnished by the insulators would be to use poles larger than eight-inch tops, or to brace the poles to withstand this wind strain. Fifty-foot poles having tops greater than eight inches are now hard to find, and although 35-foot poles were used on a part of the company's private right of way, nevertheless many 50-foot and even a few 65-foot poles were required to avoid obstructions and for crossing railroads and highways. The only feasible plan, therefore, would seem to be to brace the poles laterally, which can readily be done if set in pairs, but which would be very difficult to accomplish in a satisfactory manner with a single line.

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[1] Read before the N. E. L. A. Abstract.

This naturally brings us back to the question, Are insulators such insurmountably weak links in such a chain, and is it not possible to get insulators which can be depended on even when supporting wires under a pressure of 10,000 volts? This can be most satisfactorily answered by again narrating the experience with this line. During the past eight months insulators have been sent to Niagara Falls by four of the works which are among the first six in this country in the production of porcelain for electrical use. Of a sample lot of ten received a few days ago for test from one of these factories, one had broken in transit, eight broke under the strain of electrical pressure varying from 16,000 to 36,000 volts, and the last broke under 40,000 volts strain. This latter would seem to be a minimum safe test limit for any insulator expected to sustain a regular strain of 10,000 volts and is a test which any mechanically good, well vitrified insulator of ordinary design will pass. As several previous lots from the same factory showed even poorer results, the manager of that company states that he hopes within a few weeks to be able to furnish insulators which will stand a 40,000 volt test. It is only fair to state that these insulators were of a smaller type than, and different design from those in use in the Niagara line. Several lots of somewhat similar insulators from another factory gave about the same results.

Several thousand insulators of a diameter almost equal to the round type now on the line, but of a design somewhat different in details, were furnished by a third porcelain works. These were all supposed to have been tested and to have successfully withstood a pressure of 40,000 volts at the factory before shipment. When, however, these were tested at Niagara Falls by Mr. Lincoln, the electrical superintendent of the Cataract Construction Company, it was found that a large majority of them broke down under a 40,000 volt test, illustrating that a dry test, such as had previously been made, is useless for practical purposes.

The method of test used at Niagara Falls was as follows: The insulators were set inverted in a shallow iron pan in lots of about 20, the bottom of the pan being covered with an inch or two of water containing a little salt. A little of the same brine was poured into the pin hole of each insulator, and into this was thrust a small piece of metal such as an ordinary iron spike or the small round zinc rod from an ordinary sal ammoniac battery, this being connected to one side of the testing circuit, the other being connected to the pan containing the insulators. After the metal rod had been placed in the brine in the pin hole of an insulator, the primary circuit of the testing transformers, specially built for the purpose, was closed; and if the insulator was weak, this was quickly manifested by a series of sparks through the punctured porcelain. Experiments made with pure water and with brine showed that there was no difference in the results; but that any weakness was manifested a little more quickly with brine, besides which the salt imparted the characteristic bright sodium color to sparks otherwise almost colorless and difficult to detect.

As it was important that the line should be ready to deliver current by a specified date, the test was reduced on these insulators to 20,000 volts, and all which withstood this pressure were passed for temporary use. These insulators were later replaced by some of those now on the line, all of which successfully passed a 40,000 volt test made as above described. A lot of the temporary insulators illustrated the old saying that every rule has its exception, for when after removal from the line they were tested under 40,000 volt pressure, a solitary insulator from a total of 1,150 was able to pass muster.

Of the insulators shipped by the fourth factory, and of the two types now on the line, about 25 to 40 per cent. were usually found to be defective, breaking down under 40,000 volts, this percentage decreasing in the last shipments received. It is, however, worthy of special note that since the last of the temporary insulators were moved from the line, there has not been one minute's suspension of current supply due to defective insulators. During this time, some three or four months, three insulators have been replaced, none of these being of the oval type. Two of these three had been broken while being put in place, and the third was broken by a stone or other missile. In all three cases only the outer petticoat was broken, and the insulator continued to do satisfactory service until such time as it could be replaced without affecting the operation of the line.

Apparently, therefore, it has been demonstrated that it is possible to secure insulators which are reliable. That there have been no greater troubles in the past from defective insulators is probably due to the fact that most of the large transmission plants in operation under high voltage up to within a few months have been in the far West, where the climate prevails very different from that natural to this immediate region.

In the above and other experiments with insulators some interesting facts have been developed and are worthy of note. The insulating strength of porcelain depends almost entirely on the thoroughness of its vitrification and very little on its thickness, a thin china tea cup having successfully withstood a pressure of 60,000 volts, while a coarse piece of porcelain two inches thick was readily pierced by 20,000 volts. It is therefore, practically unnecessary to test electrically any insulator which, when broken, will not pass a good absorption test, using red ink or other fluid.

It is quite, if not entirely, impossible to puncture a glass insulator, even an ordinary pony telegraph insulator, notwithstanding any pressure which can be applied, the last being determined by the pressure which will send an arc around the insulator. The objection to using glass insulators in the past has been due to the difficulty in getting a well annealed and mechanically strong insulator, of such massive design as is needed for this work and to the hygroscopic property of glass, which is not shared by porcelain. The first can unquestionably be overcome by care in manufacture. The importance of the second has probably been exaggerated in most calculations made in the past, due to an inadequate appreciation of the static effects of 10,000 volts in warding off snow flakes and drops of rain, and to a less extent of the rapidity with which water falling on such insulators is evaporated by the heat of the current leaking over the surface.

It is consequently reasonable to expect that the use of glass insulators for high voltage lines will greatly increase with improved manufacture. Meantime any lines erected should have the best obtainable porcelain, and every insulator should be subjected to test.

Before closing it is natural to ask, "Is the line as built a genuine success? Can it be depended on, and is it effective?" In answering let me give briefly some of the facts. The line now in operation is over 25 miles long, of which the last 4,000 feet is underground, the current being carried in lead covered cables with rubber insulation, these having been drawn into terra cotta duct conduit built specially as part of this line. These cables successfully withstood a test of 40,000 volts, are guaranteed for five years under working pressure up to 25,000 volts, and were punctured during test only by a pressure, estimated by Mr. Lincoln at about 80,000 volts. They have given no trouble since current was first turned on the line, November 15 last, except at two joints imperfectly made. Except for the short time needed to repair one of these joints there has not been a single shut-down chargeable to the transmission line itself, since the last temporary insulators were removed some three or four months ago.

A number of interruptions to service have occurred during that time, due to derricks used on the work now being done on the Erie Canal hitting wires, undermining of poles and conduit by this work and to allow new lightning arresters to be put in circuit at transformer houses. Except for these extraneous and unusual causes the service has been perfect with the one slight exception above noted. One short interruption early last winter was due to the dead limb of a tree blowing across the wires, illustrating the fact that all trees should be cut down for some considerable distance on both sides of any high voltage line. The line shows an insulation resistance of some 250,000 to 300,000 ohms on wet, and about 1,000,000 ohms on dry days, this being between any one of the three wires and the ground, the insulation therefore varying from six to twenty-five million ohms per mile of wire.

The actual working efficiency as shown by the wattmeters in the low tension alternating circuits at Niagara and the direct current 500-volt circuit at Buffalo was 79.6 per cent., this being for a considerable period and a fluctuating load. This efficiency included loss in step-up transformers, line, step-down and rotary transformers. It is probable that any decrease in this due to greater line loss with larger load would to a considerable extent at least be offset by increased efficiency of transformers. In view of these figures we hope you will feel warranted in endorsing the opinion that Niagara power is now being satisfactorily delivered in Buffalo.

One of the questions often asked is why this entire line was not placed underground. One of the principal reasons was that the line of twelve wires, having a capacity of 20,000 horse-power would cost, irrespective of right of way, fully a million and a quarter of dollars if underground, and only about one-third of that amount overhead, making a serious difference in interest charge. Of such total costs about 20 per cent. would cover cost of conduit complete, including manholes, the remaining 80 per cent. being lead-covered cables. Of the overhead construction cost, slightly over 80 per cent. is bare copper wire, less than 10 per cent. covers poles set in place, and about 3 per cent. covers insulators.

It is probable, therefore, that the depreciation of the lead-covered cables will greatly exceed that on pole line, the first cost being some thirty times as great, and the depreciation of the bare copper being negligible. Aside from this experience to date has not demonstrated that the underground line would be more reliable, which alone could justify the increased depreciation and interest charge.

As a final deduction it seems reasonably certain that it is now possible to build either overhead or underground transmission lines, even in regions subject to much cold, damp weather, capable of carrying current at 10,000 volts or higher pressure, which can be operated with efficiency and every assurance of uninterrupted service.

REPORT OF COMMITTEE ON STANDARD CANDLE-POWER OF INCANDESCENT LAMPS.[1]

DR. LOUIS BELL, Chairman.

THE task that your committee undertook was to draw up a suitable specification for a standard incandescent lamp and to devise a proper method for the commercial application of this standard. This problem divides itself into the three following heads:

I. The determination of a standard of light and the method of applying it under commercial conditions.

II. The specification of a direct, simple and rapid method by which the members of this association and other users of incandescent lamps can apply such a standard of light to the testing of commercial incandescent lamps.

III. The specification of a normal standard of luminosity, to which commercial incandescent lamps shall adhere.

I. The first task was the selection of a primary standard of light to serve as the basis of operations, proper apparatus and methods for its utilization for the purpose in hand. There are in use as primary standards of light a considerable variety of sources of light, to wit: Two standard candles, English and German; three standard lamps burning definite substances under definite conditions, the Carcel lamp, the Harcourt Pentane lamp and the Hefner-Alteneck amyl acetate lamp; one standard gas light, the Methven, and, finally, the Violle platinum standard, one square centimetre of platinum at its point of solidification. In addition, there are more or less desirable forms of photometer.

Even assuming a standard light and method, the comparison of an incandescent lamp with it may be under all sorts of conditions and at all sorts of angles.

In this state of affairs your committee requested the co-operation of the American Institute of Electrical Engineers, and, through the courtesy of the council, the problem was referred to the Committee on Units and Standards. The following determinations were presented by that body, in which your committee, having discussed the matter in joint conference, concurs:

A. The Hefner-Alteneck amyl acetate lamp is recommended as the primary standard, it being, on the whole, the most reliable and uniform. It possesses the additional advantages of having been subjected to most exhaustive tests to determine its behavior under different conditions, and of being readily obtainable in standard form from an authoritative source.

B. The Lummer-Brodhun photometer screen is recommended as being well suited, from its great sensitiveness, to exact and refined determinations.

C. It is recommended that in testing incandescent lamps by these means the lamps be revolved on a central axis at the rate of about two revolutions per second. This process gives the mean luminosity in the plane of revolution without a multiplicity of measurements.

D. It is recommended that, in so far as the conditions of commercial testing allow, the normal standard incandescent lamp be rated in terms of its mean spherical candle-power.

It now became the task of your committee to put these recommendations in such concrete form as would most directly render them useful to the members of this association and others interested in the everyday work of testing lamps.

For easy and accurate photometric work it is highly desirable that the lights compared should be of nearly equal color and intensity. The Hefner-Alteneck standard is of about one candle-power, and has a slight orange cast, so that while giving very precise results in careful hands, it is somewhat inconvenient for rapid comparisons. Your committee, therefore, recommend the use of the Hefner-Alteneck standard to prepare secondary standards for commercial use. These standards should be incandescent lamps of uniform shape, construction and character, standardized with the greatest attainable exactness and suitable for direct comparison with commercial lamps. In testing lamps by these secondary standards, the above-mentioned photometer screen being rather difficult of manipulation for rapid work, we recommend a form of photometer designed specifically for use in connection with a standard method of measurement hereinafter described.

To avoid the complication incident to spinning both the secondary standard and the lamp being tested, we advise placing on the socket of the secondary standard a definite mark showing the direction in which the directly given light is exactly equal to the mean determined by spinning. By placing this mark toward the photometer screen and in the plane of the photometer bar, only the lamp under test need be spun.

It is obvious to your committee that the common rating of incandescent lamps by their mean horizontal candle-power is objectionable and should not be continued. In the first place, as incandescent lamps and other lights are practically placed, one is invariably below them, and hence, if their axes are vertical, below the principal plane of illumination. If their axes are tilted we still get the full advantage of but a portion of this principal plane. Second, it is unfortunately only too easy to produce lamps in which the maximum light is only in the horizontal plane, but which in all other directions give decidedly poor illumination. Such lamps are practically of far less than their rated candle-power.

The ideal distribution of light would be a uniform spherical one, except in so far as the socket might prevent. In any ordinary position such a lamp would distribute at least half its light uniformly downward, where it would be of most use. In practice this cannot be readily obtained, but it is easy to produce a lamp that will give a fairly uniform distribution, at least below the plane of the socket when the socket is uppermost. Rating lamps by mean spherical candle-power will strongly tend to produce lamps having such a distribution. The measurement of mean spherical candle-power is, however, a very troublesome matter, and, even under the most favorable circumstances, is a slow process, not readily applied to commercial testing.

Your committee, therefore, cast about for a practical method of testing, such as would insure a good and useful distribution of light and would be easy to apply. In other words, how shall the light of a lamp be measured so as to rate it as nearly as practicable on its useful distribution of light?

After looking into the distribution of light actually given by commercial lamps, your committee believe that the light given half way between the vertical and horizontal planes forms the best simple criterion available. This can readily be measured by rotating the lamp socket down, with its axis inclined 45 degrees toward the photometer screen and in the plane of the photometer bar. This measurement gives a fair mean between the horizontal and vertical illumination, and in most commercial lamps is a tolerable approximation to the mean spherical candle-power. Furthermore, it insures a good downward distribution of light, even in a lamp designed to meet this particular method of measurement.

Your committee are fully aware that no simple measurement can truly calculate the effective luminosity of all forms of lamp, but recognizing that in the rapid commercial testing of lamps a single simple measurement is highly important, strongly recommend this one as most nearly meeting the necessary conditions.

By this process of simplification we have reduced the measurement to be made by the use of incandescent lamps to the comparison of two nearly equal and similar lamps, of which only the lamp under test has to be revolved. Furthermore, in much commercial testing it is not necessary accurately to determine the candle-power of the lamp under test. In most cases it is sufficient to determine that it falls within certain definite limits prescribed for the normal standard lamp. Hence, it will generally not be necessary to make an exact setting of the photometer screen, but merely to observe the conditions existing when the screen is resting against stops in two fixed positions, one corresponding to the minimum permissible candle-power of the lamp under test, the other to the maximum.

The actual process of testing would then be as follows:

Having placed the standard lamp in its marked position, and adjusted the voltage to its normal value, the observer would then place the lamp to be tested in its socket and spin it, having first pushed the photometer screen against the stop. If the candle-power was all right on this test, he would pull the screen against the other stop and look again. The whole process need not take over fifteen to thirty seconds, according to the skill of the operator, and would show definitely whether or not the lamp fell within the standard limits. Your committee will in due season place in the hands of the secretary a full specification for the making and use of a simple photometer, designed to be used in the manner just indicated.

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[1] Presented at the N. E. L. A. Convention, Niagara.

We now reach the third portion of our task, to wit: the definition of a normal standard to which commercial incandescent lamps should conform. At present there is much confusion on this matter, and we feel that it must be reduced to terms at least simple and definite.

It seems to your committee inadvisable at present to complicate the situation by introducing considerations of efficiency, life and variations of candle power with life. Efficiency, the candle-power being known, is settled at once by the application of a volt and ammeter, and the matter of life may properly be left to the natural course of competition to settle. Variation of luminosity with time is a matter of importance, and, after a general and uniform standard has been promulgated, may properly be considered. For the present, however, your committee is of the opinion that attention should be confined to the adoption of a standard specification for light alone, and the production of suitable apparatus for testing the fulfillment of this specification. To this end we believe it best to rate commercial incandescent lamps by the illumination obtained when the lamp is spun with its tip inclined 45 degrees from the vertical, toward the line of observation, and to specify the rating in candle-power, this being the most familiar measure of light and definitely legalized in some States. The ratio between the English standard candle and the Hefner-Alteneck lamp has been accurately determined by several experimenters, so that it is easy to pass from the latter to the former, thus avoiding the extreme unsteadiness when used directly.

As a matter of manufacture it is very difficult to produce a lamp of a given voltage for an exact specified candle-power. Hence certain limits must be set, rather than a certain definite candle-power, and these limits should be so drawn as to meet both the conditions of manufacture and to insure a reasonably close accordance with the rated intensity. For an incandescent lamp rated at sixteen candle-power (oblique zonal as above indicated), fifteen candle-power for the minimum and seventeen candle-power for the maximum afford limits fair to all parties concerned, and these your committee recommends.

As to the method of procuring and distributing the secondary standards to be used with the photometric method already outlined, the following is desirable. Incandescent lamps of uniform shapes and in standard sockets, with filaments uniform in shape and section, in all respects unmarked, should be furnished by the lamp manufacturers to the standardizing committee. These lamps should then be properly aged and standardized at such voltage as may give precisely sixteen candle-power with the greatest attainable precision, marked on the sockets with a reference line, numbered, certified and dated. They should then be turned over to the secretary for distribution at a price covering the cost of standardizing and handling.

Your committee therefore recommends:

1. That the standard sixteen candle-power incandescent lamp shall be a lamp which, when measured in rotation at about the rate of 180 revolutions per minute, with its axis inclined 45 degrees, as herein specified, shall give not less than fourteen one-half and not more than seventeen one-half candle-power, and that every ten lamps shall average between fifteen and seventeen candle-power.
2. That your committee shall be empowered to make suitable provision, with the consent of the Executive Committee, for the production of the secondary standards and to request the co-operation of the American Institute of Electrical Engineers in the formation of a non-partisan committee to supervise and certify said lamps.
3. That the secretary be directed to undertake, under the direction of your committee, the procuring of lamps for standardization, their distribution when standardized, and the preparation and distribution of the specifications of your committee for a standard form of photometer and a standard method of employing it.

MR. A. C. STEVENS, manager of the Oelwein, Ia., Electric Light and Power Company, writes: "We are very much pleased with The Electrical Engineer. Each number is full of interesting and valuable information."

VERESTCHAGIN, the Russian artist, says that the piercing brilliance and startling liveliness of Emperor William's eye are truly remarkable. "I have seen such eyes but once before and they were Edison's." If this is true, we are sorry for Edison. Our own experience with the "Old Man's" eye has been quite different, and we must admit that even in his most jocular moments he never tried to trip us up with his sword.

LETTERS TO THE EDITOR

THE LEGAL STATUS OF THE JANDUS ELECTRIC CO.

We have been informed that a notice has been generally distributed by the Jandus Electric Company to the effect that their contract with this company as exclusive selling agents has been terminated, and that they will not hereafter supply their lamps through this company.

I beg to inform you that the action of the Jandus Electric Company is unwarranted and illegal. We have taken immediate steps in the courts to compel the Jandus Electric Company to recede from its position and to continue to supply us with lamps as heretofore under the contract which we have with that company, which has continued for two years without interruption and which has still five years to run at our option.

It is not necessary for us to comment upon the action of the Jandus Company in the premises, except to inform you that our rights will be protected to the fullest extent of the law, and the interests of our customers will receive equal care and protection.

We are advised by our counsel in this city, that the Jandus Company will be compelled to comply with the precise terms of its agreement with us, and that an adjudication to that effect will be procured within a very few days.

MANHATTAN GENERAL CONSTRUCTION CO.,
S. MARSH YOUNG,
Vice-President and General Manager.
New York, June 8, 1897.

LITERATURE

THE LOCALIZATION OF FAULTS IN ELECTRIC LIGHT MAINS.—By F. Charles Raphael. New York: D. Van Nostrand, 1897. pp. 180, 5½x8½ in. Illustrated. Cloth. Price, $2.

Fault finding is generally credited with being among the easy things to do, but many an electrician would be willing to go on record on the contrary proposition.

In the present work, which is reprinted from the columns of the London "Electrician," the author describes a considerable number of methods for localizing faults in both high and low tension mains, with special reference to tests while the current is on.

Electrical engineers operating underground systems will be interested in the description of Dr. Kallman's excellent system of fault-signaling networks, in which the pressure wires are employed for localizing faults, a method which ought to be better understood than it appears to be, and which has worked very successfully in Berlin.

The descriptions of testing instruments specially adapted for this class of work will also prove helpful to many. The book is well supplied with formulæ, that bugbear of the "practical" man, but when it comes to testing out four and five-wire systems they are simply indispensable, and besides even in simple work they must be used to some extent, if rule of thumb methods are to be avoided. The book will prove of value in the hands of all central station electricians.

TAUNTON, MASS.—The city is to buy the plant of the Taunton Electric Light Company for $125,000.

HOLYOKE, MASS.—A bill is going through the Legislature which enables the Holyoke Street Railway to carry freight and small parcels.

COUNCIL BLUFFS, Ia.—The nuptial knot was tied recently on a trolley car plying between Council Bluffs and Omaha, and the conductors are quite nervous now about being suddenly roped in as witnesses to a runaway wedding.

AT CLEVELAND, O., and other points adjacent, the Lake Shore Railroad has placed commutation tickets on sale with the object of preserving its suburban travel against the serious inroads of the trolley competition. This is regarded as the beginning of a cut-rate war all around.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. O. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - -	1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - -	916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - -	per year.	$3.00
Four or more Copies in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, JUNE 16, 1897. No. 476.

THE NIAGARA N. E. L. A. CONVENTION.

IN every respect the convention of the National Electric Light Association, at Niagara Falls last week, must be regarded as a great and brilliant success, far beyond that which was expected by those who had worked hardest to secure a happy result. The attendance was large; the papers were excellent and timely; the devotion to work was exemplary; harmony prevailed; the weather rang the changes so that the Falls could be seen in every aspect, and a good choice was made of officers to carry out the programme of usefulness to which the association has for some years past so consistently pledged itself. President Nicholls retired from office in a literal blaze of glory.

One of the most notable achievements in recent electrical history is the adoption of the National Code. That a large number of important national bodies could be induced to cooperate in a vital matter where jealousy was inevitable, that rules could be formulated and agreed to by all, and that the work could be carried through to a definite issue, seemed wellnigh impossible. Many people said the case was hopeless. But necessity has prevailed, and the National Code of Wiring now stands a solid, tangible reality. Capt. Brophy, Mr. W. J. Hammer, Prof. Crocker, Mr. J. I. Ayer and the other loyal workers deserve the thanks of the whole electrical art in America for their labors, and are to be congratulated on their hard won success; but the association above all is to be felicitated. It was an association campaign, and had the body never done anything else this piece of invaluable work would be sufficient to justify its existence. It was a pleasant thing that the association could by mere chance be the first to stamp with unanimous assent the work which it had itself begun.

One of the most significant things was the election of Mr. Insull as president for 1897. The last meeting of the association at Niagara was conspicuous for discord and angry feeling. This recent meeting showed that in some respects at least a better understanding has been reached, for Mr. Insull happens to be also the president of the Edison Association. That the N. E. L. A. and the Edison body should choose the same man as their president would have been deemed absurd a few years ago, but time has wrought many changes, and the event signalises the beginning of a new period in the development of electric light and power. Mr. Insull is a strong man, full of individuality, anxious to be useful, experienced in affairs far beyond the ordinary, and although young has spent his life in the upbuilding of the electrical arts. Like his predecessor, he knows all there is in manufacturing, but as a central station manager on the largest scale he is in a position of peculiar advantage to harmonise conflicting conditions while promoting the welfare of the great local lighting industry. We are satisfied from what we know of Mr. Insull that the double election must gratify him deeply and yet be regarded as an opportunity for work as useful and helpful as any he has done in his exemplary career as an adopted son of America. It is certain that Englishmen cannot complain of lack of recognition of their merits in this country.

Coming to the papers we may say that Mr. J. G. White's, describing the operation of the Niagara-Buffalo line, was full of just such information as is wanted at this stage of the proceedings, when long distance transmissions are contemplated on all sides. From what Mr. White stated and what was brought out in the discussion, it may be taken as a fact that this transmission line is an established success, the small difficulties experienced in the first few weeks of its operation having been entirely overcome. Naturally the integrity of these lines depends primarily upon the quality of the insulators employed, and it is gratifying to know that American manufacturers have so easily and rapidly succeeded in supplying an article adapted to the purpose. The experience with the early insulators show that what is wanted in a high tension insulator is not so much quantity as quality; that is to say, a small insulator thoroughly vitrified is far more effective than a large one incompletely vitrified. Another interesting and unexpected point, is the benefit derived from the electrostatic action of the lines, which repel water and snow flakes, while the heat evolved by the leakage over the insulators keeps them clear of ice and snow. Mr. White was of the opinion that the use of glass as an insulator would increase in time on high tension circuits, it being merely a question of making this material of the proper strength and toughness to stand the mechanical strain which is put upon it, its electrical properties being well adapted for the purpose. We need only cite as an instance of this the 6,000-volt alternating line at Springfield, Mass., described in our last issue. It has been a perfect success in all weathers. As to the adoption of wooden poles in preference to iron the projectors of the line probably feared to risk a metal structure, although iron poles have been used on the transmission between Tivoli and Rome. The climatic conditions, of course, in the latter installation are not nearly as severe as those encountered at Niagara, and hence probably the adoption of the wooden poles at the latter place. But we note that for the Lachine transmission iron poles will be used, and the results obtained with them will probably be a determining factor in future pole line construction for long distance power transmission. Incidental to Mr. White's paper the discussion touched upon the effect of long distance transmission rivalry on the commercial prospects of local plants. The opinion prevailed among several of the members of the association that there was nothing to fear from competing long distance transmissions owing to their limitations of cost. But even where they are profitable it is more than probable that long distance transmission will be a direct benefit and gain, not only to its promotors, but to the owners of existing plants in the cities to which such power is transmitted. In support of this view we need only mention the fact that, in nearly every instance in which power has been transmitted for long distances into cities where private local plants previously existed, the local plant has leased power from the power transmitting company,—where the two were distinct organizations,—and was, therefore, a direct gainer by the bringing in of the cheaper power. This is practically the case in Buffalo, where the transmitting company and the local companies are working in harmony. It will also be the case with the proposed transmission plant from Leavenworth to Kansas City, and other like examples could be mentioned.

That the question of rates is one of the most important before the electric light fraternity at the present time was thoroughly demonstrated by the interest aroused by the papers of Messrs. Wright and Cahoon, the discussion of which extended over two sessions of the convention. If we understand aright the remarks that were made during the meeting, and outside of it in private intercourse among the members, it is not putting it too strongly to say that in spite of the improvements that have been made in the last five years, the matter of rates in the average American central stations is in little better state than that of chaos. Mr. Cahoon struck the keynote when he stated that most small stations could not continue to exist if they were deprived of their public lighting contracts, and as this statement was not denied or controverted in any way, it is safe to assume that it is frequently the case. Of course this does not apply to the big stations in populous localities, but rather to the small ones in cities not exceeding thirty to fifty thousand inhabitants. That this should be the case after nearly twenty years of life in an industry on which so much money and ingenuity has been lavished is a reproach to American financiering and engineering ability. Of course it must not be forgotten that many stations are suffering from the fact that they are obliged to operate early types of apparatus, working at low efficiency for only short runs, but Mr. Wright contends that the root of the trouble lies in the methods adopted for charging for current. We need not enter into the details of Mr. Wright's arguments, as these are fully given in his paper appearing elsewhere in this issue, but we recommend this paper most heartily to the consideration of all interested in central station management. That Mr. Wright's views are in the main correct there can be no reasonable doubt. If the exact methods employed by him are carried out, or others tending to accomplish the same results, it must stand to reason that a revision of rates must be undertaken by the majority of the central stations in the United States, if they would hope to survive the onslaughts of the gas interests.

And this brings us to a point raised in the discussion of Mr. Wright's paper, in which one of the most influential members insisted that it was wrong for electric light stations to attempt to go under the price of gas; all that was necessary or desirable, he contended, was to meet gas on equal terms, and no more. If ever there was a false and pernicious doctrine promulgated in electric lighting circles, we think that doctrine deserves to be so characterized. The supply of electricity, so far as the public is concerned, differs in no way whatever from that of gas, water or any other commodity for which the public has granted franchises to the companies providing them, and it is safe to say that the same public will always seek to obtain those commodities at the cheapest rate at which they can be produced. Take the case of New York City, in which only within the last month the State Legislature has compelled a reduction in the price of gas from $1.25 to $1.00 per thousand cubic feet, the reduction to be made gradually over a period of five years. Does anyone suppose that if it could be successfully demonstrated that an electric light company were making enormous profits it would be allowed to maintain high rates for the sole purpose of keeping above gas rates and permitting the general manager to stand in good favor with the stockholders? We think not. What electric lighting companies want to do, above all, is to reduce their rates to the lowest point at which they can be maintained and afford a fair profit to those who have invested their money in the enterprise. The public has unquestioned rights in the premises, and experience has shown that it will exercise them when it believes them to be infringed. We are exceedingly glad to know that this matter of reducing rates to the lowest possible limit, consistent with a fair profit, is recognized among some of the largest and most prosperous electric lighting companies in the country, notably New York, Chicago, Boston and Philadelphia, and that some of them can rightfully boast that their largest customers are actually getting electric lighting for less than the cost of gas. These companies are to be commended in every sense of the word, and we cannot too strongly express our disapproval of the theory that the public has got to wait on cheap gas in order to obtain cheap electricity.

Apropos of gas it came out during the discussion that what the electric lighting central stations had to fear most was the isolated plant, and that if it were a mere case of limiting the price to meet the competition of gas, the central station might shut down. Although evidence shows that the isolated plant cannot produce current cheaper than it can be furnished from a central station, yet it will probably take a long time to convince owners of large buildings that such is the case. However, we note a growing practice among owners of large buildings, even if they furnish current for lighting, to connect the building with the street mains, and sometimes to let each tenant pay for as much current as he consumes, according to the meter, paying directly to the lighting company. There is no hardship in this, so far as we can see, as the rent would, of course, be reduced in the absence of current for lighting, while on the other hand each tenant only has to pay for exactly the amount of light consumed by him, which he can easily regulate.

The report of the committee on data was limited, so far as the number of central stations reported is concerned, to a little more than a baker's dozen. It nevertheless makes good reading, and points out some facts which are not as well understood as they ought to be. It shows, of course, that the weak end of every steam-driven station is the engine and boiler, and more particularly the engine. It will be noted that the best showing made is 3.71 pounds of coal per kilowatt hour, or 269.5 watt hours per pound of coal. It is needless to say that in this case the engines are compound condensing direct connected to the dynamo. There are probably few stations that can equal this showing, but it indicates the point that can be attained when both the mechanical conditions and the conditions of the load itself are favorable. Taken in connection with the interesting chart of the losses which occur in a steam central station, published as a supplement to our last issue, the reasons for the showing made by most stations are not difficult to discern.

VACUUM TUBE LIGHTING.

COMMENTING on the exhibition of vacuum tube lighting made by Mr. D. McFarlan Moore, the "Electrical Review" in its last issue states that, as it "predicted" a year ago, "the vacuum vibrator has been abandoned; a rotary device is now adopted which, we believe, will meet the same fate;" and it expressed its further belief "that practical and competitive lighting by the Moore system is a problem far from being solved." Every one is entitled to his predictions, beliefs and opinions, and it has never been our object to champion Mr. Moore's or any other inventor's work specifically, but we take most emphatic exception to the implication conveyed by our contemporary's remarks that Mr. Moore has made no progress in his work during the past year. Any one who had special facilities for observing the action of Mr. Moore's vacuum vibrators a year ago, which it is only truth to say, required more or less attention, expected advances, but the exhibition given two weeks ago, in which a rotary vibrator was employed, must have satisfied most people that a pronounced improvement had been made by Mr. Moore in the abandonment of the vibrator and the adoption of the rotary interrupter in its place. Our hopeful views will be confirmed by any one who has had similar facilities for observation. As to whether "practical and competitive lighting by the Moore system is a problem far from being solved," that is a matter of opinion purely. We have expressed our belief that the Moore system is in at least as good practical commercial shape as the Edison incandescent system was in 1880, and we still adhere to that opinion. The incandescent art itself would have failed if it stood at the 1880 standpoint. From what we have seen we believe that to-day Mr. Moore could take a contract for vacuum tube lighting and carry it out in as workmanlike a manner as were the contracts carried out on the Edison system at the time mentioned. At any rate we have seen enough to convince us that if Mr. Moore does not solve the problem of vacuum lighting, somebody else will, and not in the far distant future either. It is, indeed, poor encouragement to designate as futile the work of an inventor who for an hour and a half continuously lights up an apartment with a pure, bright, cold white light, representing the results of several years' labor. Many another has reaped fame and fortune on a less successful demonstration than that given by Mr. Moore. If we did not encourage Mr. Moore, or any other inventor giving his life work to improving the art, we should be derelict to duty. We cannot satisfy ourselves with the gentle process of damning with faint praise. New industries are not built up that way.

GAS ENGINES FOR ELECTRIC LIGHTING.

IN a recent issue we drew attention to the abandonment of gas engines in favor of steam in the Coatbridge, Eng., electric light station. There were several circumstances connected with the operation of this plant which may be considered out of the usual run, and we expressed the opinion that the incident by no means warranted the conclusion that gas engines are entirely unsuitable for electric light work. That we were not misled in this assumption is shown by a communication appearing in the last issue to hand of the London "Electrician," in which a correspondent gives the results of the working of a gas engine plant of the Midland Railway Company at Leicester. This is a 250 h. p. plant, with 75 h. p. in reserve. The gas is produced in Dowson generators and costs only .205d. per unit as against 2.545d. at Coatbridge, or less than one-tenth, with coal at Leicester costing 16s. 6d. per ton, as against 18s. at Coatbridge. Even allowing for light loads at Coatbridge, the difference is more than remarkable. It must be acknowledged, however, that even at Leicester the cost for repairs is 25 per cent. greater than that for fuel. As regards American experience with gas engines we printed last week a contribution giving the results of a several years' working of gas engines in the Hamilton, Ohio, electric lighting plant. So far as the operation of the gas engines is concerned the result has proved so satisfactory that the gas engine plant is to be enlarged; while as to cost of fuel, that item is apparently satisfactory, due, of course, to the fact that the gas is produced by the company on a large scale. Nevertheless, the testimony, so far as it relates to the working of the gas engines as such, is of value and goes far to strengthen us in the opinion expressed on the issue above referred to, that the gas engine is not by any means out of the running.

THE TWENTIETH CONVENTION OF THE
NATIONAL ELECTRIC LIGHT ASSOCIATION
NIAGARA FALLS, N.Y. JUNE 8-9-10-1897

THE twentieth convention of the National Electric Light Association was held at the International Hotel, Niagara Falls, N. Y., on June 8, 9 and 10, with an unusually large attendance and great success.

Among those in attendance at the convention were the following:

BIRMINGHAM, ALA.—J. M. Bradley.

BELGIUM.—ANTWERP.—Louis Schaffer.

MONTREAL, CAN.—John Carroll, Ernest Carus-Wilson, Prof. Chas. A. Carus-Wilson, R. S. Kelsch, Charles Morton, J. F. Rothsay, A. E. Smaill, W. M. Lea Walbank.

NIAGARA FALLS, ONT.—Frank LeBlond, Banker R. Paine, W. Phillips.

OTTAWA, CAN.—John Murphy.

ST. CATHARINES, CAN.—E. E. Cary, Geo. A. Powell.

TORONTO, CAN.—F. C. Armstrong, E. B. Bigger, W. F. Johnson, John Langton, E. D. McCormack, Frederic Nicholls, Geo. W. Watts.

LOS ANGELES, CAL.—W. J. Barret, H. C. Hybro.

STOCKTON, CAL.—Frank P. Adams.

BRIDGEPORT, CONN.—W. C. Bryant, L. W. Eaton, J. B. Hubbull.

DERBY, CONN.—Robert E. Wyant.

HARTFORD, CONN.—A. D. Newton, A. H. Pease, C. L. Tolles.

NEW BRITAIN, CONN.—T. H. Brady.

NORWICH, CONN.—Samuel Hurlburt.

STAMFORD, CONN.—A. J. Purinton.

WATERBURY, CONN.—John E. Sewell, A. M. Young.

ENGLAND.—Mr. Magden, Mr. Reason, Mr. Arthur Wright.

ATLANTA, GA.—T. J. Harper, Geo. Sandt, W. E. Moore.

SAVANNAH, GA.—T. P. Keck.

DUBUQUE, IA.—Horace Torbert.

RED OAK, IA.—A. M. Miller.

CHICAGO, ILL.—E. H. Allen, W. L. Arnold, Maurice Coster, Fred DeLand, L. A. Ferguson, J. Holt Gates, Edw. R. Grier, Thos. C. Grier, F. S. Howard, Samuel Insull, M. J. Isaacs, Joseph Kittlestrings, W. A. Kriedler, W. W. Low, W. B. McDonald, Geo. A. McKinlock, Chas. F. Medbury, F. L. Perry, J. A. Radford, C. A. Ross, R. A. Swain, F. S. Terry, C. D. Wilkinson, C. H. Wilmerding.

JACKSONVILLE, ILL.—J. P. Doan.

PEORIA, ILL.—G. A. Schaefer.

ST. JOSEPH, ILL.—C. E. Roehl.

ELKHART, IND.—John C. Boss.

EVANSVILLE, IND.—C. P. White.

FORT WAYNE, IND.—C. S. Knight, J. J. Wood.

INDIANAPOLIS, IND.—C. C. Perry, G. O. Rockwood, Evans Woolen.

JONESBORO, IND.—R. E. Lucas.

PERU, IND.—F. D. Covington, D. A. Schutt.

WABASH, IND.—F. W. McNamee.

NEW ORLEANS, LA.—Wm. von Phul.

BALTIMORE, MD.—E. F. Baker, W. H. Harding, W. H. Lundell.

BOSTON, MASS.—Jas. I. Ayer, M. H. Baker, Comr. F. E. Barker, Wm. Brophy, H. H. Brooks, Jas. Bradley, A. R. Bush, Geo. W. Davenport, Chas. B. Davis, Comr. Flood, R. H. S. Hale, Caryl D. Haskins, Fred. M. Kimball, J. H. Mason, H. P. Moore, Sidney B. Paine, F. B. H. Paine, Chas. B. Price, D. F. Urquhart, B. G. Underwood, Arthur Wright.

FITCHBURG, MASS.—A. H. Kimball.

HOLYOKE, MASS.—S. B. Winchester.

LYNN, MASS.—W. D. A. Ryan.

MARLBORO, MASS.—H. Bottomley.

NEWTON, MASS.—Wells E. Holmes.

NEW BEDFORD, MASS.—Geo. R. Stetson, Chas. R. Price.

NORTH ADAMS, MASS.—Frank Richardson.

PEABODY, MASS.—M. L. Livingston.

SOMERVILLE, MASS.—F. Ellwood Smith, E. S. Sparrow.

SOUTHBRIDGE, MASS.—Andrew F. Hall.

SWAMPSCOTT, MASS.—Prof. Elihu Thomson.

WALTHAM, MASS.—Thos. P. Smith.

WESTBORO, MASS.—Ralph D. Smith.

WORCESTER, MASS.—H. H. Fairbanks.

BROOKLYN, MICH.—L. W. Greene.

CHARLOTTE, MICH.—W. P. Engel.

DETROIT, MICH.—T. J. Austin, Wm. J. Harting, E. E. Philips.

FENTON, MICH.—D. W. Peabody.

HOUGHTON, MICH.—Jas. R. Dee.

MARINETTE, MICH.—G. W. Hanley.

MONROE, MICH.—G. P. Hurd.

ST. JOSEPH, MICH.—W. Worth Bean.

PONTIAC, MICH.—Chas. J. Willis.

ST. LOUIS, MO.—A. C. Garrison, J. H. Rhotehamel, Ferd. G. Schwattmann, H. A. Wagner.

LINCOLN, NEB.—Prof. R. B. Owens.

HALIFAX, N. S.—E. T. Freeman.

NEW GLASGOW, N. S.—Fred. A. Bowman.

BROOKLYN, N. Y.—W. S. Barstow, L. H. Conklin, S. K. French.

BROCKPORT, N. Y.—W. H. Roberts.

BUFFALO, N. Y.—J. O. Cushing, T. C. Frenyear, C. C. Gartland, C. R. Huntley, Mr. Maguire, C. A. Roberts, H. Stott, G. Urban, Jr.

CHATHAM, N. Y.—E. F. McCabe.

DOLGEVILLE, N. Y.—Henry J. Meyer.

ELMIRA, N. Y.—S. N. Blake.

FREDONIA, N. Y.—M. M. Benner.

LEROY, N. Y.—S. M. Wheeler.

NEW YORK, N. Y.—P. C. Ackerman, F. B. Baker, C. O. Baker, Jr., H. W. Benedict, Willard L. Candee, S. A. Chase, C. T. Child, A. B. Clements, R. B. Corey, Stephen L. Coles, W. F. D. Crane, Stephen A. Douglas, D. C. Durland, H. T. Edgar, C. E. Estabrook, M. K. Eyre, Stephen H. Goddard, J. W. Godfrey, B. E. Greene, H. McL. Harding, A. W. Harvey, Dr. W. M. Habirahaw, Wm. J. Hammer, F. W. Harrington, Alec. Henderson, Chas. I. Hills, P. H. Hoover, T. E. Hughes, W. T. Hunt, H. B. Jagoe, F. A. Johnston, W. J. Johnston, E. O. Johnson, T. Kiely, E. A. Leslie, J. W. Lieb, Jr., J. C. Lott, Geo. T. Manson, Geo. R. Macintire, T. C. Martin, K. G. Martin, L. B. Marks, Thos. I. McLeod, J. McGhie, J. T. McRoy, W. McCullough, J. P. McQuaide, E. P. Morris, A. H. Mustard, M. Nathan, D. E. Newell, W. F. Osborne, N. W. Perry, E. H. Peck, G. F. Porter, E. L. Powers, C. W. Price, Thorburn Reid, E. W. Rockafellow, A. C. Shaw, J. Sachs, E. W. Scribner, C. D. Shain, J. I. Solomon, H. A. Strauss, L. Stieringer, J. H. Astruck, G. H. Swan, H. M. Swetland, E. E. R. Tratman, W. D. Weaver, N. D. Webster, Jos. Wetzler, Jeff. Wetzler, Arthur Williams, J. P. Williams, Geo. L. Wiley, S. W. Wise, J. Harry Astruck.

NIAGARA FALLS, N. Y.—G. E. Cox, ——. Brackenridge, J. P. Devine, O. E. Dunlap, W. Caryl Ely, A. C. Hastings, F. G. Lott, E. F. Price, E. T. Price, I. L. Roberts, A. Schoellkopf, L. B. Stillwell, W. E. Tuttle.

OLEAN, N. Y.—G. Forbes.

ONEONTA, N. Y.—G. A. Lane.

ROCHESTER, N. Y.—J. A. Almstead. C. R. Barnes, Chas. F. Burns, Geo. A. Redman,

SCHENECTADY, N. Y.—Jas. M. Andrews, S. Dana Greene, G. B. Green, J. W. Kirkland, J. R. Lovejoy, C. P. Steinmetz, H. C. Wirt.

SENECA FALLS, N. Y.—N. T. Wilcox.

SYRACUSE, N. Y.—P. T. Brady, H. B. Crouse, T. J. Gorke, H. A. May, S. B. Van Rauss.

TROY, N. Y.—E. G. Bernard.

UTICA, N. Y.—M. J. Brayton, W. E. Ballda.

CAMDEN, N. J.—E. A. Armstrong, Wynn Armstrong, Walter E. Harrington.

ELIZABETH, N. J.—E. H. Stevens, M. V. Foster.

JERSEY CITY, N. J.—W. W. Ritzen.

MT. HOLLY, N. J.—Jos. H. Gaskill.

MORRISTOWN, N. J.—A. H. Lynch.

NEWARK, N. J.—Ald. John Gaffney, C. McIntyre, Henry Hayes, A. D. Page.

NEW BRUNSWICK, N. J.—A. J. Jones.

TRENTON, N. J.—Paul Lupke.

MANCHESTER, N. H.—J. B. Smith.

NEWPORT, N. H.—Wm. F. Richards, M. W. Tenny.

WOODVILLE, N. H.—Geo. E. Mann.

BEN AVON, O.—E. F. Gwynn.

CANTON, O.—H. M. Lyman.

CHILLICOTHE, O.—C. H. Juneman.

CINCINNATI, O.—Edw. K. Gillett, John I. Beggs.

CLEVELAND, O.—Thos. E. Adams, M. C. Canfield, H. J. Donds, R. C. Foster, Herbert P. Glidden, S. M. Hamill, Geo. M. Hoag, H. W. Jones, S. C. D. Johns, W. H. Lawrence, Geo. R. Lean, W. J. MacConnell, J. R. Massey, J. R. Prentiss, J. Rice, W. S. Rogers, A. D. Spear, E. Whipple.

COLUMBUS, O.—T. W. Dixon.

FOSTORIA, O.—H. A. Tremaine.

GENEVA, O.—A. F. Dickinson.

NEW PHILADELPHIA, O.—O. P. Taylor.

DAYTON, O.—A. A. Thresher.

SPRINGFIELD, O.—Jno. H. Miller.

SALEM, O.—D. L. Davis.

SANDUSKY, O.—Emil G. Shurlat.

TOLEDO, O.—W. S. Smith.

WARREN, O.—W. D. Packard.

WELLSVILLE, O.—D. W. Low.

YOUNGSTOWN, O.—E. A. Biel, B. P. Holmes.

ALTOONA, PA.—J. P. Graham, E. B. Greene.

BRISTOL, PA.—Chas. E. Scott.

EASTON, PA.—Howard Reneck.

JEANNETTE, PA.— A. E. Carrier.

JOHNSTOWN, PA.—J. W. Reeves.

McKEESPORT, PA.—F. R. Upton.

OIL CITY, PA.—W. H. Cooper.

PHILADELPHIA, PA.—S. Bilyea, C. Bragg, H. Clay, H. B. Cutter, A. V. Dee, Geo. M. G. Holman, A. H. Jones, H. Lloyd, J. Mustard, E. L. Nash, Geo. L. Peeples, J. W. Perry, J. Sigg, T. C. Smith, J. F. Stevens, T. L. Townsend, J. H. Vail, E. Ward Wilkins.

PITTSBURGH, PA.—J. McN. Bennie, J. C. Callsch, Thos. Cooper, J. S. Crider, Jas. F. Cummings, D. D. Dickey, W. K. Dunlap, W. S. Elliott, E. H. Heinrichs, C. B. Humphrey, Benj. G. Lamme, F. M. Laughlin, Chas. F. Scott, C. E. Skinner, F. S. Smith.

RENOVO, PA.—James Murphy, F. M. Noecker.

SCRANTON, PA.—G. G. Sturges.

WASHINGTON, A.—Wm. P. Wieman.

WEST CHESTER, Pa.—Jas E. Pyle.

WILLIAMSPORT, PA.—H. L. Allen.

WILKINSBURG, PA.—J. J. Jennings.

PAWTUCKET, R. I.—H. C. Adams, Jr., Henry A. Pierce.

PROVIDENCE, R. I.—Geo. E. Claflin, John I. Drake, Robt. Fessenden, Wm. C. Woodward.

FORTRESS MONROE, VA.— Geo. O. Squier.

NORFOLK, VA.—Jas. L. Belote, Wm. W. Chamberlain, Jno. B. Whitehead, Jr.

RUTLAND, VT.—W. Parsons.

WASHINGTON, D. C.—S. W. Tulloch.

LA CROSSE, WIS.—F. A. Copeland.

MILWAUKEE, WIS.—Thos. R. Mercein, Wm. Wilson.

Among the ladies present were:

Miss Elizabeth W. Armstrong, Mrs. C. O. Baker, Jr., Miss H. Billings, Mrs. S. L. Coles, Mrs. H. Clay, Savilla E. Clay, Mabel Clay, Mrs. H. B. Cutter, Mrs. Davis, Miss H. Douglass, Mrs. Foster, Miss Helen Frisbie, Mrs. Jos. H. Gaskill, Mrs. Gorke, Mrs. Greene, Mrs. Henry Hayes, Mrs. W. T. Hunt, Mrs. M. J. Isaacs, Mrs. H. B. Jagoe, Mrs. W. J. Johnston, Mrs. W. A. Kriedler, Mrs. Lovejoy, Miss Mae E. Mason, Miss Carrie W. Morgan, Mrs. Frederic Nicholls, Miss Charlotta Packard, Miss Lena Powell, Mrs. G. A. Redman, Mrs. Thos. P. Smith, Mrs. Swetland, Mrs. Joseph Wetzler, Miss Mary Whitall, Mrs. Young, Miss Lucy C. Young.

ELEC. ENG'R. N.Y.

NIAGARA FALLS CONVENTION, N. E. L. A., JUNE 9, 1897.
This group contains only a small proportion of the delegates and friends.)

MORNING SESSION.

PRESIDENT FREDERIC NICHOLLS called the meeting to order at 10:45 a. m., and read letters from the following, extending courtesies to the association from the Niagara Falls Power Company; Niagara Falls Hydraulic Power and Manufacturing Company; Buffalo and Niagara Falls Electric Light and Power Company; the Carborundum Company; the American Telephone and Telegraph Company; from Mr. B. E. Green, rental agent, Grand Central Palace, New York. Also letters of regret from the following: Prof. Edward L. Nicholls, of Cornell University; Sir William Dawson, Magill University, Montreal; Prof. Henry T. Bovey, Montreal; and a letter of thanks from Lord Kelvin, of Glasgow University, Glasgow.

THE PRESIDENT then read his address.[1]

MR. SWETLAND then read a synopsis of the report of the Committee on Data,[2] and added that it was his belief that in future the conduct of this work would perhaps be better confined entirely to the hands of the secretary, letting him secure such information as could be obtained by correspondence, without any further expense to the association. A motion to this effect was carried and the committee discharged with a vote of thanks to Mr. H. M. Swetland, chairman of the committee.

MR. JOHN A. SEELY, chairman, then read a report of the Finance Committee, showing a balance of over $2,500 in the treasury of the association, with no liabilities. He gave notice to the chair that he would move to change the by-laws to the effect that the retiring presidents shall all become honorary members of the association.

A recess was taken till 2:30 p. m.

ARTERNOON SESSION.

On reassembling the president read a letter from the Erie Gas Engine Company, inviting the association to send a committee to Erie, Pa., for the purpose of testing and reporting upon the efficiency of the company's gas engines, as well as those of other manufacturers.

PROF. R. B. OWENS, of the University of Nebraska, then addressed the association, inviting it to hold its next convention at Omaha, in connection with the Trans-Mississippi Exposition.

MR. EVANS WOOLEN invited the association to Indianapolis, Ind. Both invitations were referred to the Executive Committee.

MR. J. B. CAHOON, of Elmira, N. Y., then read his paper entitled "The Establishment of a Base Price for Current."[3]

MR. CAHOON added that with regard to the superintendent's monthly report that was a sort of a cosmopolitan thing obtained from working over the reports of about sixty different stations. Each man had his own particular ideas on the subject, and the only object of putting them in was to bring the subject up and see if a standard set of blanks could not be gotten up.

MR. J. I. BEGGS, of Cincinnati, stated that in a new station to be built by his company he hoped to generate as many kilowatt hours for $18,000 for what now took $54,000 in coal per annum. Blanks should, therefore, give not only the price of coal and the quality of it, but the type of the apparatus that is being used, as well. Some of the larger stations in the country, and particularly those supplying current from the Edison three-wire system, have agreed upon and adopted uniform sets of blanks whereby the distribution of the various items of expense in the operation of stations are made exactly the same, and they exchange these blanks or have them criticized from month to month. They all see what their different stations are doing; and there is nothing better calculated to bring about an improved condition of station operation.

Further discussion of the paper was deferred.

THE PRESIDENT.—The next item upon the programme is the topic for discussion entitled "Theft of Current and How to Deal with It." During the past year when I have been looking into several matters and considering lines, or directions, in which work could be done that would serve the best interests of the members of the association, I was very much astonished to find that in hardly any State of the Union was there provision made in the common law for the punishment of any person who would deliberately steal current from the street mains or otherwise. It seems to me that that is something that should be provided for. I know in Canada we have provision made for the punishment of theft of current; and it seems to me that a question of this kind should be taken up by the association, and that the different members should work together so that there could be a clause added to the criminal code of the different States providing for the punishment of this offense. Mr. T. C. Martin was speaking to me in reference to this matter this morning and had with him the draft of a law that has just been passed in one of the States.

MR. T. C. MARTIN.—The bill was brought up at the last session of the Connecticut Legislature and was referred to a committee, was approved and returned to the Lower House and passed, was sent up to the Senate and was passed there; went through both Houses, I understand, with very little opposition from any quarter; and within the last ten days, I think, the bill has received the assent of the Governor and I presume is now part of the law of the State of Connecticut. There is a small money fine attached to the offense, or a short term of imprisonment. The bill seemed to me weak in regard to the requirements as to the proof of theft. Whether that feature has been improved in the bill as made law, I am not able to say. I had some conversation not long ago with Mr. Russell B. Harrison, who had encountered the difficulty of theft of current at Terre Haute, and I found that, although the cases were pretty well proved, he had hesitated to bring action because he was advised by his lawyers that under the existing state of the law it would be difficult to secure a satisfactory conviction within the law as it then stood. There have, however, I believe, been one or two other cases, among them one in Louisville, Ky.

MR. J. I. AYER moved that a bill be drafted by the association which would meet the requirements of the offense, and that it be uniform in the different States.

MR. YOUNG, of Waterbury, Conn., stated in relation to the law that has just now been passed in Connecticut, it happened to be his duty as treasurer of the Connecticut Electric Lighting Association to have this particular bill drafted, and it was drafted by the attorney for their association, and it passed, as Mr. Martin had stated, without any serious opposition through the Legislature and had been signed by the Governor. The penalty attached is a fine of $50 and imprisonment for ninety days, or both.

MR. STETSON.—If it is thought well to appoint this committee, I might say it would be well to examine the law that is in force in Massachusetts. Last year or the year before the law was made to apply to the theft of current the same as to the theft of gas; and it gives me pleasure to report that a man that had ordered out his meter and had put in wire to occupy the space that the meter previously occupied and had gone right on in the lighting business, was brought into court and it cost him $55 to get about 50 cents' worth of electricity.

COM. BARKER.—Mr. President, I do not think I can add anything to what Mr. Stetson has said. The law, I think, was promoted by the efforts of the Massachusetts Electric Lighting Association. It was passed by the Legislature with practically no opposition, and perhaps the passage of the law was aided by the fact that a law prohibiting such theft of gas had been upon the statute books for a number of years. I think the courts in our State have held that it is not a common law offense to purloin gas, and therefore they would be likely to hold in the same way with respect to electric current; but the statute seems to be a sound one. I think there have been a number of prosecutions successfully carried out under it in our State—if I mistake not, in the city of Lynn. It has been in existence for a couple of years and is modeled after the act which prohibits and punishes the theft of gas; and I think the general opinion is that it is a good law.

MR. MARTIN.—Mr. President, Mr. Stetson's suggestion moves me to believe that perhaps it would be a good thing if I could supply the omission of bringing the bill with me by placing it in the hands of the official stenographer. That would make it a part of the transactions, and in that way it would very quickly reach a great many members of the association who are not here and other electric lighting men throughout the country who are very much interested in this question, as I know from the number of letters that I have received on the subject. Cases of theft seem to be getting daily more numerous, and now that we are threatened with the application of it in large quantities for the purpose of burglarizing safes, it seems to me perhaps it would be well to protect ourselves before that new industry gets upon its feet. (Laughter.)

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[1] See page 671.
[2] See page 664.
[3] See page 669.

W. P. ENGEL, of Charlotte, Mich.—Mr. President, with your permission and that of the members, as I am not a member of this association, I would say that legislation has been inaugurated in the State of Michigan, upon this subject, through the efforts of several central station men, and the Municipal Light and Power Company, of Grand Rapids, sent out a circular which embodies a law called House Bill No. 955, Legislative Session of 1897. That law embodies punishments, and it also includes gas, water and electric current. I have a copy of it and if a committee is appointed I will deliver this to them that they may look at it; or it may be read if you so choose.

MR. BEGGS.—I have been instrumental in having one conviction brought about in the city of Cincinnati, although the Ohio law is somewhat indefinite upon the point. We could only proceed under the law that was passed for tapping wires, for an entirely different purpose. But this case was so clear that we brought the action. Our principal difficulty is tampering with the measuring instruments themselves; not so much tapping the wires, taking the current direct. Therefore when a bill is drawn it seems to me it ought to be broad enough to cover every condition in which a man attempts, not only to steal current but in any way to tamper with the instruments that are employed for measuring, and which is the most prolific source of loss to the central station. In the case I referred to we prosecuted the man, and, I believe, he was subjected to a fine of $50. But our greatest difficulty was to have the grand jury even bring in a bill against him because of his political pull. But it was a saloon in which we never even had furnished the current. He had been cut off for nonpayment of bills by one of our competitors. Our lines happened to cross near the rear end of his premises. He threw out a grappling hook and got connection on there and lighted himself for several months in that way. There was really no law applicable in the State of Ohio unless we prosecuted him upon the charge of tapping wires, under a law that was passed for the protection of race courses and things of that kind.

MR. CLAY.—I fail to see how a committee would accomplish any satisfactory results to the members of this association, owing to the fact that the conditions differ in the various States of the Union. Two years ago we put upon the statutes of Pennsylvania a law which makes it a misdemeanor punishable on conviction by fine and imprisonment for any person to take current or in any way interfere with electrical apparatus.

JUDGE ARMSTRONG.—From what has been said in relation to the various laws that have been passed I judge that the penalty is grossly inadequate. You know there is an old adage, where there are twelve lawyers there are thirteen opinions always, but I am strongly under the impression that if a grand jury should return a bill of indictment for larceny to my court against a man for tapping a wire and taking power, and the jury believed that he had done it, I should not hesitate to sentence him for larceny under the law as it now stands. There is nothing in our State that I recall, no decision of the Supreme Court, that would prevent that thing. This Michigan proposed bill, and the one in Connecticut, makes it a slight misdemeanor only. If a man steals above $30, I think it is, it is grand larceny and he may be imprisoned for from two to five years, depending on the circumstances. Here three months, and $100 is the maximum penalty, in this bill. In the Connecticut bill it was $50. I want to protest as strongly as I can to this association against their recognizing by anything they do the propriety, if I may say so, of anybody taking electric current the same as they would take in sunlight or take in air. That has been the idea upon which they have acted heretofore; and we may by any act that we do give a good deal of credit, a good deal of strength, to that. Judge Armstrong described the methods adopted by his company to educate the intelligent public in the idea of the cost of producing current for use.

THE PRESIDENT.—It has been moved and seconded that the chair appoint a committee of three to prepare a report upon this subject and draft a bill which would be uniform and apply to all the different States; and the mover of the resolution also suggests that so soon as that report be drafted that it be forwarded to each of the members of the association. Is it your pleasure that the motion be declared carried? (Carried.)

THE PRESIDENT.—The convention ordered this morning that the report of the Committee on "Rules for Safe Wiring," Capt. William Brophy, chairman, should be presented this afternoon. I now call upon Capt. Brophy, as chairman of the committee, to present his report. The report was read.[1]

CAPT. BROPHY.—I believe I was one of the original members of the conference first held at Capt May to bring about this result. I have been a member of this committee from that time on. I have labored faithfully to bring about this end. Sometimes, as I have described here, the task seemed almost hopeless, but I never was ready to sacrifice the right of the men engaged in the electric business to have their say in the formation of rules under which they were obliged to install their apparatus. As I said before, I have given both time and means to bring about this end. I hope to see it consummated; then I shall be satisfied and consider my task done. (Applause.)

MR. AYER described in detail the arduous work of the committee of which he was a member, and particularly of Captain Brophy and Mr. W. J. Hammer. He urged immediate approval by the Association of its own work now presented.

MR. CARNES moved the adoption of the report. Seconded. Carried.

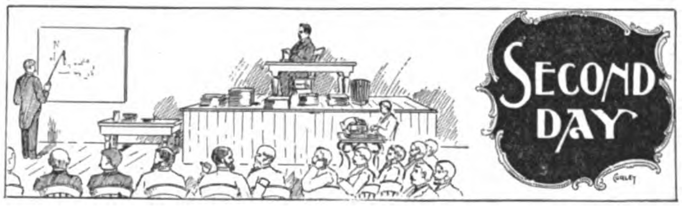
THE PRESIDENT.—The next order on the programme is a paper on "Municipal Lighting," by Mr. W. Worth Bean, of St. Joseph, Mich. I will call upon Mr. Bean to read his paper. The paper was read.[1]

MR. DOUGHERTY.—I consider this subject a very, very serious one. I am out of the woods myself, but I have had a little experience in it. Mr. Bean has, and several other members. I think it is a matter that would warrant the attention of this association—their continued attention, rather; and the portion referring to the data furnished, except by sending a representative to the plant, I wish still further to corroborate. I have had a little experience in that as former chairman of the Northwestern Electric Association. The city plants now in operation are, many of them, a dismal failure, but every one of them sends out reports that look very inviting to other cities. I merely rose to urge that although the paper may not have a great deal of discussion, the members treat it seriously and continue the protection in this line that the association has already endeavored to provide.

MR. BEGGS.—The remarks of Mr. Dougherty prompt me to suggest, taking a text from the president's remarks this morning, that he didn't think it was necessary for an association of this kind to have a large surplus fund. It seems to me that there is no use to which the association could devote a part of those funds with greater advantage to the central station and lighting interests of the country than to employ an intelligent, painstaking expert to get reliable data from a number of municipal plants in different sections of the country. As has been well stated in this paper, the data that is available, except in very few cases, is unreliable in the extreme. Mr. Beggs went on to urge the employment of an expert to get and analyze some of the municipal plant figures.

THE PRESIDENT appointed Mr. Ayer as the mover, Judge Armstrong and Senator Foster S. Voorhees, of Elizabeth, as members of the committee to draft a law providing for the punishment of the theft of electric current.

An invitation was read to take the next convention to Old Point Comfort. Referred to Executive Committee. The meeting went into executive session and then adjourned.



MORNING SESSION.

PRESIDENT NICHOLLS in the chair.

THE PRESIDENT introduced Mr. J. G. White, of the White-Crosby Company, New York, who read a paper on "The Niagara Power Transmission Line."[2]

MR. SEELY inquired whether it was necessary to shut off the current when replacing insulators.

MR. WHITE.—Some insulators have been changed without shutting down, and it is quite practicable to do that where the wire has not been tied in. Where it has been tied in, unless on a very dry day, I should rather somebody else would attempt to replace the insulators with the current on. But I know of other 10,000-volt lines where it is done, and by having a large stool mounted on four porcelain insulators on which a ladder can be placed, it will be entirely possible for a man to get up to the line and replace the insulator. The only trouble about that is that with 10,000 volts the capacity of a man is sufficient to absorb considerable spark, and if the man was nervous he might get shock enough to knock him off the ladder. So it is not a pleasant task, but it is entirely possible. We did replace a number of insulators where the wire had been tied by lifting the wire on the top of another insulator which was mounted on a long stick and then replacing the insulator and letting the wire come back into place. In actual construction the wire, as you probably know, was not placed at the corners of a triangle, but the line was divided into six sections, and at five points three wires were given a twist, so that for two of the six sections each of the three wires occupied relatively the position of 1, 2 and 3, and this counteracts to a considerable extent the induction which would otherwise be exerted. I should say that under all circumstances where it is possible, unless the right of way cost too much, or is too expensive, trees ought to be cut 30 or 40 feet on each side of the line, and more if possible.

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[1] See page 672.

[1] See page 655.
[2] See page 674.

MR. SEELY.—I presume time only will demonstrate the efficiency of the 30,000 or 40,000-volt tests applied to the insulators?

MR. WHITE.—There is no data as to that. But the mere fact that not a single insulator has broken down during this time is pretty good evidence. With the other insulators which were put up temporarily, the depreciation on the line was quite rapid, as mentioned in the paper. We used to have cross-arms burn off quite frequently, and that came from the fact that although these insulators had stood that 20,000-volt test, and there was only 10,000 on the line, yet enough rain would strike them to gradually moisten the porcelain, and, of course, as they absorbed this moisture the insulating properties would drop down to so small a value that they allowed the current to go through until it burned off the cross-arms from the arc that would form. That, of course, would break the contact and the arc would stop of its own accord. The brim on the helmet insulator had not yet proved to be of much importance in shedding the rain as it was hoped. The lightning arrester problem is still in the process of being solved. There are very few of them on the line. The line is protected as much as we could from lightning by running two barbed fence wires on top of the poles, one carried on the outer cross-arm by an iron pin 18 inches long and 1 inch in diameter, which went through the cross-arm and had a little fork at the top supporting the barbed fence wire. A second similar wire was carried on the peak of the pole, the poles all being roofed, and a third is intended to be put up on the other side of the cross-arm when additional wires are put up. Every fifth pole these barbed fence wires are grounded with a No. 6 copper wire running to the bottom of the pole and being coiled there, so that we can expect discharges will be carried off by these numerous points without accumulating sufficiently to give a lightning stroke. But the lightning arresters themselves are placed only at the transformer houses up to date, and those have given some trouble; so that probably none will be placed on the line until something has been put in the transformer houses that is perfectly satisfactory.

MR. SEELY.—I would assume that it would be preferable to place the wires underground entirely. It would cost probably, according to your figures, about $800,000, or $40 per h. p., and would be free from the defects of the overhead wire.

MR. WHITE.—That view, of course, is possibly correct. But as I stated it has not been demonstrated up to date, from the fact that the only trouble due to the line so far was from a joint in the cable. There is no trouble due to the insulator; and there are 4,000 feet of underground as against over 24 miles of insulators; so that we have about thirty-five chances to one as far as distance is concerned of trouble with the overhead as compared with the underground.

MR. S. D. GREENE.—It seems to me that the question of lightning on a line is really the most serious point to be considered, as to the comparative advantages of the overhead and the underground lines. It is a fact that no tests which any manufacturing company that I know of can produce at their works are at all indicative of the results to be obtained on the line here; and it has been found actually necessary for them in testing lightning arresters and fuses to bring the experimental apparatus to Niagara Falls and actually test it by short-circuiting the machines here. In other words, the effect of a short circuit with 5,000 h. p. generators on a 10-000-volt line is very different from anything obtained in ordinary use and practice. While it is probable that the lightning protection that has now been devised in the line will be sufficient to answer the purpose for the present, yet there will always be more or less risk from lightning until the wire is put ununderground.

MR. SAMUEL INSULL.—Did I understand Mr. White to say it would cost $600,000 more for a line to carry 20,000 h. p. under ground?

MR. WHITE.—It would cost about a million and a quarter for a line carrying 20,000 h. p.; that is, four series, three wires each, making 12 wires total, for a distance of 27 miles; with lead-covered cable, of which 4-5 would be for lead-covered cable and 1-5 for conduit. That would mean $60 per h. p., and overhead about ⅓ of that amount, or $20 a horse-power. If placed underground at $60 the interest charge of course would be $3, allowing 5 per cent., and at least an additional amount equal to that would be allowed for depreciation, and probably a good deal more than that.

MR. INSULL inquired whether lightning arresters up to 1,000 h. p. would carry a lightning discharge and at the same time interrupt short circuit of the dynamos without serious trouble?

MR. GREENE thought it might be possible, but he did not think any company would guarantee such a device. Of course the network which Mr. White described as having been placed on the top of the poles was a good protection, but he did not think it was an absolute protection against lightning under all conditions of stroke.

MR. INSULL did not believe, after looking at the Niagara plant, that it could be installed for much less than $100 a horse-power. It seemed, therefore, that a long distance power transmission plant, including the underground conductors, would cost at least 60 per cent. more than the steam plant to produce the best possible results from steam in the city of Buffalo.

MR. BEGGS thought that existing plants had nothing to fear from long distance transmissions, and he questioned whether even the great Niagara Falls plant could compete with the modern steam plant fifty miles from Niagara Falls. He instanced several propositions recently submitted to him, among them one for transmitting 40,000 h. p. at 60,000 volts 60 miles.

MR. WHITE agreed with Mr. Beggs that the localities were very few and the circumstances must be very exceptional which would support a transmission line 50 miles long.

MR. STEINMETZ thought it was dangerous to generalize too freely in such matters, and to state that it is or is not economical to transmit power 50 miles. It all depended upon what the power was used for. The problem changed very greatly according to whether the power is used in a factory for 24 hours a day, a steady load, or whether it is used where the whole load is only an hour a day run and the remainder is idle, and you have to pay the same price; and other conditions.

MR. C. F. SCOTT gave the results of the successful attempts in overcoming the effects of lightning at Telluride, Colo., on a 10,000-volt circuit.

MR. WHITE corroborated Mr. Steinmetz's remarks and cited the case of Leadville, Colo., where it was found that power in some instances was costing the miners as high as $2,000 a horse-power for the actual indicated horse-power on a hoist. In such a case as well as at Cripple Creek power might be transmitted 50 miles at a profit.

MR. W. L. WALBANK.—We have just constructed a steel pole line from Lachine Rapids into Montreal. We took a channel iron and cut it diagonally through and then riveted the reverse ends so as to make it about 8 inches at the top and 20 inches at the bottom; put two of these columns up and then latticed them together; the wooden cross-arms are almost identically like those at Niagara, but without any braces underneath, and we have altogether 36 wires on. Our poles are placed 108 feet on centers and they stand probably 30 feet high, including 7 feet in the ground. They are bedded 7 feet in concrete. Our pole line complete, with wire, insulators, cross-arms and everything, will cost us for a distance of 30,000 feet, for the complete line, about $92,000. We figured that for underground work it was going to cost over $300,000, to do the same thing with lead cable. We have not tested it practically yet, because it is just about completed now.

MR. ARTHUR WRIGHT, of Brighton, England, then read his paper on "Profitable Extensions of Electricity Supply Stations."[1]

In the discussion, Mr. Wright, in reply to a question stated that the whole of the plant at Brighton, England, is direct connected, and in the years analyzed in his paper there was no condensing plant. His longest transmission line was two miles from the station. The least price for a kilowatt hour is 14 cents; the price for extra hours was 3 cents per hour for every additional hour. The average income per kilowatt hour this year will be 6 cents. Gas sells at 66 cents per 1,000 cubic feet. In reply to a question by Mr. Beggs, Mr. Wright stated that his most favored customer was paying 3½ cents per kilowatt hour.

MR. J. I. BEGGS stated that this was cutting the price of gas in two, and that it was a great injustice to the small consumer. He never felt that electric light companies ought to cut under gas. He merely tried to bring it down to the price of gas. He believed the greatest menace to central station companies was the isolated plant. In the companies with which he is now connected he had opened an account whose technical ledger title is "depreciation, reconstruction and reserve," to which a certain amount of money is carried monthly as a liability of the company, and the funds kept in hand for use in the years to come when either present installations may become antique or some unforeseen circumstances arise whereby the company would have the means to put themselves in position to compete with the advances made in either the production of gas or more modern lighting plants.

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[1] See page 656.

MR. SAMUEL INSULL.—I am running a company that is operating on the Wright demand system in practice, but not in theory. As Mr. Beggs pointed out we have to compete with the isolated plant, and I assure you that if you are going to assume that the lowest price you can charge for electric current is the price that is at present charged for a unit of light by the gas companies of this country you cannot compete with incandescent isolated plants. I can show you cases where you have got to go as low as 6, or 5, or 4½ cents per kilowatt hour, if you are going to compete with the isolated plant.

MR. INSULL advocated the differential rate of Mr. Wright and gave examples of its necessity. As regards a remark of Mr. Beggs that his basis of discounts gets over the difficulty, that was not so. Thus, he referred to one building where, if bills were rendered against the owner of the building stead of the tenants, they would be entitled to the biggest discount. It is the largest building in Chicago; and yet, as a matter of fact, it was not very profitable business at 20 cents per kilowatt hour. On the other hand, a man who has a comparatively small store, and who pays just about the same amount per annum, has a business which is ever so much more profitable at 70 per cent. off 20 cents a kilowatt hour, or 6 cents a kilowatt hour.

MR. STETSON fully indorsed the desirability of the plan devised by Mr. Wright, and, with Mr. Insull, believed that by its adoption the smaller companies would no longer have to look for their profit to the city contract.

MR. FERGUSON criticised Mr. Wright's plan in that it made no distinction in regard to the time of day on which that maximum load comes.

MR. WRIGHT, in reply, stated that all these standing charges were not hourly, monthly or daily charges. They were an entire charge against the whole investment, and if you had an installation taking current before six o'clock, and another equal installation taking current after six o'clock, both these installations ought to pay half of the necessary investment charges, and not one.

In reply to a question by **DR. FENNER**, as to just how the Wright system was worked in practice, **MR. WRIGHT** said: There is an instrument put alongside the ordinary meter. This instrument tells the station manager and the consumer how much per annum he must pay the company to pay off the charges for getting the plant ready. The ordinary meter shows him the total bill. The other is what we call the demand indicator. The meter shows the total amount of electricity consumed and the demand indicator tells him by direct inspection how much of that electricity has to be charged at a high rate, and all the balance at a low rate, in order to make him profitable. The instrument does it without calculation. Mr. Insull had stated that it might be possible to do this without an instrument, but he thought the cost of doing that would be exceedingly great.

DR. FENNER.—Do you vary this 14-cent per k. w. hour initial charge in accordance with whether it is all done in an hour or whether it is spread over the 24 hours?

MR. WRIGHT.—Yes. When we first started it, we charged 14 cents for two hours per day, or 730 hours per annum. As we got larger the standing charges in proportion diminished. Then we diminished the time during which it was necessary to insist on the high charge.

After some additional remarks by **MR. S. D. GREENE** and **MR. FERGUSON** the further discussion of the paper was deferred until the afternoon session.

A letter was read from Mr. H. H. Littell, vice-president and general manager of the Buffalo Railway Company, inviting the delegates to visit the power house of the company, on Niagara street, Buffalo.

AFTERNOON SESSION.

PRESIDENT NICHOLLS called the meeting to order at 3 p. m., and read a letter from Mr. W. Caryl Ely, president of the Buffalo and Niagara Falls Electric Railway, inviting the delegates to an excursion on special cars, from Niagara Falls to Tonawanda and return. Also a letter from Mr. Wm. H. Brown, of the Royal Electric Company, Montreal, suggesting Montreal as the place of the next convention of the association.

The discussion on Mr. Wright's paper was then resumed, and by request, **MR. RAWSON** gave a brief description of the Wright demand indicator as follows:

The instrument which we are now using, is really a differential gauge adapted with various modifications, so that we really have a thermo self-recording ammeter, or what we may practically call an ammeter, that shows at a glance the maximum demand that the consumers have made upon the station. The index is non-returning and liquid; consequently we lose nothing. The delicacy of the readings is very great.

I should just like to mention one or two points in connection with my own personal experience with this instrument as being used in other cities besides Brighton. We have the instrument now in use in 40 cities in the United Kingdom; and certainly in more than one case it has turned non-profitable companies into dividend paying companies. I refer more particularly to Northampton, Eng., and Preston, Eng. In both those cases the companies had been operating for some three or four years in a very disheartening way. I think I am safe in claiming that as a recording ammeter there is nothing that can be obtained so cheaply. There was the question raised this morning as to whether our experience at Brighton, which Mr. Wright set forth, really, last year, yielded a profit at all. Now, last year at the central station in Brighton, in addition to the setting aside of a sum equal to 5½ per cent. of the whole capital for depreciation and redemption, which is really a dividend of itself according to the ideas of a great many managers, we, in addition, earned nearly £6,000 net; that is to say, nearly $30,000 net on a capital of $200,000, or an extra five per cent. over that first 5½ per cent. That, I think, puts that question clearly. In Brighton, Eng., we averaged on our tariff something over nine cents per kilowatt hour right through, surely we are friends of consumers; and if we made, as we did last year, the profit I have told you about, surely we are the friends of central station managers. The smaller central stations in England were very glad to welcome us. Those of the large districts of London have adopted the Wright system, and we have also the City of Glasgow, in Scotland, which is our next largest city. The big industries, of course, do say, "Well, while we are doing well let us alone"; but I submit to you, gentlemen, who are in control of large stations that the security of that prosperity must surely be based on your answer to the dissatisfied customer. We make our instruments and calibrate them absolutely to read directly in kilowatt hours. Give us your fixed charges, give us your lamps, on the other hand, and we will tell you what the tariff ought to be.

The speaker then referred to the flat rates in vogue among telephone companies, which included the stand-by charges. Also to the practice among livery stable men to charge more for the first hour than for subsequent hours. The speaker declined to admit that gas was an ideal in any shape or form, except for heating, and that it had any right to arbitrarily define what is the proper basis for electricity supply. That being so, he wished to point out that on a flat rate one must always make the good customers pay for the bad; that was commercially inexpedient and theoretically and absolutely wrong. The first thing his friends and he saw on landing in this country were gasoliers provided with electric lights, but the electric lights were out,—because they didn't land until half past eight; the same as in the large English cities. In Brighton they had improved the load factor; that is to say, the earnings per horse-power demand at the station were something like 45 or 50 per cent. The cost of installing the Wright instruments did not come at more than two or three per cent. on the whole of the capital.

The next paper read was that by **PROF. CHARLES A. CARUS-WILSON**, of McGill University, Montreal, entitled, "The Induction Factor; a New Basis of Dynamo Calculation and Classification."[1] Prof. Carus-Wilson added that he was much indebted to the General Electric Company for this data, and that he would be glad to correspond with the members on the subject of his paper.

The president then introduced **PROF. ELIHU THOMSON**, who read his paper on "Recent Progress in Arc Lighting."[2]

MR. T. C. MARTIN'S paper on "The Daylight Work of Central Stations" was read by title.[3]

The meeting then went into executive session.

MR. F. W. JACKSON, the secretary of the San Diego, Cal., Gas and Electric Light Company, says: "Each issue of The Electrical Engineer is replete with articles of the highest interest and value to anyone engaged in the electrical industry."

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[1] See page 667. [2] See page 662. [3] See page 660.

MORNING SESSION.

PRESIDENT NICHOLLS called the meeting to order at 10:30 a. m., and introduced Mr. B. F. Lamme, of Pittsburg, Pa., who read his paper on "Polyphase Motors," discussion on which was postponed.

The meeting went into executive session.

AFTERNOON SESSION.

PRESIDENT NICHOLLS called thte meeting to order at 2:30 p. m., and called upon LIEUT. F. JARVIS PATTEN, of New York, to read his paper on "Frequency Transformation."

This was followed by that of MR. CHARLES F. SCOTT, of Pittsburg, Pa., entitled "Rotaries for Transforming Alternating into Direct Current."

MR. J. I. AYER then read the report of Committee on Standard Candle-Power of Incandescent Lamps.[1]

MR. AYER.—I will state in connection with this report that the idea is to have a form of incandescent lamp specified which may be produced by the different manufacturers without identification marks, and submitted to the secretary; these in bulk to be turned over to some college testing laboratory; the test to be made under the supervision of the non-partisan committee of the association and of the Institute of Electrical Engineers. As to the photometer arrangement, it is proposed to make a specification of a photometer, which would cost little, which would be handed over to different manufacturers, and when made would be submitted to this committee as to its approval. This puts the central station man in a position to have a photometer which can be easily operated by any ordinarily intelligent station employé.

MR. INSULL moved a resolution that the report of the committee be accepted, and that their recommendations be adopted by the association, and, if necessary, that the committee be continued. Carried.

On motion, the secretary was instructed to prepare the customary resolutions for the retiring president.

MR. AYER called attention to the matter of freight classification on electrical merchandise, which, he said, was all out of reason; that is to say, there is no discrimination. Thus one might ship a dynamo frame with no wire on it, just a simple piece of casting, and yet have to pay on it as electrical merchandise at double first-class classification. He moved the appointment of a committee to take this matter up with the chairman of the Traffic Association, with a view of revising the freight rates. Carried.

THE PRESIDENT then referred in fitting terms to the loss sustained by the association in the death of Messrs. H. J. Smith and J. M. Orford.

The convention then went into executive session and adjourned sine die.

MR. STILLWELL'S N. E. L. A. LECTURE ON NIAGARA POWER.

On Wednesday evening Mr. L. B. Stillwell, director of the Niagara Power Company, delivered a lecture entitled "Niagara Power" in the pavilion of the State Reservation.

The lecturer introduced his subject by showing how every utilization of the forces of nature made for civilization, and affected the social conditions of mankind for the better. Coming to the power of Niagara, he stated that the average output of fifty men working continuously is equivalent to 1 h. p. The power which the whole human race could exert, would, therefore, about equal that represented by the Falls of Niagara. Niagara, in fact, was a solar engine, every pound of water above the rapids representing 200 foot-pounds of energy, the entire falls being equal to 5,800,000 h. p. To produce an equal amount of power by steam would require 13,000,000 tons of coal per annum, equivalent to about one-third the total coal output of the world. To put it in another way, Niagara could supply 3,000,000 arc lamps, or 600 generators such as those installed by the Niagara Power Company, having a capacity of 65,000 incandescent lamps each. Of the total power of the Falls, about 4,000,000 h. p. could be delivered to turbines, and of this about 3,000,000 would be available in practice.

Mr. Stillwell then gave a brief sketch of the plans which were originally considered for distributing the power, the methods being, shafts, cables, hydraulic, and compressed air transmission, and electricity. As the lecturer aptly put it, the mediums of transmission considered were of four kinds, namely, by solid, liquid, gas and ether in a state of strain; that is, from the material to the immaterial. The numerous advantages of electric transmission had led to the choice of that method. The lecturer emphasized the fact that the Niagara Power Company was building not only for the present, but for the future.

A large number of lantern views were then thrown on the screen, which illustrated the dynamos, turbines and other details of the great power house at Niagara Falls.

SECRETARY G. F. PORTER has, it was learned at the convention, accepted a very responsible position with Mr. Brixey in the Kerite wire and cable business, but owing to the irresistible pressure brought to bear upon him from every quarter has consented to hold office for a while. He hopes to issue the current volume of proceedings in very quick order. If any association has ever had a better secretary than Mr. Porter, history has failed to record his name.

ONE DOLLAR was the small sum for which the association issued a coupon book full of double passes or "return trips" for all the leading attractions around the Falls, representing a saving of nearly $2 to every purchaser. Some three hundred coupon books were sold. The hackmen were remarkably moderate in their charges but reaped a golden harvest.

PRESIDENT F. NICHOLLS gave an evidence of his thoughtful courtesy in presenting every lady at dinner Wednesday evening with a bouquet of roses.

SOUVENIRS were more in evidence at this convention than ever before, and included samples of wire and cable mounted as letter weights, X-ray coin purses, mirrors, cigars, real and wooden, match safes and holders, lead pencils, metal pencils, pocketbooks, badges, planigraphs, cases for wiring rules, memorandum pads, cigar cases and a great many other objects of bigotry and virtue. The intrinsic value of many of these presents was considerable, but, in spite of the demand, the supply held out surprisingly.

THE CAKE WALK.—On Tuesday night, Messrs. Dale and Carroll entertained the members and the ladies with a cake walk in the most approved Afro-American style. The exhibition evoked roars of laughter and the cake was voted to the walkers by unanimous consent. The walk took place very appropriately in the ball room, which was crowded with enthusiastic onlookers.

MR. C. O. BAKER, Jr., was very successful again in his work as Master of Transportation, although the spell of summer holiday beginning at noon on Saturday interfered with the success of the special trains. Still, as there were delegates and visitors from twenty-five States, Canada and England, Mr. Baker must have felt that his share in bringing the convention together was not without its happy results.

MR. C. R. HUNTLEY, of the Buffalo General Electric Company, more than sustained his reputation as a charming host by the breakfast he gave at Lewiston, at the foot of the Gorge, on Wednesday morning, to a party of twenty-five friends. A special car was provided, which ran over the Gorge road, and whose trip over that wild and romantic railway, along the edge of the rapids, through the morning mists —and with the aid of a Whirlpool cocktail—will not be soon forgotten. The party included Messrs. Huntley, Nicholls, Insull, Gilbert, Hamill, Baker, Porter, Dana Greene, Seely, Habirshaw, Ferguson, Rhotehamel, Martin, Brackenridge, Ridall, McIntire, Requa, Brophy, Henderson, Flood, Brooks and others. A delicious fish breakfast was served, the chief items of which had been drawn from the cold storage of the placid river but a few minutes before, and many of the guests were tempted to believe they could live on fish forever. Only President Nicholls and Secretary Porter appeared to care whether any convention was held that day. The reason for calling the road the Gorge Route was understood by the time the meal was finished, and as one of the party said, they were all about as slow as Niagara in eating their way backward to the Falls. On the trip home, Mr. Huntley had a photograph taken of the party at the Buttery Rapids, as a souvenir of the occasion.

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[1] See page 676.

Mr. BANKER R. PAINE, of Drummondville, Ont., was able to show a good many inquirers the nature of the ground around Chippewa and Navy Island, where it is now seriously proposed to undertake a large development for power by a canal coming out on the bluff just above Cedar Island.

SHAWMUT FUSE WIRE COMPANY, of Federal street, Boston, Mass., displayed a line of new switches, notably their quick break switch, which was recently passed on very favorably by the Boston Fire Underwriters. The exhibit was in charge of Mr. H. P. Moore.

THE JANDUS ELECTRIC COMPANY, Cleveland, O., exhibited on the ground floor nine different patterns of their enclosed arc lamps comprising constant potential, constant current, alternating, railway power current; a direct burning 220-volt lamp, short type, etc. The exhibit was a very interesting one, and was in charge by Mr. Geo. R. Lean.

THE DIAMOND ELECTRIC COMPANY, located on the ground floor of the hotel, exhibited the Scheeffer transformer and wattmeter, which is claimed to be a marked improvement on the old style, this new transformer being the core type instead of the shell type. Their wattmeter also was shown and attracted attention by its simplicity of construction. They exhibited also the Cardew earthing device, which they manufacture under English patents. It is used for the purpose of protection of buildings and life against high pressure currents. The exhibit was in charge of Mr. G. A. Scheeffer and Mr. Wm. Wilson.

BUCKEYE ELECTRIC COMPANY, Cleveland Ohio, exhibited a very attractive case of their incandescent lamps of every variety and in different colors. The exhibit showed their latest designs of ornamental and decorative lamps. Also candelabra lamps for high voltages, covering a new field. Mr. John R. Massey, the factory superintendent of this company, had charge of the exhibit.

CUTTER ELECTRICAL MANUFACTURING COMPANY, Philadelphia, Pa., showed their full line of I-T-E circuit breakers. The I-T-E motor starting rheostat, their latest device, created unusual interest. It is a new device affording a very high standard of protection. The exhibit was in charge of Mr. Henry B. Cutter, president and general manager of this company.

MR. T. H. BRADY, of New Britain, Conn., showed samples of his cut-out box, which is having a large demand among the trade the past year. Mr. Brady is one of the original members of the National Electric Light Association and has an unusually large acquaintance, forcibly illustrated by his continual handshaking with friends met at the convention.

PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., had a large board tastefully arranged, showing a varied line of their china insulation, also their well known Hercules and Laclede batteries. Among their specialties we noted cut-outs, transformer fuse boxes, conduits, tees, ells, crosses, etc., also new multiple tablet boards for two and three-wire systems. The exhibit was in charge of Mr. D. A. Schutt and F. D. Covington.

CLOOS BOX. Adjoining the exhibit of the Diamond Electric Company was the Cloos high potential junction box for alternating and direct current. The main feature is that it allows the testing out without cutting any joints or cables. It is extremely simple in construction. The device is meeting with favor from many concerns interested in underground construction. H. M. Underwood & Company, Chicago, Ill., are the general agents for this junction box.

L. A. CHASE & COMPANY, 161 Fort Hill Square, Boston, showed on the ground floor a full line of their new junction boxes and couplings, which attracted considerable attention due to the novel method of connecting conduits. They exhibited also the well known "Elden" alternating circuit breaker, which is now being extensively used by the largest companies throughout the country. They reported a number of good sales made at the convention. The exhibit was in charge of the general manager, Sears B. Condit, Jr.

PARTRICK & CARTER COMPANY, Philadelphia, Pa., exhibited on the ground floor a large line of push buttons, bells, annunciators and other electrical specialties, all of which were of interest to central station men, upon whom the diversity of the demand becomes daily wider and more surprising.

STANDARD UNDERGROUND CABLE COMPANY, of Pittsburg, Pa., had an extensive and complete exhibit of their superior line of cables in Parlor G on the first floor of the International Hotel. Their line comprised notably lead-covered cables for underground installation for electric lighting, their celebrated "Tip Top" brand and "Sterling Brand" rubber covered wire, etc. The exhibit was well arranged and in charge of Geo. L. Wiley and Mr. Thomas Hughes.

HOPE ELECTRIC APPLIANCE COMPANY, Providence, R. I., had an excellent exhibit of their latest designs of switches for direct and alternating current; also lamp hanger boards, mast arms, tree insulators and pole steps. They distributed catalogues and circulars of their specialties, and reported also having made a number of sales on the premises. The exhibit was in charge of Messrs. Robt. Fessenden and John I. Drake.

C. C. GARTLAND, 370 Maryland street, Buffalo, displayed his recent invention, a regulator for arc dynamos, the object of which is to regulate the current so that at 1-10 ampere increase or decrease the regulator will come into action and bring the current to normal strength again. The regulator created quite an impression on all visitors for its high value and simplicity. The inventor himself, Mr. C. C. Gartland, had charge of the exhibit and will be pleased to send descriptive circulars to all inquirers regarding the device.

H. B. CAMP COMPANY, Aultman, Ohio, displayed sections of their underground and interior conduits of vitrified clay and metal covered clay; also junction boxes. A neat catalogue was also distributed by their Mr. A. L. Daniels, who had charge of the exhibit.

WELLS, FARGO & COMPANY'S EXPRESS, through their agent at the hotel, Mr. W. C. Clark, distributed a highly interesting souvenir in the shape of a neat box containing pure carborundum crystals, composed of coke, sand, salt and sawdust as taken direct from the electric furnace.

BELKNAP MOTOR COMPANY, Portland, Me., had an exhibit which attracted considerable attention from many visitors at the exposition. Their ingenious device, "The Chapman" direct and alternating current voltage regulator was shown in active operation in conjunction with their small alternating current generator and exciter. A number of instruments were sold on the premises, which certainly speaks well for the device. This was also partly due to the curves displayed of actual results recorded on a chart taken from a self-recording voltmeter in a station having the regulators in use. The exhibit was in charge of the Brewster Engineering Company, of Thames street, New York, selling agents. The operation of the instruments was shown by Mr. W. H. Chapman, of Portland, Me.

H. W. JOHNS MANUFACTURING COMPANY, New York, showed a very interesting exhibit of some of their electrical specialties, among which were a new arc lamp hanger and the "Toggle clamp" insulator. Their electrotherm heating pad and H. W. J. street car heaters were shown in operation on the hotel circuits. The simplicity of operating and the method of regulating the temperature by a simple switch interested a large number of persons. Samples and descriptive circulars were freely distributed. The exhibit was in charge of Mr. W. F. D. Crane.

THE BRYANT ELECTRIC COMPANY was well represented at the convention by Mr. L. W. Eaton, Mr. W. C. Bryant, Mr. J. B. Hubbell, Mr. E. M. Scribner, of the Eastern office, and Mr. E. R. Grier, of the Chicago office.

K. McLENNAN & COMPANY, of Chicago, manufacturers of the celebrated Gale's commutator compound, displayed on the ground floor of the hotel a full line of their compound samples, which were eagerly sought for by the delegates. The exhibit was in charge of Mr. J. Isaacs, who reported having also made satisfactory sales of the Gale's commutator compound. Souvenir leather memorandum books, with the firm's advertisement, were widely distributed.

ELECTRIC ARC LIGHT COMPANY, of New York, manufacturers of the Pioneer enclosed arc lamp, exhibited a number of their 150 hour arc lamps of different designs adapted for both indoor and outdoor purposes. The high efficiency, steadiness and pure white light this lamp produced attracted unusual attention and drew a large number of visitors to their headquarters, situated on the main floor of the hotel.

They reported also having booked a number of nice orders. The exhibit was in charge of their genial general manager, Mr. Harry Astruck. Many visitors were also entertained at the exhibit by the inventor of the Pioneer enclosed arc lamp, Mr. L. B. Marks. Their souvenir, a sterling silver match box, was unquestionably one of the handsomest things of its kind ever given away at an electric convention, the supply very shortly not equaling the demand. Literature in regard to the enclosed arc lighting art was also freely distributed.

HUGO REISINGER has done splendid work in educating the electrical public up to the use of better carbons and he received plenty of evidence at the convention that his efforts had been appreciated. The "Electra" carbons have become widely popular through his persistent and intelligent work.

MR. W. D. PACKARD, of the New York and Ohio Company, Warren, Ohio, was there to speak for the celebrated incandescent lamps bearing his name.

PETTINGELL-ANDREWS COMPANY, of Boston, were represented by their Mr. C. B. Price.

BRUSH ELECTRIC COMPANY had Mr. W. S. Rogers on from Cleveland, where "the Colonel" still hangs on gallantly.

PHOENIX GLASS COMPANY, New York, had again entrusted their cause to Mr. E. H. Peck, and in the hands of that young veteran of conventions it seemed quite safe.

CENTRAL ELECTRIC COMPANY, so long and widely known among central stations, could not have sent a better representative than Mr. George A. McKinlock, who made no exhibit but found himself extremely busy meeting central station and other friends. He reports a very large trade and a hopeful outlook.

MR. J. T. McROY, of Chicago, came on from New York to speak a piece or two in favor of his conduit, which has lately been contracted for by several large new plants, and is rapidly becoming very well known.

MR. J. P. McQUAIDE, the buoyant, blithe and debonnaire, graced the occasion as usual in behalf of the National Conduit and Cable Company. His company is busy up to the hilt, and he proposed to keep the blade fleshed.

PARANITE INSULATED WIRE COMPANY, Jonesboro, Ind., were in line with Mr. R. E. Lucas, to present armfulls of samples for them.

MR. F. M. LAUGHLIN came to speak for the Solar Carbon and Manufacturing Company.

ELECTRIC APPLIANCE COMPANY, of Chicago, who have built up so large a supply trade among stations, distributed their neat little house paper and sent Mr. W. W. Low, without whom no such gathering is now complete.

ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, were represented direct from headquarters by Mr. Herbert Lloyd himself. Quite a change has come over the central station companies to-day, and their demand for batteries, once nil, is now simply enormous. Mr. Lloyd did not have a single spare moment.

PERKINS ELECTRIC MANUFACTURING COMPANY were present in the person of Mr. C. I. Hills, who did not have to add much to his circle of acquaintances, large as the convention was.

MR. E. O. JOHNSON was the embassy from the Boston Electric Company, the Boston supply house.

MR. R. S. HALE, of Boston, was present as the American agent of the Wright meter, the discussion of which was so marked a feature of the convention proceedings.

HEINE SAFETY BOILER COMPANY, knowing that water is sometimes turned into steam for running electrical plants, wisely sent a persuasive talker in the person of Mr. C. D. Humphrey, who hasn't much use for turbines while he can recommend such a good boiler.

THE ERIE CANAL was represented by Mr. John A. Seely.

CHARLES A. SCHIEREN & CO.'S leather belting found an active advocate in Mr. A. N. Harvey.

OKONITE COMPANY were represented by Capt. W. L. Candee and G. S. Manson. They made no special exhibit, but gave away a clever little souvenir in the shape of a key pencil, the handle of which formed in the shape of the famous Okonite trade-mark. But these gentlemen needed no key to open their way to the hearts of the delegates.

AMERICAN ELECTRIC COMPANY, of Detroit, was represented by W. J. Hastings.

NEW YORK INSULATED WIRE COMPANY had present Messrs. Hoover and Woolf, both of whom had a host of friends to renew touch with and give quotations to.

THE STERLING COMPANY, of Pittsburg, were represented by Mr. W. Elliott.

CORNMAN COMPANY, of Cleveland, Ohio, were represented by Mr. R. C. Foster.

INTERIOR CONDUIT AND INSULATION COMPANY were quietly but none the less ably represented by Mr. D. C. Durland, of the engineering staff, who reported that the factory is running with fullest activity in all its lines of conduit, fan motors, power motors, generators, switch specialties, etc. Mr. Durland has plans in hand for several new installations.

MR. A. L. DANIELS, on behalf of the H. B. Camp Company, of Aultman, Ohio, not only made a neat exhibit of their terra cotta conduits, but gave away pocket match safes that were in great demand. He accompanied several delegates to the great power house to show them the Camp conduit there.

WASHINGTON CARBON COMPANY was vouched for by Messrs. L. M. Baine and J. S. Creder.

PUTNAM ELECTRIC COMPANY, of Boston, had their Mr. M. H. Baier on the ground.

AKERMAN ELECTRIC WORKS, of New York, sent Mr. J. R. Belote as their official mouthpiece.

CUTTER ELECTRIC COMPANY, of Philadelphia, could have desired no better spokesman than its chief, Mr. H. B. Cutter, whose opinions and influence carry weight with all who have the pleasure to know him.

ARMORITE CONDUIT interests were very ably looked after by Mr. J. F. Cummings, who had a practical illustration of their work to show in the high tension conduit that has been working successfully for two years on the main street of Niagara Falls. It was visited and admired by many delegates.

MR. R. B. COREY, in behalf of the Simplex wires and Columbia incandescent lamps, and General Incandescent arcs, demanded and received a most respectful consideration.

HABIRSHAW WIRES AND CABLES were very much to the fore, having present Dr. W. M. Habirshaw, J. W. Godfrey and Frank Harrington. The pretty Habirshaw celluloid badges flying the Stars and Stripes were seen by the thousand all over the town, and the greatest desire to get them possessed not only the delegates, but all the pretty girls both sides of the river. The Habirshaw cables and bus-bars at the big power house were the subject of the greatest interest, and elicited many high encomiums.

FORT WAYNE ELECTRIC COMPANY were represented by Messrs. C. S. Knight, J. J. Wood and J. Adott.

MR. C. T. BURNS was in his own person an adequate representative of the Burns supply interests of Rochester, N. Y.

FARADAY CARBON COMPANY were represented by Mr. A. E. Carrier.

BEACON LAMP COMPANY were represented by E. H. Allen.

PHILLIPS INSULATED WIRE COMPANY were represented by Mr. H. C. Adams, secretary, who had some samples of their product.

BAKER & CO., platinum merchants, were represented by Mr. C. O. Baker, Jr., of the firm.

WYKOFF CREOSOTED WOOD CONDUIT COMPANY were represented by H. L. Allen.

NATIONAL TUBE WORKS, of McKeesport, Pa., were represented by their general sales agent, Mr. F. R. Upton.

MR. McLEOD, manufacturer of desk lights, spark arresters, etc., did not find much spare time at the convention, there were so many people who wanted to see him about his goods. Mr. McLeod represented McLeod, Ward & Co., New York.

THE CANADIAN GENERAL ELECTRIC COMPANY were represented by Messrs. Frederic Nicholls and F. C. Armstrong.

MR. KIELY, of Kiely & Mueller, New York, was present in the interests of their steam specialties, and gave an excellent exhibition of their well known devices for greater economy and safety in the use of steam and water.

MR. S. M. HAMILL, general manager of the Brush Company, found many friends among the delegates and received numerous compliments on the new Brush multiple circuit arc machines. We may soon expect to hear of further developments in the Brush machine.

ELMER P. MORRIS, of New York, displayed a large number of the specialties for which he is the agent, in Rooms E and F, Cataract House. His popularity is always in evidence and was shown by the large number of friends and customers visiting his rooms. Among his specialties we noted the Keystone volt-ammeter, Nowotny long burning arc lamp, Garton-Daniels lightning arrester, Electric Railway Equipment Company's iron poles and brackets, etc.

GALE'S COMMUTATOR compound was used for three consecutive days on the generators in the Westinghouse Company's exhibit at the convention. Sample sticks were in great demand among the delegates and visitors.

AMONG THE VISITORS we noticed Mr. W. H. Lawrence, president of the National Carbon Company, Cleveland, Ohio.

THE ROCKWOOD MANUFACTURING COMPANY, of Indianapolis, Ind., exhibited on the ground floor of the International, a small dynamometer which illustrated in an admirable manner the greatly superior adhesive power of that company's paper pulleys, as compared with the ordinary iron pulley. A section of one of their pulleys, which had been run for many months, showed practically no wear at all. The dynamometer demonstration spoke so eloquently that Mr. G. O. Rockwood, in charge of the exhibit, had very little left to say. We understand that he takes home with him a good list of orders as a result of his visit.

WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., exhibited a self-starting, single-phase, alternating current motor on the main floor of the International. Their alternating current switchboard instruments were well displayed at Parlor C and D, at the Cataract House; also their ceiling fans and a multipolar direct-current motor. Both displays attracted a large number of visitors, and, we are informed, quite some business resulted from their exhibit. We noted the presence at the exhibit of Mr. Herbert A. Wagner, Mr. Fred Schwetman, Mr. John Mustard and Mr. H. H. Mustard.

INTERNATIONAL ARC LAMP COMPANY, Houston and Mercer streets, New York, distributed one of the handsomest catalogues at the convention. Fine half tones illustrate their lamps, and the many uses they can be put to, both for interior and for outside illumination. The catalogue is worth while writing for. This method of lighting shows a most decided advance. The genial Mr. McIntire, the inventor of this lamp, represented the company at the convention.

DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., were represented by Mr. B. C. Kenyon and Mr. Edwin H. Bennett, Jr., who both were kept busy receiving their many friends. The Diehl Company's electric fan catalogue was also distributed at the convention, and showed excellent cuts, etc., of their column, electrolier ceiling fans, and others in different styles and designs.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., exhibited on the main floor their specialties, among which we noted their 500 ampere circuit breaker and switch, also a line of panel boards and branch boxes. They distributed circulars of their specialties. The exhibit was in charge of Mr. W. F. Bossert.

ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, O., showed series open and enclosed arc lamps both for street and interior illumination; open, alternating and enclosed constant potential arc lamps, also. Excepting ship projectors or search lights, this firm manufactures every form of arc lamps. The exhibit was in charge of Mr. Thos. E. Adams.

AMERICAN ELECTRIC HEATING CORPORATION, Boston, exhibited their many heating devices for varied purposes and distributed interesting circulars on main floor of hotel. It was perhaps due to the wonderfully cold weather that so many delegates evinced a yearning interest in heating devices tapped on light circuits. There is nothing to equal a little practical demonstration of the ease and feasibility of new apparatus of this character. Mr. J. I. Ayer attended for the Corporation.

WESTERN ELECTRIC COMPANY, Chicago and New York, displayed their latest model fans, etc., and distributed sample cards of their W. E. weather-proof wire. Many other pamphlets and circulars relative to electric light and power apparatus were given out by the company.

MR. F. S. TERRY was present to advocate with wonted directness and perspicacity the interests of the Sunbeam lamp.

J. P. WILLIAMS, of Cortlandt street, New York, general agent for the Paragon fan, exhibited on the ground floor of the hotel a large number of his latest types of fans artistically arranged in the form of a pyramid consisting of 50 motors all styles, sizes, and colors; also several very handsome ones entirely nickel plated. They were all connected and in operation at the same time. The novel effect produced was immediately proved by the large number of visitors attracted one result of same being that the exhibit in itself was quickly sold for delivery after the convention. The exhibit was in charge of Mr. J. P. Williams personally. Descriptive catalogues and a unique advertising card were distributed.

AUTOMATIC CIRCUIT BREAKER COMPANY, Newaygo, Mich., exhibited on the ground floor their non-arcing automatic circuit breakers, which interested a large number of visitors at the convention.

D. & W. FUSE COMPANY, Providence, R. I., displayed on the ground floor of the hotel different sizes and kinds of non-arcing fuses of different voltages, in charge of Messrs. Fessenden, Drake and Woodward. The device was very fully described in the last issue of The Engineer by Wm. Woodward under his own signature.

MITCHELL TEMPERED COPPER COMPANY, Corry, Pa., displayed their commutator bars, and bus-bar clamps on ground floor. The exhibit was in charge of Mr. G. Ruhl.

MR. M. R. RODRIGUES, 19 Whipple street, Brooklyn, N. Y., showed a sample line of motors, the only distinctive exhibit of battery motors at the convention. They were located in parlor 9 of the International Hotel in connection with the exhibit of J. P. Williams, Paragon fan motors.

GENERAL ELECTRIC COMPANY. The exhibit of the General Electric Company was small, but dealt with such apparatus as most nearly concerns managers of lighting stations. Briefly the exhibits covered arc lighting, meters, transformers, lightning arresters, and general appliances. The principal exhibit was a handsome board equipped with a type of every metering and measuring device manufactured by the company. On the board were mounted recording wattmeters of every kind, the principal being a large capacity meter for measuring total station output of 2,500 amperes and over. The meter specially built for the three-wire service of the Edison Electric Illuminating Companies, was shown beside the power meter for motor service on 500-volt circuits, and the new street car meters designed for attachment to street cars, to measure the consumption of current by the car, and to act as a check on the motorman. Considerable attention was attracted by the new Prepayment meter presently to be placed upon the market. In combination with the meter is a coin-receiving device by means of which a consumer is enabled to pay for his light beforehand, know how much he has paid, and receive only what he has paid for. The operation of this instrument was very carefully explained to the delegates by Mr. Caryl D. Haskins. A Thomson astatic ammeter and an astatic voltmeter were also exhibited, the voltmeter being placed on the circuit of the Gorge railway. It was absolutely deadbeat, the needle being held to its indication without a tremor. The instrument exhibit was completed by a full line of the Thomson inclined coil instruments for both switchboard and portable use. The arc lighting department was represented by samples of the single solenoid lamp, the long burning lamp for 220-volt circuits, the focusing lamp for series arc circuits, the enclosed long burning lamp for 110-volt circuits, and that for alternating current circuits. Several lamps were hung under the hotel arcade, and every opportunity was afforded of examining them in operation. In order to enable delegates the better to comprehend the structure of the lamps, all the different parts were shown unmounted. Samples of the direct current lightning arresters for circuits up to 850 volts, formed part of the exhibit, as well as the Wirt short gap lightning arresters, a description of which recently appeared in these columns. The type H transformer, the most recent type developed by the General Electric Company, also occupied a prominent position in the room. The method of building up this transformer was shown by parts in different stages of construction, and its performance by a series of charts giving the efficiency, core loss and regulation curves. A testing transformer for measuring insulation was also shown and explained. It is offered as a substitute for the old methods, and is designed for measuring such insulation as is necessary with the higher voltage currents of to-day. An X-ray set completed the exhibit of the General Electric Company. This was shown during the afternoons and evenings, and while in operation attracted large crowds to the rooms. On Tuesday all the foreign delegates to the Postal Congress, under the guidance of Gen. Batchelor, witnessed a special exhibition given for their benefit by Mr. F. M. Kimball and Mr. Haskins. The company distributed a tasteful souvenir book, illustrative of Niagara Falls and the work which it has done in connection with the utilization of their power. It also presented the delegates with a "planigraph" or wire calculator. This was highly appreciated. For the ladies the company prepared a handsome little silver mounted souvenir. The parlors of the company were decorated with framed diplomas, and with some excellent enlarged photographs of its important installations and apparatus. Its representation included the following gentlemen: Prof. Elihu Thomson, Schenectady, N. Y., S. Dana Greene, W. L. R. Emmet, J. R. Lovejoy, H. C. Wirt, J. M. Andrews, J. W. Kirkland, G. DeB. Greene, J. H. L. Hilman, C. P. Steinmetz. Harrison, N. J., M. K. Eyre, A. D'A. Sage. Boston, Mass., Chas. W. Davis, A. R. Bush, F. M. Kimball, Caryl D. Haskins, S. B.

Paine. Lynn, Mass., W. D. Ryan. New York, C. E. Estabrook, J. McGhie. Philadelphia, H. J. Buddy, D. R. Bullen. Pittsburg, Pa., J. C. Calisch. Cincinnati, O., L. H. Cooper, E. K. Gillette. Syracuse, N. Y., H. H. Crowell. Columbus, O., T. W. Dixon. Baltimore, Md., J. P. Judge. San Francisco, W. M. Ray.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.—The display made by the Westinghouse Electric and Manufacturing Company attracted great attention. Several lines of important apparatus were in view and in actual operation. Among them was a 15 horse-power, 500-volt D. C. motor, driving a 7½ horse-power, 125 volts D. C. generator, and a 10 horse-power, 100 volts A. C. D. C. two-phase generator. From the A. C. circuits were operated a 1 horse-power two-phase induction motor, constant potential arc lamps, induction motors, etc. The circuits were all supplied with the Shallenberger wattmeters, showing their operation to great advantage. A full line of converters were exhibited from the smallest size up to a 25 k. w. converter in oil. The new type of panel switchboards was on exhibition for both A. C. and D. C. generators. A full line of lightning arresters was shown both for arc and incandescent high potential circuits.

The exhibitions of the Westinghouse Electrical Manufacturing Company and the Sawyer-Man Electric Company were situated in the south end corner upon the veranda of the International Hotel, where a large parlor and a private office had been engaged. The parlor was very tastefully decorated, and in front of the windows, as well as in the interior, numbers of incandescent lamps, three constant potential arc lamps illuminated the exhibits at night. A large amount of literature descriptive of the Westinghouse Company was also on hand for distribution among the delegates and guests. Good-sized photographs of the apparatus which the Westinghouse Company installed at the plant of the Niagara Falls Power Company were suspended from the wall, and attracted a great deal of attention. The exhibits were in charge of Mr. W. K. Dunlap and Mr. M. McLaren, of Pittsburg, Pa. The Westinghouse Company were represented at the convention by the following gentlemen: C. F. Scott, B. G. Lamme, C. A. Bragg, T. B. F. Paine, F. S. Smith, Maurice Coster, Paul T. Brady, T. C. Frenyear, F. N. Waterman, W. K. Archbold, H. P. Davis, Clarence A. Ross, E. H. Heinrichs, R. S. Feicht, Arthur Hartwell, C. S. Skinner, C. F. Medbury.

THE SAWYER-MAN LAMP COMPANY, of Allegheny, Pa., had a very attractive exhibit in connection with the Westinghouse display, consisting of lamps of various candle-power and voltage. The principal feature of this exhibit was the display of 220-volt lamps. The very long filament necessary for a thoroughly satisfactory lamp of this high voltage is rendered perfectly stable by means of the three-point support for the loop, making impossible the short circuiting of the carbon due to vibration or jarring. The lamp was illustrated in the last issue of The Electrical Engineer. Attention was also called to the glass bridge between the leading-in wires which serves as a support for the anchor, from the stem. It is a well known fact that a 220-volt lamp, if made after the standard type, is liable to short circuit across the leading-in wires, this device rendering impossible such short circuiting.

CALIFORNIA ASPHALT COMPANY, whose Alcatraz paints are now being pushed with such vim and success, was represented by Mr. A. B. Clerment.

MR. B. E. GREENE was there gaily paddling his own canoe and some other fellow's whose name he forgot to mention.

THE THRESHER ELECTRIC COMPANY, of Dayton, O., were represented by Mr. H. A. Thresher.

THE EDDY ELECTRIC COMPANY found a devoted and successful pleader in Mr. A. D. Newton, who could instance offhand, at any moment, scores of their successful power and lighting plants in any part of the country. The popularity of the Eddy apparatus is nothing short of phenomenal, and Mr. Newton has seen and contributed to its every advance from the beginning.

MR. B. G. UNDERWOOD was the alert and able correspondent of the Boston "Herald" and the "Transcript," to both of which he sent copious reports of the proceedings, setting a good example to the New York dailies, whose chief aim in life is to write up some new sensation in crime.

BRYAN-MARSH COMPANY and the Imperial lamp were represented by Mr. J. I. Solomon, who had some curves to show consumers that were as interesting as those of Amos Rusie and just as effective.

CROUSE-TREMAINE CARBON COMPANY, Fostoria, O., were represented by principals, well known to the trade and found many users of their product at the convention.

SAFETY INSULATED WIRE COMPANY were represented by Mr. Requa, who could point with pride to the large amount of his product used in connection with work at the Falls.

AMERICAN ELECTRICAL WORKS, Providence, R. I., through Mr. Ackerman, made a distribution of handsome letter weights formed from samples of their copper cable used for the Niagara power transmissions. These mementoes were in brisk demand.

MR. S. M. HAMILL, JR., vice-president and general manager of the Brush Electric Company, was one of the best known of the manufacturers on the ground, and he had the great advantage of being able to point to standard Brush apparatus in use in every direction at or around Niagara. Brush arc lighting machinery was early popular at the Falls and the whole region has for years basked at night in the steady beams of the Brush arc lamps. A great deal of the old apparatus, now running for years, still remains in service, but Mr. Hamill has had the pleasure of selling more, from time to time, as, for example, at Buffalo, where he has sold Mr. Huntley a large number of the 65 lighters and the big new 125-lighters, no fewer than eleven of these being now in use. The new Niagara lighting plant also includes four 100-Brush arc lighters, and Mr. Hamill was able to use these as forcible arguments with managers still hesitating about big arc dynamos.

THE WALKER COMPANY, of Cleveland, Ohio, were represented by Messrs. H. McL. Harding, J. Holt Gates, Abbott, William Gibbs, H. D. Gay. Protoghaphs were shown of large sized machines with details of same, particularly of some of their 1,500 kilowatt generators now in operation in Kansas City. Much interest was manifested in their new alternating machinery, many visitors calling to investigate the subject. It is the intention of the Walker company to immediately bring out a complete line of slow speed induction alternating dynamos. The Walker company's new departure in competing for the arc light business of the country with their new multiple circuit large size arc dynamos was largely commented on by the delegates. The Walker company received many congratulations on the completeness of their line of circulars, giving most complete details of the apparatus manufactured by them.

CUTTER ELECTRIC AND MANUFACTURING COMPANY were represented by Henry B. Cutter and H. B. Kirkland, who had an exhibit of their new starting box and circuit breakers.

THE AMERICAN CIRCULAR LOOM COMPANY were represented by H. B. Kirtland and H. H. Brooks, general managers, who had on exhibit samples of their products and their new flexible armored tube. Mr. K. reports business very good.

JEWELL BELTING COMPANY was represented by Mr. C. L. Tolles, who firmly believes that belting men will long find it worth while to attend electrical conventions. It is true a few large plants get along without belts, but the vast majority, he says, still need them and use them.

HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., were represented by Mr. A. L. Pease, who found no trouble in securing a favorable audience at any moment for his monologues on the Hart switche specialties.

STANDARD THERMOMETER & ELECTRIC COMPANY, Peabody, Mass., makers of the well known Upton arc lamps, were represented by Mr. W. L. Livingston.

STANDARD PAINT COMPANY and all its famous P. & B. specialties were in the watchful care of Mr. H. W. Benedict.

J. A. ROEBLING SONS CO. were represented by Mr. W. J. Barrett.

MR. H. H. BROOKS did not indulge in circumlocution in talking about the product of the American Circular Loom Company, of Boston. He had a long list of places in which it has been installed.

PASS & SEYMOUR, the well-known makers of porcelain insulators, were represented by both the titular members of the firm, who found plenty of users of their insulators present.

J. G. WHITE COMPANY were represented by Mr. White himself, who read one of the best papers at the meeting.

AM. DIST. STEAM COMPANY, of Lockport, N. Y., were represented by Mr. Babcock, whose advocacy of the Holly system for using exhaust steam has converted more than one station to this method of enforcing economy and making larger profits.

MORE NIAGARA POWER WORK.

The Niagara Falls Power Company have awarded the contracts for the extension of the power house and wheel pit. The New Jersey Steel and Iron Company will furnish and erect the structural steel; R. D. Young, of Niagara Falls will do the mason work; Brass Brothers, of Niagara Falls, will do the carpenter work; the Westinghouse Electric & Manufacturing Company will build the new 5,000 horse-power generators, and the I. P. Morris Company, of Philadelphia, will build the turbines. The work is all expected to be completed by fall, so that the new installation may be then operated.

SOCIETY & CLUB NOTES

SEVENTH ANNUAL MEETING OF THE CANADIAN ELECTRICAL ASSOCIATION.

THE seventh annual convention of the association was held on the 2d, 3d and 4th of June in the Convention hall of the Dufferin Café, Niagara Falls, Ont., and proved to be one of the most largely attended and interesting in the history of the association, there being a noticeable increase in the number of central station men present.

A large number of new members were enrolled.

The following is a list of those present: Barrie, F. Peplar; Brockville, Henry Comstock; Buffalo, C. H. Philbrook, H. E. Adams; Chatham, James Lamont; Carleton Place, G. Brown; Fort Wayne, Ind., Thos. Duncan; Halifax, N. S., E. F. Freeman; Hamilton, Geo. Black, W. F. McLaren, F. W. Martin; Ingersoll, Stephen Noxon, G. E. Gayfer; London, C. B. Hunt, C. E. A. Carr; Lindsay, B. F. Reesor; Montreal, W. H. Browne, John Carroll, Wm. Thompson, J. A. Bayliss; Niagara Falls, G. Phemister, Wilfred Phillips, G. E. Foster; New Glasgow, F. A. Bowman; New York, W. J. Johnston; Ottawa, J. Murphy; Peterboro, H. O. Fisk; Port Hope, V. B. Coleman; Sarnia, G. Shand, W. Williams; St. Catharines, E. E. Cary, G. A. Pewell; St. Thomas, J. Farley; Seaforth, W. H. Bullard; Toronto, K. J. Dunstan, Frederic Nicholls, J. J. Wright, Geo. A. Wilkie, E. K. M. Wedd, Irving H. Smith, C. H. Mortimer; A. A. Christie, A. B. Smith, J. A. Kammerer, W. A. Johnson, A. M. Wickens, W. J. Clarke, E. D. McCormick, W. H. Bourne, Albert Esling, T. F. Dryden, James Milne, F. H. Leonard, Jr., J. W. Campbell, Jos. Wright, E. B. Biggar, John C. Gardner, Ross McKenzie; Guelph, J. Yule; Sault Ste Marie, J. A. Taylor; Walkerville, J. W. Purcell; Welland, C. G. Page; Toronto, G. Angus, official reporter.

The President, Mr. John Yule, of Guelph, opened the convention by delivering a very interesting address; he stated that the agitation in favor of municipal ownership was growing in favor and some scheme would have to be devised to protect the electric lighting business; it should be shown to the Government that it was for them to provide for the compulsory transfer and purchase of properties in cases where the local authorities assumed control of the lighting service, and thus prevent invested money being wasted. He referred in fitting words to the untimely death of the second vice-president, Mr. E. Carl Breithaupt, of Berlin, who had been killed by an explosion.

The minutes of the last convention were read by the secretary-treasurer, Mr. C. H. Mortimer, and adopted. The secretary-treasurer's report showed an increase during the year of 42 active and 2 associate members; 9 active and 5 associate members had resigned, and 6 active members withdrawn, owing to removal. There were 33 active and 14 associate members struck off the roll for non-payment of dues, and death had removed Messrs. Breithaupt and Congdon, the membership now standing at 154 active, and 19 associate members.

MR. C. B. HUNT referred to a recent Order in Council issued in regard to the inspection of meters. He stated that the charge for inspection of meters was now to be made per lamp, instead of per ampere, which meant a considerable increase to those who had a 106 or 110-volt service. He thought some action should be taken in the matter.

MR. JOHN MURPHY read a very interesting paper on "Water Driven Plants," which was well received and upon which there was considerable discussion.

MR. WICKENS then read his paper entitled, "The Steam End of an Electric Plant," upon which many practical points were brought out in the discussion.

At the invitation of the Buffalo and Niagara Falls Electric Railway Company, the convention enjoyed a trip over their road to Buffalo, and there inspected the Buffalo power house, where the members of the association were given an opportunity of seeing what could be done in long distance transmission of electric power.

SECOND DAY.—The convention was resumed at 10 a. m. The following committees were appointed:

On Statistics: Messrs. A. B. Smith, A. M. Wickens, O. Higman. Meter Inspection: Messrs. J. J. Wright, Berkeley Powell, James Milne. Legislation: Messrs. John Yule, B. F. Reesor, J. J. Wright, J. Farley, W. H. Comstock, C. B. Hunt, S. J. Parker and F. Peplar.

MR. J. A. KAMMERER read a paper on "Day Loads for Central Stations and How to Increase Them." Mr. J. J. Wright was dubious about the economy of operating incandescent lighting and power from the same machine.

MR. BROWNE named three things which must be taken into account, namely, capital invested, cost of labor, and supply cost, such as coal and oil, etc. This paper brought out considerable discussion.

MR. WM. THOMPSON presented a paper entitled, "Determination of the Heating Power and Steam-Producing Value of Coals from a Preliminary Examination."

MR. MILNE suggested that Mr. Thompson's method of determination was not altogether to be relied upon as there was a great difference in coal and the only way to overcome the difficulty would be to compel the mining companies to furnish the same grade of coal at all times.

After the adjournment for dinner a visit was paid to the Niagara Falls Park and River Railway power house.

Considerable discussion was evoked over the choice of a place to hold the next convention. Mr. Browne, of Montreal, very vividly pictured the benefits to be derived from a visit to that city, and the association decided to hold the next convention there, the time of holding the same to be left in the hands of the Executive.

In the afternoon the following officers were elected: Mr. John Yule, re-elected president by acclamation; first vice-president, Mr. C. B. Hunt; second vice-president, Mr. J. A. Kammerer; secretary-treasurer, Mr. C. H. Mortimer, re-elected by acclamation.

The five members of the Executive Committee who were re-elected were Messrs. J. J. Wright, F. C. Armstrong, John Carroll, A. B. Smith and O. Higman. The five new members of the Executive Committee who were elected were, Messrs. F. A. Bowman, W. H. Browne, Wm. Thompson, A. A. Dion and W. Phillips.

MR. F. C. ARMSTRONG read his paper entitled, "Why Some Lighting Plants do Not Pay." After the paper had been read, a lengthy and heated discussion followed as to the respective merits of the flat rate and meter systems, each system having its champions. Mr. Browne strongly upheld the meter system. Mr. Armstrong was in favor of the meter system, but the difficulty in connection with small central stations, under the meter system, was to get a return for the outlay.

MR. NOXON spoke in favor of the flat rate system; he said a yearly contract could thus be more easily obtained, and the managers of stations were enabled to estimate their revenue.

MR. PEPLAR said that the trouble with the flat rate system was with regard to the load, as the consumption could not be checked. He stated that they now had a sort of combined plan, that of using the meter system with large consumers and a flat rate with small customers, and giving a reduction to large users. The majority of the members seemed in favor of the meter system.

MR. C. A. CARR, manager of the London Electric Railway, read a very interesting paper on "How Electric Railways Might be Made a Commercial Success."

MR. W. A. JOHNSON read a paper entitled, "Accumulators—Their Application to Central Station Lighting and Power." He stated that the cost and maintenance of storage batteries would not exceed from 3 to 5 per cent.; that the makers gave a guarantee of 10 per cent. at the outside.

MR. ARMSTRONG said that the use of storage batteries was restricted by being confined to direct current work.

MR. BROWNE stated that his method of overcoming that difficulty was by using a direct current machine to charge the battery and then using the current from the battery to operate a motor to drive an alternator.

MR. D. H. KEELEY'S paper entitled, "Economy in Circuits," was then presented.

This closed the business of the convention.

In the evening the annual banquet was held at the Dufferin Café; after the dinner had been served, the following toasts were given: "The Queen," "Our Guests," "Electrical Interests," "The Ladies" and "The Press," with which toast the name of Mr. W. J. Johnston, of "The Electrical World," of New York, was coupled, to which he replied in a few brief remarks.

The banquet was brought to a close by the singing of the national anthem, and was declared by all present to have been a decided success. The committee to whom was due the success of the banquet was composed of Messrs. E. E. Cary, chairman, F. C. Armstrong, W. Phillips, C. B. Hunt and A. B. Smith.

THE THIRD DAY was devoted largely to sightseeing; trips were taken over the Niagara Falls Park and River Railway and on the celebrated Gorge Electric Railway; and a visit of inspection was paid to the hydraulic power house. The Maid of the Mist took the members of the association to the foot of the Cataract, after which visits were made to the power house and works of the Cataract Construction Company and the various electro-chemical works.

Votes of thanks were passed to retiring officers, to authors of papers, to the press and to all those who had tendered courtesies, after which the convention adjourned to meet at Montreal in 1898.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A preliminary programme of the proceedings of the Detroit meeting of the American Association for the Advancement of Science is to be issued by each of the sections before the middle of June. It is expected that the programme for Section B (physics) will include a number of electrical papers of especial interest, as it is becoming more and more customary for electricians to attend this meeting. Brief abstracts of papers to be presented before this section should be forwarded to its secretary, Dr. Frederick Bedell, Ithaca, N. Y., at the earliest possible date.

MUNICIPAL OWNERSHIP LEAGUE.

The American Municipal Ownership League of Brooklyn has been incorporated with the New York Secretary of State. The association is formed to advance and spread the doctrine of the municipal ownership of all railroads, public franchises, gas and electric plants, water works, etc. The directors are: Dayoe de Waltoff, Michael Russell, Bernard Cantor, Ferd W. Buermeyer, Nemesis Manassa, Thomas McCormick and John Kolb, of Brooklyn.

PERSONAL

SAMUEL INSULL.

THE new president of the National Electric Light Association, Mr. Samuel Insull, has the honor of being also the president of the Association of Edison Illuminating Companies. In each case, the office sought the man, and found a worthy recipient. Mr. Insull is the maker of his own career, the author of his own success, and yet is very far from having the air that tradition is wont to ascribe to the "self-made man." He is only 37 years old, and was born in England, where after receiving a good sound education he entered the office of the famous satirical publication "Vanity Fair." There he caught the discerning eye of Mr. E. H. Johnson, then introducing the Edison telephone in England. After a brief experience with early telephone work in England, in 1879, he came to America in 1881, and Mr. Johnson's recommendation brought him into Mr. Edison's personal service. His ability and quickness and his utter devotion to duty soon won him approval at hard working Menlo Park, and he was entrusted in short order with the management of Mr. Edison's affairs, with growing responsibility all through the stirring years that saw the upbuilding of the Edison Lamp Works, the Machine Works and Bergman's supply factory. As the result of the consolidation of these huge interests in the Edison General Electric Company, came the necessity of a new start, and Mr. Insull then created as by the waving of a wand the vast establishment of the Schenectady shops, familiar to readers of The Electrical Engineer, which described them in detail in 1891. The next big consolidation, that of Edison and Thomson-Houston interests, again saw Mr. Insull at the front of affairs, as one of the vice-presidents of the new General Electric Company; but the position was irksome and he resigned it, in order to accept the presidency of the Chicago Edison Company. Here again his executive ability displayed itself, and his mettle has been tried more than once as an organizer and financier since the panic of 1893, with the only result that the Chicago Edison Company is to-day one of the solidest and best handled corporations in the West. Of late, Mr. Insull has interested himself again in manufacturing, for which he has a strong predilection; and he is to-day not only connected with the General Incandescent Arc Light Company, of New York, but the new Fort Wayne Lamp Company, not to mention others.

Mr. Insull is a man of English stability and poise, but swift of speech and action, and alert far beyond even American ideals. He is unmarried, rises with the lark and is a total abstainer, but his cigar bill probably evens things up. He is loyalty itself to his friends and convictions, but his native reserve stands in the way of his making a very large circle of intimates. Mr. Insull was, while in New York, president of the Electric Club, to which he contributed with freehanded generosity. He is also a member of the American Institute of Electrical Engineers, taking the deepest interest in all technical matters. He is a member of several Chicago and New York clubs, and finds great pleasure in the social side of club life. Few American electrical men are so well known on both sides of the Atlantic.

MR SAMUEL INSULL.

MR. A. M. YOUNG.

THE new first vice-president of the National Electric Light Association is a typical American man of affairs. He is an old telegrapher, and may be said to have been interested in electricity all his life. He not only has large local lighting interests at Waterbury, but is prominent in at least a dozen lighting and railway enterprises in various parts of the Union. He is also the president of the New England Engineering Company, which has done a great deal of electrical construction work. Last year Mr. Young was a member of the Executive Committee of the N. E. L. A., and his advancement in the affairs of the association is a well-deserved honor.

MR. A. M. YOUNG.

MR. C. D. WARNER, recently with the Iron Clad Rheostat Company, of Westfield, N. J., has entered the service of Mr. D. McF. Moore, at the Moore Laboratory, Newark, N. J. Mr. Warner is a graduate of the University of Nebraska, Electrical Engineering Department.

MARSHALL, TEXAS.—Mr. E. L. Wells, manager and purchasing agent of the Arkansas and Texas Consolidated Ice and Coal Company, writes us: "We like The Electrical Engineer—'tis a mighty good paper."

MR. T. E. FLEMING, the admirable secretary of the Telegraphers' Mutual Benefit Association, has resigned in order to become assistant to Secretary Bruch, of the Postal Telegraph-Cable Company. Mr. Fleming finds an excellent successor in Mr. M. J. O'Leary, and has received a set of highly laudatory resolutions from the T. M. B. A.

OBITUARY

S. G. HESS.

We regret to note the death of Mr. Seymour Griswold Hess, son of Subway Commissioner Hess, of New York City. He was only 26 years old and succumbed to pleuro-pneumonia, which first attacked him while acting. After leaving the Columbia Law School he entered the law office of his uncle, Mr. C. A. Hess, but went on the stage and there soon made his mark as a clever light comedian, as well as a composer and musician. He had a great many friends in electrical circles, where his sudden death is deeply lamented.

LEGAL NOTES

MANHATTAN GEN. CONS. CO. vs. JANDUS ELEC. CO.

A petition was filed in the United States Circuit Court, Cleveland, Ohio, on June 12, by the Manhattan General Construction Company against the Jandus Electric Company for violating a contract agreement, and endeavoring to ruin the business of the Eastern company. The plaintiff company also declares that the Jandus Company has endeavored to secure the services of one of its officials for the purpose of having him turn over his knowledge to the Cleveland corporation. A writ of injunction is asked, provisionally enjoining and restraining the Jandus Electric Company from refusing and failing to carry out the provisions of the agreement; to restrain the Jandus Company from selling certain arc lamps, and to enjoin the defendant from publishing statements to customers of the Manhattan Company. On Thursday Judge Hammond, of the United States District Court, sitting at Toledo, will hear the application for a temporary injunction. The Manhattan Company has handled the Jandus enclosed arc, and claims that the Jandus company seeks to cut off the supply and get the business that has been built up.

INDIANA THREE-CENT-FARE LAW VALID.

The Supreme Court of Indiana has decided that the three-cent car fare law is constitutional. It relates to Indianapolis only. In the Federal court recently the same law, passed by the last Legislature, was declared unconstitutional, and injunctions were granted by Judge Showalter against its enforcement. The State will insist on three-cent fares unless the street car company secures injunction pending appeal to Federal Supreme Court. In the Hammond cases recently, where the State Supreme and the Federal court differed, the Supreme Court of the United States held that it was not its policy to enter into conflict with the Supreme Courts of States. On this Attorney General Ketcham thinks the three-cent fare law will stand, but that five-cent fares will be collected until Judge Showalter modifies his order, which he doubtless will do.

RESTRAINED FROM SELLING WALKER PLANS.

Judge Taft, of the United States Circuit Court, at Cleveland, on June 7, granted a temporary injunction, on the application of the Walker Manufacturing Company, to restrain W. H. Bone and R. T. Bone, respectively acting secretary and manager and assistant secretary of the company, from selling or giving to a rival company plans and tracings of inventions owned by the company. The Walker Company manufactures machinery for electric railways and it asserts in its petition that plans which cost $50,000 have been taken by the defendants with the intention of giving them to a rival.

REPORTS OF COMPANIES

WESTERN UNION TELEGRAPH CO.'S QUARTERLY SHOWING.

The Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent., payable July 15. The earnings for the quarter ended June 30, partly estimated, compare as follows with the actual figures of the corresponding period last year:

Net revenues	$1,550,000	Inc.	$149,800
Interest and S. F.	203,875	Inc.	371
Balance	$1,346,125	Inc	$149,429
Dividend	1,216,975	Inc.	25,016
Surplus	$129,150	Inc.	$124,413
Previous surplus	7,559,748	Dec.	79,200
Total surplus	$7,688,898	Inc.	$45,204

The June quarter completes the fiscal year of the company, and the results, partially estimated, compare as follows with the figures for the previous year:

Net revenues	$5,772,520	Dec.	$125,466
Interest and S. F.	934,455	Inc.	498
Balance	$4,838,065	Dec.	$125,958
Dividends	4,792,862	Inc.	25,057
Surplus	$845,203	Dec.	$151,615
Previous surplus	7,643,694	Inc.	196,218
Total surplus	$7,688,897	Inc.	$45,203

The company is to list $2,000,000 of treasury stock against improvements, representing about double that amount. The capital is now $100,000,000, now nearly all issued.

THE STOCK MARKET

"THERE'S A GOOD TIME COMING."

THE sentiment that is expressed in the headline has been heard frequently of late, with not less numerous disappointments attending, but every day brings nearer, with definite surety, normal seasons of activity and prosperity, and hopefulness is now more apparent and genuine than at any other period during the last five years. There may be further delays and drawbacks, but the rising tide will presently swamp all barriers.

Last week witnessed a genuine revival in the stock market based on improved railway returns, and the sale of bonds showed a noteworthy increase. Stock prices were also much better. General Electric rose from 31 to 33⅛, and even touched 34⅛. Western Union crossed the 80 line again and went to 81¾ on sales of 61,720 shares. American Bell was active around 230 to 231. Local lighting and railway securities also gave proof of a better inquiry and sale.

COPPER is quoted, Lake at 11½, and Western at 11¼.

STEEL RAILS, heavy section, are quoted at $19 rising, and light rail, $24 to $28.50, according to section.

MISSOURI INDEPENDENT TELEPHONE COMPANIES MEET.

A special dispatch from Sedalia, Mo., of June 7, says: Representatives of the Independent Telephone Line of Missouri held a secret conference this afternoon in the parlors of Kaiser Hotel. A. W. McArthur, of Kansas City, who furnished the information for the press, stated that the delegates present reperesented all Missouri lines not controlled by the Bell Company, and the conference was in regard to telephone business in general. There have been reports that certain lines now operated independently are to fall into the hands of the Bell Telephone Company, and to prevent such action was one of the objects of the meeting. H. E. Ralston, Maryville; A. W. McArthur, Kansas City, and E. C. Baker, Cameron, were elected delegates to the National Convention of Independent Telephone Lines to be held at Detroit, Mich., June 22, after which the conference adjourned.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 8, 1897.

Alarms and Signals:—

HOTEL ELECTRIC CALL APPARATUS. A. B. Chance, Centralia, Mo., 584,173. Filed November 23, 1896.

Combines call, telephone and fire alarm apparatus.

BURGLAR ALARM SYSTEM. W. T. Arnold, Chicago, Ill., 584,202. Filed December 15, 1896.

A burglar alarm system in which districts located in various places are connected with signal devices at a central office.

NON-INTERFERING SIGNAL BOX. J. T. Stack, Chicago, Ill., 584,297. Filed September 29, 1890.

Details of construction.

Batteries, Secondary:—

SECONDARY OR STORAGE BATTERY. A. S. Krotz, Springfield, Ohio, 583,912. Filed March 27, 1894.

Supporting plates formed of insulating material and having slotted openings with upturned edges, and electrodes formed of active material arranged between the upturned edges and openings, the plates being arranged one above the other with the slotted openings in one plate in line with the electrodes of the adjacent plates.

Conductors, Conduits and Insulators:—

FEED WIRE CONNECTION. S. H. Harrington, New York, and G. E. Somers, Bridgeport, Conn., 583,903. Filed April 8, 1897.

A connector for underground trolleys consisting of a plug secured in the rail and a plurality of flattened wires adapted to engage with a feed wire.

CONDUIT. J. T. McRoy, Chicago, Ill., 583,926. Filed March 22, 1897.

A series of sections laid end to end and each provided with longitudinal ducts and dowel-openings formed in the ends of the intersecting partition-walls of the ducts, of metallic dowel-pins arranged in the openings.

INSULATOR FOR TELEGRAPH OR OTHER ELECTRIC WIRES. C. V. Nesmith and G. F. Arnett, Manchester, Ala., 584,235. Filed March 27, 1897.

Comprises two separate parts intended to receive the wire between them and a set screw for holding the wire in place.

CONNECTION FOR ELECTRICAL CONDUCTORS. B. F. Weldon, Pittsburg, Pa., 584,299. Filed May 5, 1897.

Comprises an inclosing envelope surrounding the wires, and bent transversely.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. J. L. Woodbridge, Brooklyn, N. Y., 583,029. Filed November 13, 1895.

Means for enabling a generator to be used either as a constant potential machine for supplying energy to bus-bars or as a booster in series with a feeder.

Dynamos and Motors:—

ELECTRIC MOTOR. E. S. Pillsbury, St. Louis, Mo., 583,933. Filed November 16, 1895.

Comprises the field magnets, a progressively wound armature, a commutator, a closed winding on the armature, means for short-circuiting the progressive windings of the commutator, and a switch in the motor circuit operated by said means.

BINDING BAND FOR ARMATURES. H. Geisenhoner, Schenectady, N. Y., 583,991. Filed October 31, 1896.

A metal strip with wedges secured to its extremities, clamps provided with inclined surfaces engaging with similar surfaces on the wedges, and means for securing the clamps together.

Electro-Metallurgy:—

ART OF WELDING AND BRAZING. D. W. Payne and E. Diven, Elmira, N. Y., 584,120. Filed October 26, 1896.

Adapted for the treatment of metals of different characteristics.

PROCESS OF MAKING COMMERCIAL LEAD FROM LEAD ORES. P. G. Salom, Philadelphia, Pa., 584,242. Filed May 15, 1893.

The ore is subjected to the action of nascent hydrogen, electrolytically developed, producing thereby a spongy mass, and afterward, while the mass is in a non-oxidized condition, applying a consolidating pressure thereto.

Lamps and Appurtenances:—

SEARCH LIGHT MOUNT. F. T. & G. E. Marschand, Annapolis, Md., 583,916. Filed September 21, 1896.

Consists of a column revoluble about its vertical axis, a stationary base supporting the column, a platform surmounting the column and capable of angular displacement around a horizontal axis.

ELECTRIC LIGHT FOR VEHICLES. A. M. Rodriguez, Brooklyn, N. Y., 583,945. Filed October 7, 1896.

Adapted for bicycles. The current is supplied from a dynamo driven by a wheel.

CARBON HOLDER FOR ARC LAMPS. E. Thomson, Swampscott, Mass., 583,955. Filed Oct. 31, 1896.

Is provided with an eccentrically-pivoted rotary jaw, having a number of faces, a movable jaw, and means for clamping the same in a desired position.

SAFETY LAMP. W. Waegel, Philadelphia, Pa., 583,959. Filed September 5, 1896.

Comprises a hermetically sealed glass casing, containing a non-inflammable gas, around the lamp, and means whereby the current is shut off when the lamp is broken.

ELECTRIC ARC LAMP. G. L. Moyer, Hartford, Conn., 584,184. Filed October 22, 1896.

Feed mechanism for enclosed arc lamps.

ELECTRIC ARC LAMP. G. L. Moyer, Hartford, Conn., 584,186. Filed January 20, 1897.

Of the enclosed arc type.

Measurement:-

SHUNT AMMETER. W. B. Potter, Schenectady, N. Y., 583,934 Filed January 25, 1897.

Consists of a plurality of ammeters connected in shunt to a common resistance.

THREE-PHASE INDUCTION METER. C. P. Steinmetz, Schenectady, N. Y., 583,950. Filed January 30, 1897.

Details of construction.

ELECTRIC METER. J. Harris, Lynn, Mass., 584,900. Filed November 25, 1895.

A speed governor consisting of a rotatable fan connected to a source of power and a movable contact arranged so that at predetermined speeds the fan will press against the movable contact and operate.

MOTOR-METER. Chas. P. Steinmetz, Schenectady, N. Y., 583,951. Filed Jan. 30, 1897.

An inductive device for obtaining a definite phase displacement between a circuit and a branch, consisting of two windings having different number of turns inductively related upon a common core, the windings being included respectively in branches of the circuit.

Miscellaneous:—

ELECTROSTATIC INFLUENCE MACHINE. E. Thomson, Swampscott, Mass., 583,957. Filed January 5, 1897.

Comprises a charging exciter-plate provided with an equalizer and a pair of sector charging collectors connected to the sectors of the charging-plate, and the sectors of the working plates of the machine, the exciter having no connection with the working circuit.

ELECTRIC FURNACE. E. F. Price, Niagara Falls, N. Y., 583,936. Filed September 23, 1896.

Embodies a hearth forming one electrode, and carbon electrodes placed over it, the material being supplied through a hopper.

APPARATUS FOR PRODUCING CURRENTS OF HIGH FREQUENCY. N. Tesla, New York. 583,953. Filed October 19, 1896.

A modification of previous apparatus for converting low tension into high frequency apparatus. The condenser is subdivided and charged in multiple and discharged in series.

PRODUCING STEREOSCOPIC PICTURES BY ROENTGEN RAYS. E. Thomson, Swampscott, Mass., 583,956. Filed January 5, 1897.

Consists in exposing the object to a source of Röntgen rays in one position, and then shifting the relative positions of the source of rays and the object.

SYNCHRONIZING CLOCK. J. H. Gerry, Brooklyn, N. Y., 584,128. Filed March 11, 1896.

Method of synchronizing the second hand.

PROCESS OF AND APPARATUS FOR AGEING ALCOHOLIC LIQUIDS. H. Deininger, Berlin, Germany, 584,050. Filed November 1, 1895.

Consists in first impregnating the liquid with oxygen, and then subjecting it to the action of an alternating current of electricity.

IGNITING DEVICE. B. Jolles, Vienna, Austria-Hungary, 584,056. Filed February 1, 1897.

The valve for admission of gas is opened by an electromagnet.

SYNCHRONIZING MECHANISM. H. F. Parshall, London, Eng., 584,062. Filed December 31, 1895.

Consists in controlling the speeds of the different generators by means of acting upon their prime movers and actuated by the variations of phase relation between the generators.

THERMOSTAT. H. Van Hoevenbergh, New York, 584,249. Filed January 16, 1895.

Comprises a slender metallic wire extending through a non-conducting casing closely embracing it, the conductor being fixed at one end and co-operating with a detent at the other.

Railways and Appliances:—

RAIL-BOND. S. H. Harrington, New York, and G. E. Somers, Bridgeport, Conn., 583,902. Filed March 19, 1897.

A shoulder near its end and a separate sleeve adapted to slip over the end and to bear against the shoulder, one end of the sleeve being diagonal to its axis.

SERIES PARALLEL CONTROLLER. W. B. Potter and F. E. Case, Schenectady, N. Y., 583,935. Filed October 10, 1896.

Comprises a plurality of stationary contact brushes, moving contacts engaging therewith, and a plurality of blow-out-magnet coils each included in a separate circuit.

PNEUMATIC CONTROLLER. E. D. Priest, Schenectady, N. Y., 583,938. Filed September 18, 1896.

Comprises a plurality of separate pneumatically operated contacts, with a valve for regulating their operation.

PNEUMATICALLY ACTUATED CONTROLLER. E. D. Priest and F. A. Merrick, Schenectady, N. Y., 583,939. Filed September 28, 1896.

Similar to above.

TURN TABLE FOR SURFACE CONTACT ELECTRIC RAILWAYS. E. M. Hewlett, Schenectady, N. Y., 583,997. Filed November 18, 1896.

Employs permanent contacts of opposite polarities, exposed studs upon the turn table, and intermediate contacts operating by the rotation of the exposed studs and the permanent contacts thereby to reverse their polarities.

RAIL-BOND. W. B. Potter, Schenectady, N. Y., 584,013. Filed December 18, 1896.

Comprises roughened plates, a conductor connecting the plates, a plastic compound of good conductivity filling the roughened portion of the plates and means for securing the plates to the rails.

PREPAYMENT MECHANISM FOR ELECTRICAL OR OTHER METERS. Charles O. Bastian and Herbert C. Hodges, London, England, 584,258. Filed August 17, 1896.

Adapted to be operated by an exterior handle on the insertion of the proper coin.

Regulation:—

ELECTRIC REGULATOR. C. C. Gartland, Buffalo, N. Y., 584,155. Filed September 4, 1896.

A device operated by the diaphragm to control a rheostat.

Switches, Cut-Outs, Etc.

ELECTRIC SWITCH. G. Winckler, Schenectady, N. Y., 583,963 Filed June 4, 1896.

Double-throw knife switch.

LIGHTNING ARRESTER. A. Ekstrom, Schenectady, N. Y., 583,987. Filed May 15, 1896.
Comprises a number of spark-gaps in series, of a kind to have their resistance decreased by use, combined with means controlled by such decrease in resistance, for increasing the number of spark gaps in series.
SAFETY PLUG. T. S. McClintock, Pittsburg, Pa., 584,009. Filed August 5, 1896.
Details of construction.
AUTOMATIC ELECTRIC TIME SWITCH. L. H. Watters, Media, Pa., 584,149. Filed April 1, 1896.
Details of construction.
CUT-OUT SWITCH. G. L. Moyer, Hartford, Conn., 584,185. Filed November 18, 1896.
Details of construction.

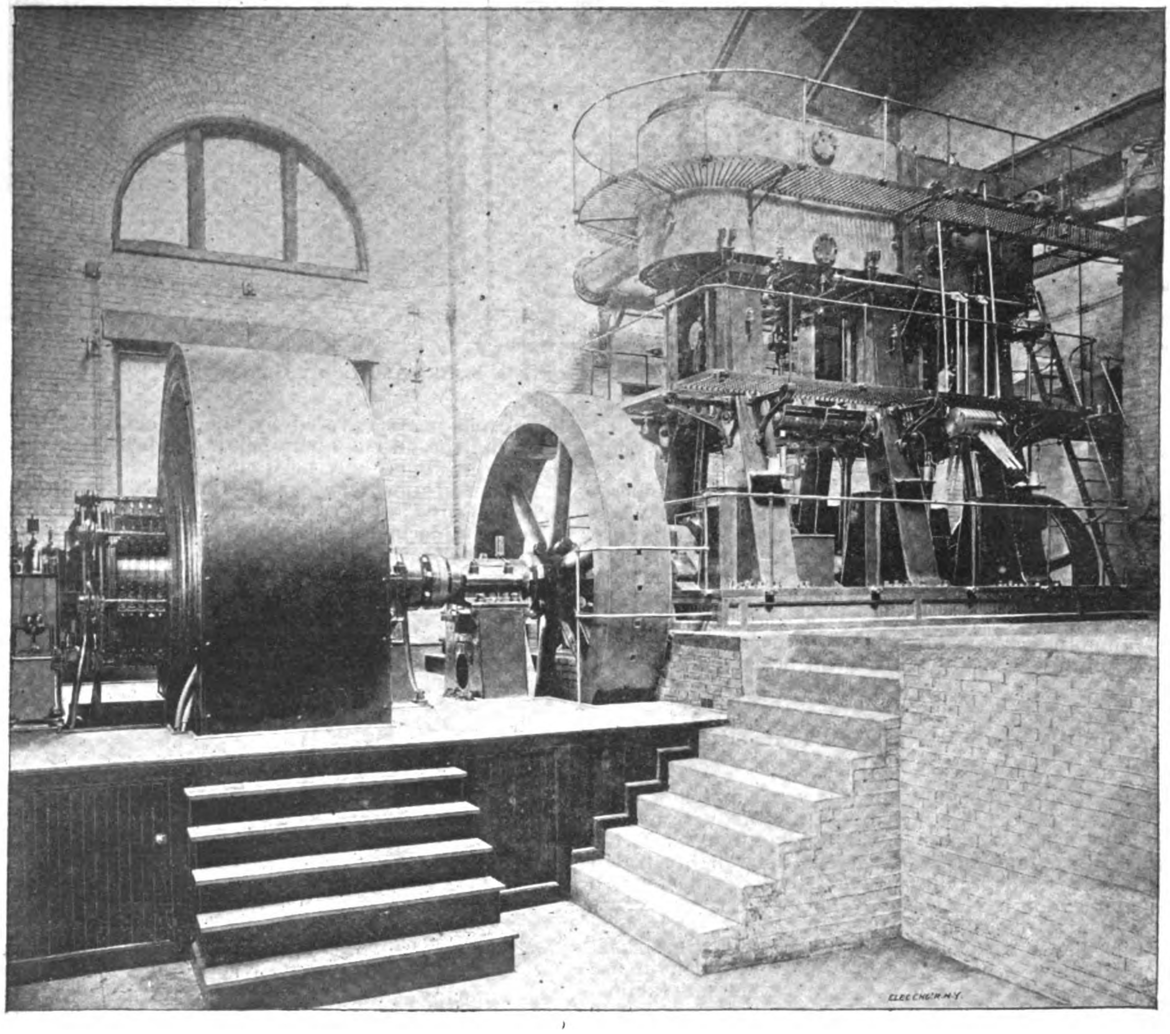
Transformers:

ROTARY CONVERTER. E. W. Rice, Jr., Schenectady, N. Y., 583,944. Filed March 14, 1896.
An armature of the alternating current type, comprising winding and collecting rings, each collecting ring connected to leads equally spaced around the armature winding and connecting equipotential points of each phase to one of the collecting rings.

TRADE NOTES & NOVELTIES

ELWELL-PARKER 1200 H. P. RAILWAY GENERATOR.

THE Elwell-Parker Electric Company, of Cleveland, O., whose motors were illustrated in our last issue, also build generators of large power. The accompanying engraving illustrates a generator built for and installed by the Cleveland City Railway Company. It has been in continuous service for about 22 hours a day for 17 months, during which time it has cost nothing for repairs. There is no sparking on any load within the capacity of engine up to 1,500 horse-power, and the position of the brushes on the commutator has remained fixed and unchanged ever since the machine started, 17 months ago. The bearings are oiled by little force pumps (mounted on the bearing) insuring a sure and continuous oiling of the bearings and a constant and continuous straining of the oil which is thus always clean and thus greatly economized. The commercial efficiency is 96 per cent. between coupling and terminals. The engine is a vertical triple condensing built by the Globe Iron Works Company, of Cleveland. The all-round efficiency and commercial economy of this generating plant is claimed to be unsurpassed in railway work.



Elwell-Parker 1,200 H. P. Railway Generator, Cleveland City Railway Co.

THE GARTLAND REGULATOR FOR CONSTANT CURRENT SERIES ARC MACHINES.

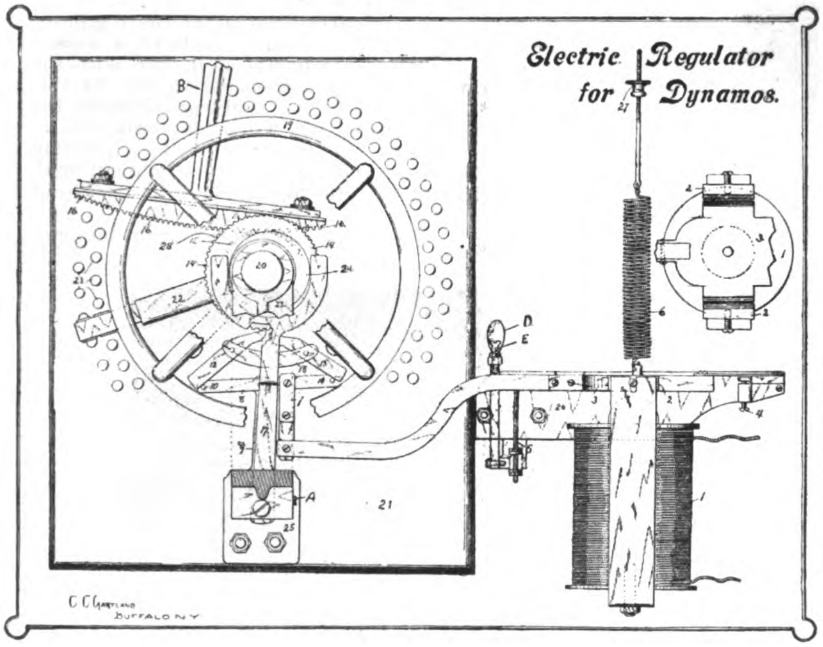
AMONG the exhibits at the N. E. L. A. convention, at Niagara, was the Gartland regulator for series arc machines.

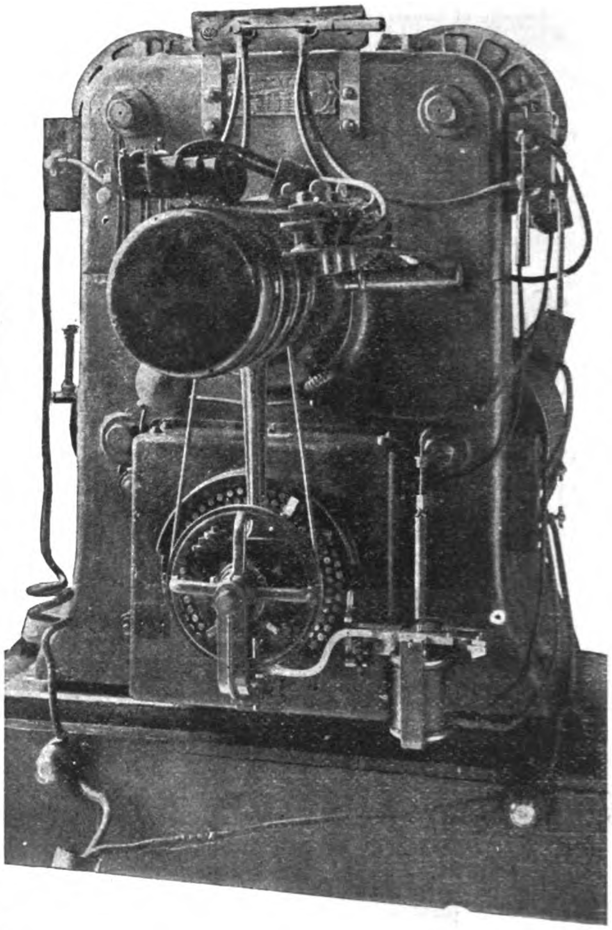
Fig. 1 shows the regulator attached and in working order, while Fig. 2 shows the general arrangement of the regulator in which (1) is the spool which is wound to have a power sufficient to hold the armature (3) balanced in line with the poles (2), acting of course against tension spring (6). In this condition the armature is maintained midway between the stops (5), and the rocking lever (8), which is connected to armature by connecting link (7), is maintained in position which supports the pawls (12 and 13) out of engagement with the ratchet wheels (14 and 14), and the whole is in a state of equilibrium.

If now the current of the dynamo decreases, from increase of load or otherwise, the decreased power of the spool will allow the armature (3) to be lifted by the tension spring (6), and this will rock the lever (8) and allow the pawl (12) to engage the ratchet wheel (14).

The constantly oscillating arm (17) will then cause the pawl to move the ratchet (12) toward the right and slightly move the brush rocker the opposite way and at the same time rotate the gear which meshes with the rack (16), and this will move the rheostat arm (22) to which the gear and ratchets are all three secured by screws.

This regulator may also be applied to constant potential regulation in the same manner, the spool being wound according to the e. m. f. required. It may also be applied to the regulation of alternating current machines, as well as to separately excited machines generally, by connecting the rheostat in series with the field coils of the exciting machine, and in the case of the alternating machine, preferably connecting the spool in the secondary circuit from a transformer in which circuit a second rheostat operated by a spool in the primary circuit of the alternator is also interposed; this same amount of current (and, hence, of strength) with 110 volts potential around it as at 100 volts, thus automatically taking care of the line loss on primary circuit in exact proportion to the loss, at all variations of load. When used to regulate the speed of machinery the arm is connected to any suitable speed governor, and electric current is supplied to the spool from any convenient source.





Figs. 1 and 2.—The Gartland Regulator for Series Arc Light Generators.

It has no sparking contacts to become oxidized and inoperative, no wall controller, no shunt coils or circuits, and when it is once adjusted to the desired current, it will always remain so, making it unnecessary to interfere with it at any time when starting or stopping the generator, being perfectly controlled by the current generated in the machine. The combined movements of rheostat and brushes are operated with such promptness than an increase or decrease of about one-tenth of an ampere in the circuit will bring the regulator into action.

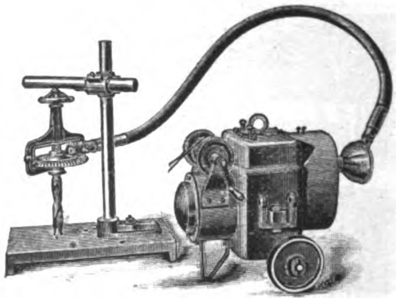
STOW FLEXIBLE SHAFT AND ELECTRIC MOTOR COMBINATION.

The combination of the Stow flexible shaft and new iron-clad electric motor, designed and manufactured by the Stow Manufacturing Company, of Binghamton, N. Y., as adapted to drilling, tapping, reaming, etc., is well illustrated in the accompanying engraving which tells its own story so far as the application is concerned. The motor, however, requires more detailed mention.

The combination of an electric motor with a flexible shaft for the performance of this class of work, has been in use for some years and, in the main, has given good satisfaction. There yet remained, however, some improvements needed to bring this combination to practical perfection as voiced in the demand which has sprung up for a dust and waterproof motor, which this new iron-clad motor has been designed to meet.

The frame of this motor is in the form of a hollow cube, with inwardly projecting poles. In each end of the frame is a circular aperture, over which are bolted the end plates supporting the bearings. One of these is extended into a short cylinder forming a case for the commutator and brush holder. The field coils are protected by metallic cases and can be easily removed. The motors below 2 h. p. are bi-polar and those of 2 h. p. and over have four poles. The best of material is used in construction. The bearings are self-oiling; mica insulation is used, and the rheostats protected by an iron case, and gears covered by simply changing the end plates to bring the oil chambers below the bearings; this motor can be run in almost any position.

Motors of this type can be furnished for direct connection when desired, also for electric street railway track drilling. The portable motors, as shown, are fitted with truck wheels, leg, eye-bolt, side brackets, reel, 20 yards of insulated wire, and



The Stow Flexible Shaft and Motor.

one set of reduction gears. By use of speed regulator and gears, almost any practical speed can be obtained. Either the company or their European agents, Messrs. Selig, Sonnenthal & Co., 85 Queen Victoria street, London, E. C., England, may be addressed for prices or for further information.

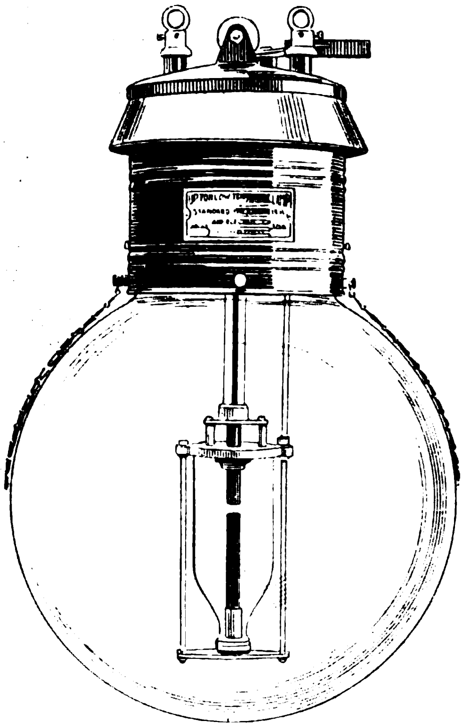
FORT WAYNE LAMP CO.

An important piece of news is the formation of the Fort Wayne Lamp Company, which has just been incorporated with a capital stock of $100,000. The directors in the new company are R. T. McDonald, Samuel Insull and H. J. Miller.

The company's plant and property consist of those bought recently from the Adams-Bagnall Company, of Cleveland, O., which sold out all its incandescent lamp business to Messrs. McDonald and Insull. One of the notable "talking points" of the lamp is the absence of a sealing nipple, and the consequent smooth finish of the bulb. It is understood that the lamp is to be made in the best possible style of the art, and to be very vigorously pushed.

THE UPTON "MIDGET" ENCLOSED ARC SERIES LAMP.

In comparing the efficiency of enclosed arc with open arc lamps for service on street lighting and commercial circuits, the question of their respective candle-powers is naturally an important consideration. While it is true that with an enclosed arc the candle-power is lessened somewhat, actual experience has proved that this loss is more than counter balanced by the gain in steadiness of light, equality of diffusion and absence of shadow in the use of an enclosed arc over an open arc lamp; especially in the high tension series lamp has this fact been developed.



The Midget Enclosed Series Arc Lamp.

The Upton "Midget" enclosed arc series lamp, manufactured by the Standard Thermometer and Electric Company, of Peabody, Mass., embodies in its mechanism all that is best and simple in the recent development of arc lamp construction. It is designed so it can be easily adjusted to take from 65 to 80 volts as may be desired and burn on from 4½ to 7 ampere circuits without readjustment. Each lamp is provided with a switch, and an automatic cut-out which is positive in its action. These lamps are now in use on street lighting and commercial circuits, and the manufacturers claim to have flattering reports of their successful operation. Full information and circulars will be furnished by them on application.

CENTRAL ELECTRIC CO. AND FOREIGN TRADE.

It is quite rare that wholesale houses located at inland points enjoy much foreign trade, but a notable exception can be found in the Central Electric Company, of Chicago, who state that for some time they have had quite a large trade with points in Japan as well as South America, and quite recently they received a very large order from South Africa, which was secured by submitting quotations in competition with other places.

V. J. MAYO, 100 North Clinton street, Chicago, reports that he has received some nice orders for the "Mayo" alternators, and that he is having a number of inquiries right along. He is very hopeful of making some more good sales in the near future.

THE O. K. DRY BATTERY.

The Non-Polarizing Dry Battery Company, of 347 West Broadway, New York, are well satisfied with the remarkable success of their O. K. dry battery. The company now number among their customers all the leading railroad companies, who use this battery for their signal and grade crossing work. The leading gas engine companies also find in the O. K. battery a great saving both in actual cost of the battery and in the reduced bills for attendance. A number of telephone companies have also found the O. K. battery to be just what they have been looking for.

THE O. K.
Dry Battery
MANUFACTURED BY
THE NON-POLARIZING
DRY BATTERY COMPANY
347 W. Broadway, New York
For use in open-circuit work of all kin
including Electric Gas Lighting, Electric Bells, B
lar Alarms, Telegraph, Telephones, Ann
ators, Door Openers, Railway Signals, Me
Apparatus, and wherever a strong, durable, and
quickly recuperating battery is needed.

The O. K. Dry Battery.

THE GRAVES ENCLOSED ARC LAMP.

Our illustration represents one of the various types of enclosed arc lamps manufactured by the W. D. Graves Electric and Machine Works, of Cleveland., O. This lamp, designated as their No. 99, is made for 110-volt circuits, or will run two in series on 220 volts, or five in series on 500 volts. The company guarantee perfect regulation, and the lamp is arranged to pass from 4 to 5½ amperes, as desired, with a potential of 80 volts at the carbon points.

The Graves Enclosed Arc Lamp.

Any of the long burning lamps of the Graves Company are adapted for constant current circuits of 6½ amperes. The lamps are finished in polished brass, oxidized brass, oxidized copper, or nickel, and are very ornamental.

ADVERTISERS' HINTS

THE STANLEY ELECTRIC MANUFACTURING COMPANY'S San Francisco office is now at 300 California street.

THE DIAMOND ELECTRIC COMPANY, Peoria, and Fisher Building, Chicago, Ill., illustrate and point out the advantages of the well-known Diamond transformers and Scheeffer's wattmeters. These have both made a reputation for themselves and are daily enlarging it.

HENRY F. NOYES, 56 Liberty street, New York, has undertaken a correspondence course of instruction in patent office practice for inventors and business men and invites those interested to write for particulars.

THE J. I. CASE T. M. COMPANY, Racine, Wis., claim the Raymond improved gas and gasoline engines, 1 to 100 h. p., to be unexcelled in efficiency for driving electric light and stationary power plants.

JACQUES ULLMANN, 16 Boulevard St. Denis, Paris, France, requests illustrated price lists concerning the electrical trade. He refers to the Bradstreet Company and the Crocker-Wheeler Electric Company, New York.

V. J. MAYO & CO., 100 North Clinton street, Chicago, pronounce their alternators a success. They are built for any voltage, speed, frequency or number of phases; the armature is stationary and coils are easy to replace; the efficiency is claimed to be 94 per cent. or better.

J. G. BIDDLE, advertises the "Bowdoin" X-ray focus tube. They are made in two styles at prices respectively $6 and $7.50, and will be shipped immediately on receipt of order.

THE WALKER COMPANY, are of the opinion that the public needs a new arc lamp that may be truly considered a superior production and they are further of the opinion that the new Walker lamp is just the one to fill the need.

THE STOW MANUFACTURING COMPANY, Binghamton, N. Y., advertise the combination of the Stow flexible shaft and iron clad electric motor. It is described elsewhere in this issue.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, are sending free samples of the "Highland" soldering paste and remind their friends that it costs nothing to give it a trial.

THE ANCHOR ELECTRIC COMPANY, Boston, Mass., state that their improved push button switches are durable and require but little power to operate them.

THE REPLOGLE GOVERNOR WORKS, Akron, Ohio, advertise their new relay returning water wheel governor as representing the most efficient, accurate and satisfactory type ever placed on the market.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., publish the happy results obtained by another central station using the Holly system of heating by exhaust steam.

THE H. T. PAISTE COMPANY, Philadelphia and Chicago, make some very pithy remarks on things in general and their switches, cut-outs, etc., in particular.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Iowa, say the sales of their lightning arresters have doubled this year over last, and give a list of well known companies employing their apparatus.

NEW ENGLAND NOTES

THE HART & HEGEMAN MANUFACTURING COMPANY have issued catalogue "C," describing and illustrating their new line of the well known and popular Hart switches. Dimensions of switches are given in detail; wiring diagrams are given for three-way, four-way and electrolier switches; special switches, such as "Two-circuit," "No. 9" and "Dinner switch," are described. Full and interesting information is given regarding Hart flush switches and switch boxes. All interested in switches will find much profitable and interesting information in this catalogue, and should write for a copy if not already supplied with one.

SCRANTON, PA.--The Berlin Iron Bridge Company, of East Berlin, Conn., are erecting a new roof for the power station of the Scranton Illuminating Heat and Power Company, of Scranton, Pa. The building is 42 feet wide and 195 feet long, divided into two portions; a boiler room and an engine room. The framework of the roof construction is of steel and absolutely fireproof. It has been the aim of the Scranton Company to erect a substantial and fireproof building, to replace the one which they recently lost by fire.

DICK, KERR & CO., LTD., London, have inaugurated their new electric railway department under Mr. W. Rutherford, by taking a contract for the complete equipment of the Dover Corporation Tramways.

THE COMPAGNIE D'ELECTRICITE, of Nancy, France, now furnishing current for lighting and power to an extended territory, is about to enlarge its area of work, by the installation of two direct current units of 400 k. w. each. The construction of this work will be carried out by the firm of Fabius Henrion, of Nancy.

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The Electrical Engineer.

Vol. XXIII. JUNE 23, 1897. No 477.

ROENTGEN RAY DIFFUSION PHENOMENA.

BY PROF. ELIHU THOMSON.

IT is well known that many substances subjected to the radiation from an excited Crookes tube diffuse the Röntgen rays received by them. It is known also that the diffusive action takes place throughout the substances or media, or that they are turbid in relation to the rays. It is probably owing to this that such substances as paraffine, wood, etc., possess apparently greater diffusive power than denser materials like heavy metals. With the latter, when the surface is smooth, there appears to be a tendency to regular reflection as demonstrated by Prof. Rood, of Columbia University, New York, and what diffusive action is noted is most marked near those directions which denote regular reflection. A mass of crystals of tungstate of calcium appears to be so devoid of diffusive action as to give no discoverable effect of diffusion. This is probably owing to the conversion of the energy of the rays into ordinary light, leaving no diffusive effect on the rays themselves. The diffusion is, so to speak, light itself. Barium platino-cyanide is feebly diffusive.

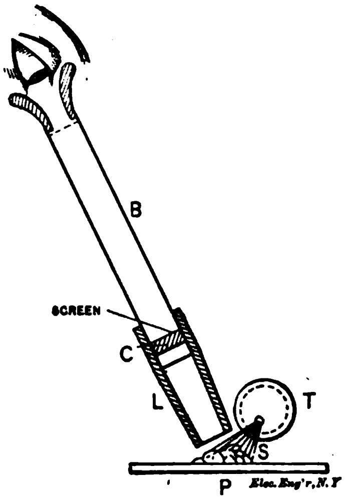


FIG. 1.

By the use of a form of Crookes tube devised by the writer for obtaining strong radiation, tests of diffusive action are rendered comparatively easy and simple. The tube referred to is one in which the glass wall closely surrounds the platinum target, so that it is easy to work very close to the bombarded spot, especially if a magnet be used to deflect the spot toward the edge of the platinum and near the glass wall.

With such a tube placed horizontally the rays emitted may pass immediately to the object or substance to be tested. A piece of heavy sheet lead, which has but very slight diffusive action, is provided. Upon this lead plate and in the most favorable position for receiving the rays is placed the substance to be tested, either in the form of a lump, slab or mass of crystals or granules. For liquids, such as oils or water, etc., a small but rather deep cup of lead is a convenient receptacle.

To observe the diffusive rays the fluorescent screen is required to be thoroughly protected from the direct rays of the tube. The writer has used a piece of heavy brass tube about 8 inches long, upon one end of which is fitted a wooden eye cap fitting closely around the eye and blackened, while the other end of the tube is stopped by a cork carrying fluorescent material on the face within the tube. The face of the cork turned toward the eye end is, in fact, coated with a varnish carrying barium platino-cyanide, which is more active than calcium tungstate. The end of the tube which has the cork screen fitted into it is now elongated by a heavy lead extension as a piece of lead pipe covering about an inch or two of the brass tube and surrounding, therefore, the cork screen and extending downward about 2 to 3 inches beyond the end of the brass tube. The lower end of the lead tube may be narrowed with advantage.

The whole arrangement is shown in Fig. 1, where T is the narrow part of the Crookes tube; S the substance to be tested resting upon a lead plate, P; B is the brass tube with its expanded eye end; C the cork screen; L the lead shield preventing direct rays reaching the screen. These parts may be clamped in relative position, with the lead plate, P, removable for substitution of other substances.

The writer has long had it in mind to discover, if possible, whether the diffused rays from a substance had the power of again undergoing diffusion. This may be termed secondary diffusion, to distinguish it from the ordinary or primary diffusion. Some trials made many months ago showed the futility of attempting to get any results except when working at short range with the most intense source, and with the most effective shielding. When it is remembered that at best it can only be that a very small percentage of the original rays will be emitted as primary diffusion in any particular direction, and that the secondary diffusion will be on a similar small percentage of the first or primary effect, the great delicacy of such a test can be imagined. The writer succeeded, however, in fully satisfying himself that secondary diffusion does take place. He was enabled to strongly irradiate a block of paraffine, receive the rays therefrom upon a second block and note the feeble illumination of a screen by the secondary diffusion from the second block. The removal of the second block, or the first block, or both, left the screen entirely dark.

The apparatus is a modification of that shown in Fig. 1, and is shown in Fig. 2. Here S^1 is the first block under the strongest rays from tube T. Diffusion takes place upward from S^1 within the heavy lead tube or shield, L, into the upper end of which is inserted the second block, S^2. Both pieces, S^1 and S^2, are cut on a slant or wedge-shaped to favor the action. The brass screen tube, B, is inserted into an opening, LL, opposite the second block, S^2. The screen, C, is put as near the block, S^2, as possible, but not so near as to allow any of the first diffused rays, or primary diffusion to reach it. It is imperative that the observer's eyes be kept in the dark for some time prior to work of the kind, and even the light of the Crookes tube itself should be carefully shaded from them. It was only after taking these precautions that the writer was able to obtain any decided effect, but then the result was unmistakable.

Other substances not so diffusive for the rays as paraffine is, gave no definite result, though it is thought that with further experience they will be found to act as does the paraffine, but more feebly. The writer has in mind several ways of multiplying the effect, but has not yet been able to carry them into practice.

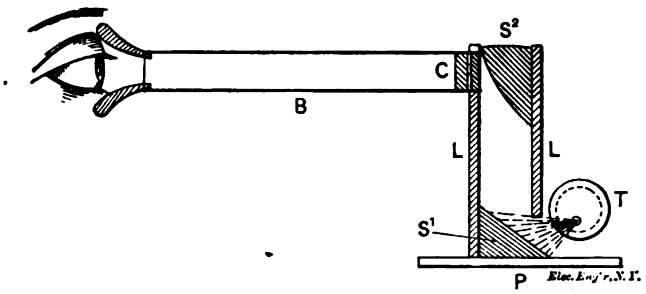


FIG. 2.

It may be mentioned here that the question of the different wave lengths of Röntgen rays would have considerable light thrown upon it, should there be found selective absorption or diffusion according to the substance used. By changing the substance of S^1 with relation to that of S^2, in Fig. 2, interesting relations might be found.

Since paraffine and many other substances diffuse Röntgen rays, while calcium tungstate does not, but gives out light instead, may it not be possible that there exist substances which absorb Röntgen rays and give out wave lengths above the visible rays in pitch or ultra-violet rays; and may not the choice of the substance determine where, in the range of wave lengths, between the luminous and Röntgen orders, the diffused rays may be found. It is even conceivable, but not probable, that substances exist which might, when submitted to Röntgen radiation emit rays below the red.

MISCELLANEOUS

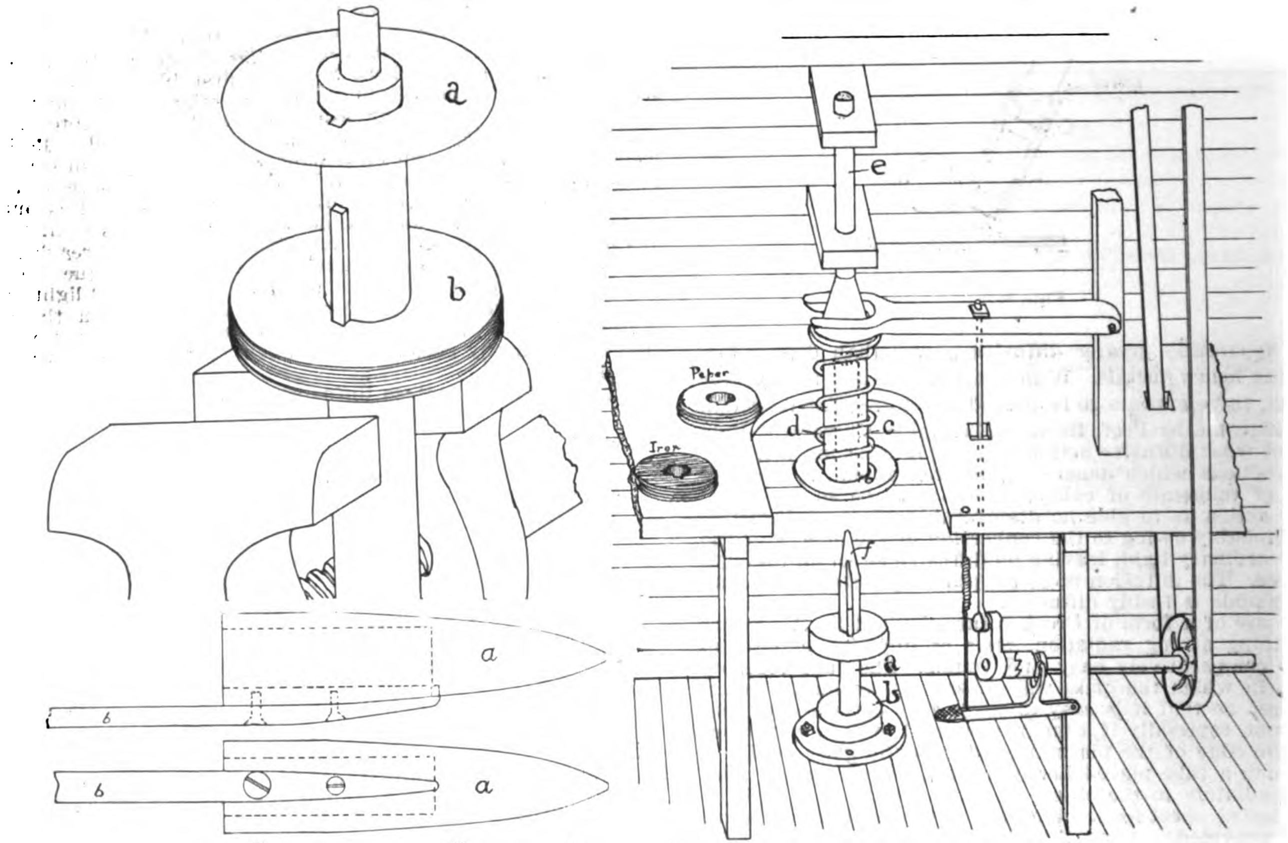
ELECTRICAL MACHINE SHOP PRACTICE.—I.

BY JAMES F. HOBART, M. E.

THE machinist has had so many new forms of material forced upon him during the past decade, and so many new designs, both mechanically and electrically, that he is entitled to the broadest possible exchange of ideas, especially through the media of his favorite journals. Only by exchanging and profiting by ideas have the machinist and the electrician been able to make the tremendous advance placed to their credit.

It is the writer's intention, in this series of articles, to give a description of general (and also special) shop practice as he finds it exemplified in the construction of electrical machinery. He also proposes to illustrate possible improvements in existing methods, as they appear to him, viewed from the standpoint of a mechanical engineer.

In motor and dynamo construction, too much importance cannot be given to the proper building up of the armature.



FIGS. 1, 2 AND 3.—HAND AND MACHINE METHOD OF STACKING ARMATURE DISCS.

Formerly it was considered the best practice to stamp out all the thin discs, one by one, in a press which also formed the channels for the winding. At the present writing, a number of concerns punch armature discs, some punching them all at once, by a single stroke, others punching them by the "step by step" method.

For the better class of armature work, it has been found that the forming of the wire grooves before setting up the armature, does not give the results that can be obtained by milling the armature slots after the discs have been all put in place, and the armature baked. The punching should be done with shearing dies on anything larger than 4 or 5 inches in diameter, and the hole for the shaft, and the key should be punched at the same time, a compound punch being used for the purpose. Discs less than 4 or 5 inches in diameter may be pressed out with a punch which strikes all around at the same instant.

The paper discs must also be punched, and the same dies that cut the iron, can be used for paper, but they must be kept very sharp or the thin paper will not be cut satisfactorily. One man should be given charge of all the dies and die work. He should have a good assistant, and no one else should be permitted to use, or even touch the dies, for it is very easy to spoil a $100 set of dies by a single cut if they are not properly set.

The making up of an armature as now usually practised, is a tedious operation, and should be improved at once. Fig. 1 shows about how it is managed in a majority of the shops. The armature shaft is caught vertically in a vise after one head has been put on, and a disc of paper put on over the top and worked down by hand, keeping the key-way so as to engage the slot cut in the disc for that purpose. It is a lot of work to do this, and consumes a lot of time.

It is desirable that a machine be worked out for putting on armature discs, both the iron and the paper. Something after the scheme shown by Fig. 2 might answer, the armature, a, being set into a stationary chuck, b, which is made fast to the floor, under a bench as shown. A hollow plunger, c, is fitted above the bench in suitable guides, so as to stand exactly over, and in line with the armature shaft as shown.

By a system of levers connecting with a crank shaft, the plunger, c, is made to travel vertically back and forth over the armature shaft, the collar disc at bottom of plunger fitting tight enough to the shaft to prevent any doubling of the paper discs under it. The spiral spring, d, serves to soften the pressure applied, also to allow the plunger to work when the shaft is nearly filled. Another spring, not shown in the engraving, but located at the top of the shaft, e, serves to raise the plunger to the position shown, whenever it is released by taking the foot from the treadle.

A cone, f, Fig. 2, is placed on top of the armature shaft, and serves as a guide to start the discs, both on to the armature shaft, and on to the key, or feather, as well. A detail view of the cone is shown by Fig. 3. The body of this jig is made of cast iron, or, preferably of brass. It is bored out to fit the end of the armature shaft, where the latter is shouldered down to receive the journal box. A number of bushings may be provided to fit the inside of cone, thus allowing it to be used on a number of shafts of the same diameter, but having differently shouldered ends.

The key, or feather, b, is fastened to the cone by means of a couple of screws and a turned-in pin at tip end of the key. This key is tapered both ways, as shown, so as to allow the discs to be easily revolved into position, with the slot fair with the feather. Then, the disc will follow down easily, to the feather on armature shaft, without danger of letting the discs get out of line with that feather, or of getting the paper crumpled up.

Referring again to Fig. 2, it will be seen that the discs are subjected to a considerable pressure every time a disc is put on. The result will be that the armature clamps together a good deal better than where it is put up by hand, and the discs are on much more even, making two points in favor of the machine, outside of the saving in time, which is very great.

By hand, in putting up 8-inch armatures, a good workman will put on a paper disc in about 15 seconds, and an iron disc in a little less time, making two discs of iron (with the intermediate paper) per minute. With the machine it will be very possible to start it to running about 60 revolutions per minute, letting it run continuously, and putting on a disc every time the plunger gets up out of the way, the discs being laid in piles, conveniently on the bench, as shown. The cone makes it very easy to arrange the discs so they will go down over the feather, thus making the machine put on 30 iron and 30 paper discs per minute, against two by hand. Surely nothing more needs be said in this direction.

The grooving of the armature for the reception of the winding should be done on a stiff milling machine, the dividing head being used in the same manner as for gear cutting. Where the number of armatures is large, and the sizes few, it will be economical to procure a special milling machine for this purpose alone, and have a double dividing head so arranged that two armatures may be milled at the same time, with very little more expense for setting and attending, than when one is milled at a time.

MAKING SODIUM PEROXIDE AT NIAGARA.

BY ORRIN E. DUNLAP.

THE Niagara Electro-Chemical Company have completed their electrical equipment, and the installation is one that is attracting some little attention. The company's buildings are of brick, and cover an acre of land; they number eight, besides the offices, and are devoted to transformer room purposes, pot room, etc. This plant was the fourth to start operations on the lands of the Niagara Falls Power Company.

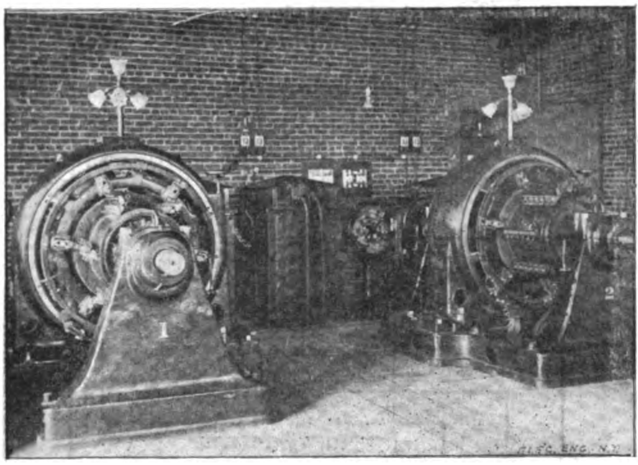


FIG. 1.

The electrical equipment consists of three 175 k. w. rotary transformers, which run at 500 revolutions per minute, and six static transformers which reduce the multiphase current of the Niagara Falls Power Company of 2,200 volts to 118 volts and arranged with Stillwell regulators, which still further reduce the voltage to 90 volts, as may be required. Rotaries Nos. 1 and 2 are shown in Fig. 1 and rotary No. 3 in Fig. 2. This last mentioned rotary is of the new induction type, and is the first ever installed commercially. The ordinary transformer has field coils which receive direct current from the rotary itself, but the field poles of this new type of machine derive their magnetism from the armature. No copper of any description is to be found around the field poles.

In addition to the above mentioned machines the transformer room contains a marble switchboard fitted with high potential plunger switches, instruments, dynamo changing switches, fuse plugs, field rheostats, circuit breakers, etc. The whole outfit was supplied by the Westinghouse Electric and Manufacturing Company, and installed under the supervision of Mr. W. K. Dunlap, the popular representative of the Westinghouse Company at Niagara.

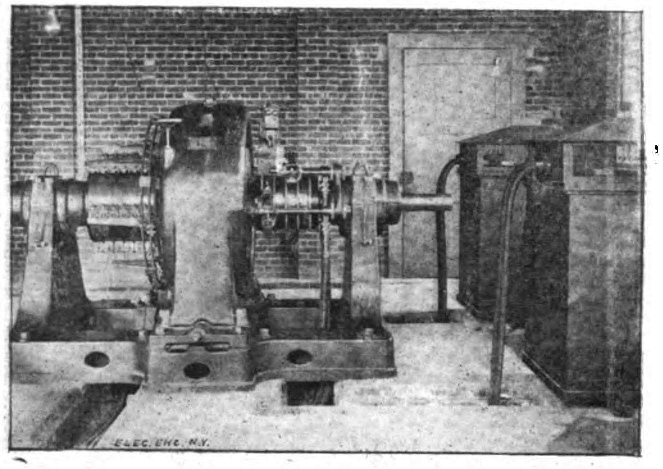


FIG. 2.

Copper leads run from the switchboard to the pot room, and current passes in series through the pots, which are filled with molten caustic soda. The sodium is bailed out of the pots regularly, and cast into bricks. There is a very conveniently arranged recovery plant for caustic soda, the pump for the liquors being driven by an induction motor.

Metallic sodium is converted into peroxide of sodium by a very interesting process. The sodium is put in regulated quantities into dishes which travel through a long tube fixed in a furnace. Dry air in regulated quantities is then passed through the tube, which is kept at a certain temperature, and the sodium is oxidized to peroxide. The peroxide comes out as a beautiful canary-colored substance, which is immediately sent to the grinding room to be ground and packed.

It will undoubtedly seem strange to some that a metal like sodium, which a few years ago was barely seen outside of the laboratory, should be made in such quantities, be handled with such ease, and be converted into a peroxide which gradually but surely seems to be taking the place of barium peroxide. Both are used in the manufacture of hydrogen peroxide solution. Until recently the bleacher has been obliged to buy his peroxide of hydrogen in the form of a solution, which is bulky and likely to lose its strength, and it is difficult to keep a bath of uniform strength. In peroxide of sodium, however, the bleacher has a substance which, it is said, contains twelve times as much oxygen available for bleaching as the ordinary ten-volume hydrogen peroxide solution, and which can be kept an indefinite time.

The plant of the Niagara Electro-Chemical Company employs about fifty men, who are divided into two shifts, as the process is continuous. The laboratory is well equipped, and Manager Brindley finds in it especial reason to be proud. Max Friedrichs is in charge of the company's office at the Falls.

STORAGE BATTERY ENGINEERING PRACTICE.—XIV.

BY JOSEPH APPLETON. (Copyright, 1897.)

The engravings Figs. 56, 57 and 58 illustrate the Bowling Green battery and apparatus. This is the latest of the three battery plants operated by the New York Edison Company and is equipped with the most modern devices and arrangements. The plant consists of 150 cells arranged 75 on each side of the three-wire system. Each cell consists of 33 plates mounted in a lead-lined wooden tank of the following dimensions: 40¾ inches high, 30½ inches long and 20½ inches wide. The cells rest on special double petticoat porcelain insulators to insure good insulation. The adjacent cells are connected together by lead bus bars to which the individual plates are welded in the manner previously described.

There are 20 regulating cells at each end of the battery

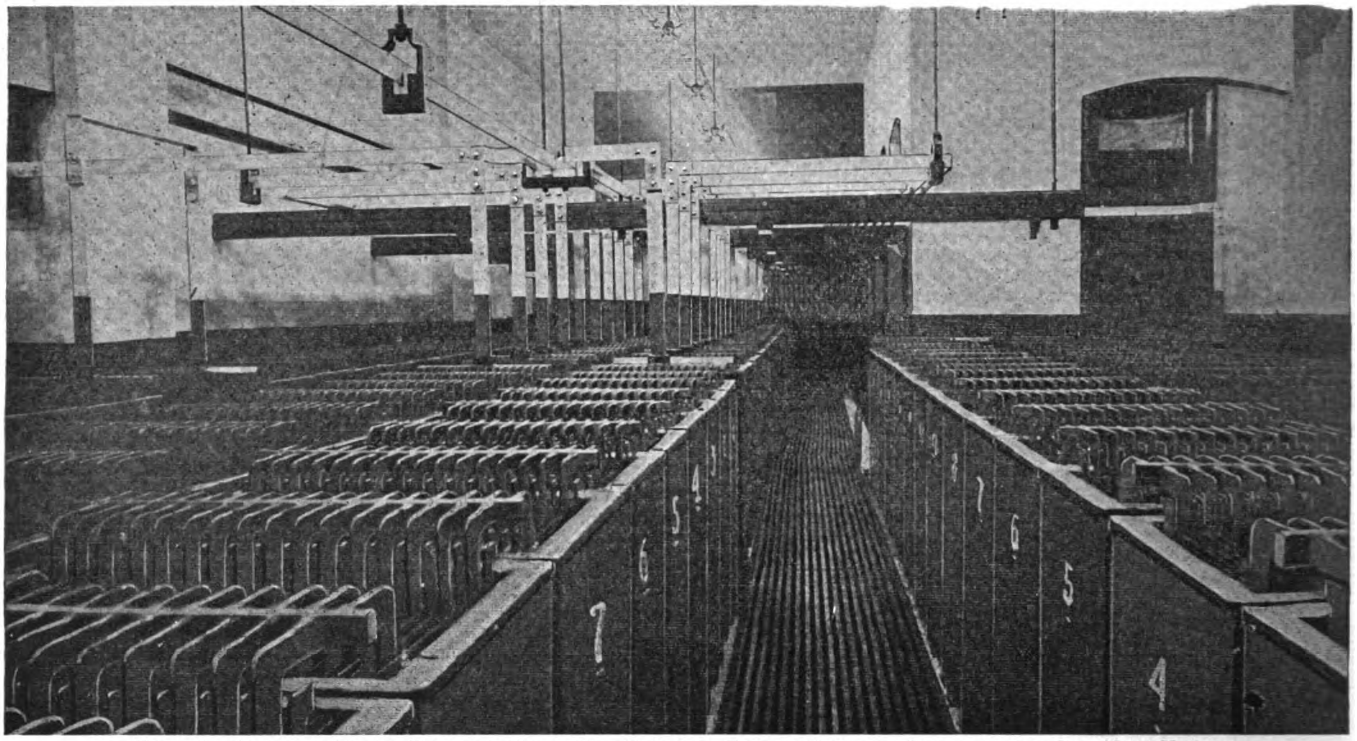


Fig. 56.—Battery Room, Bowling Green Sub-Station, Edison Electric Illuminating Co., New York.

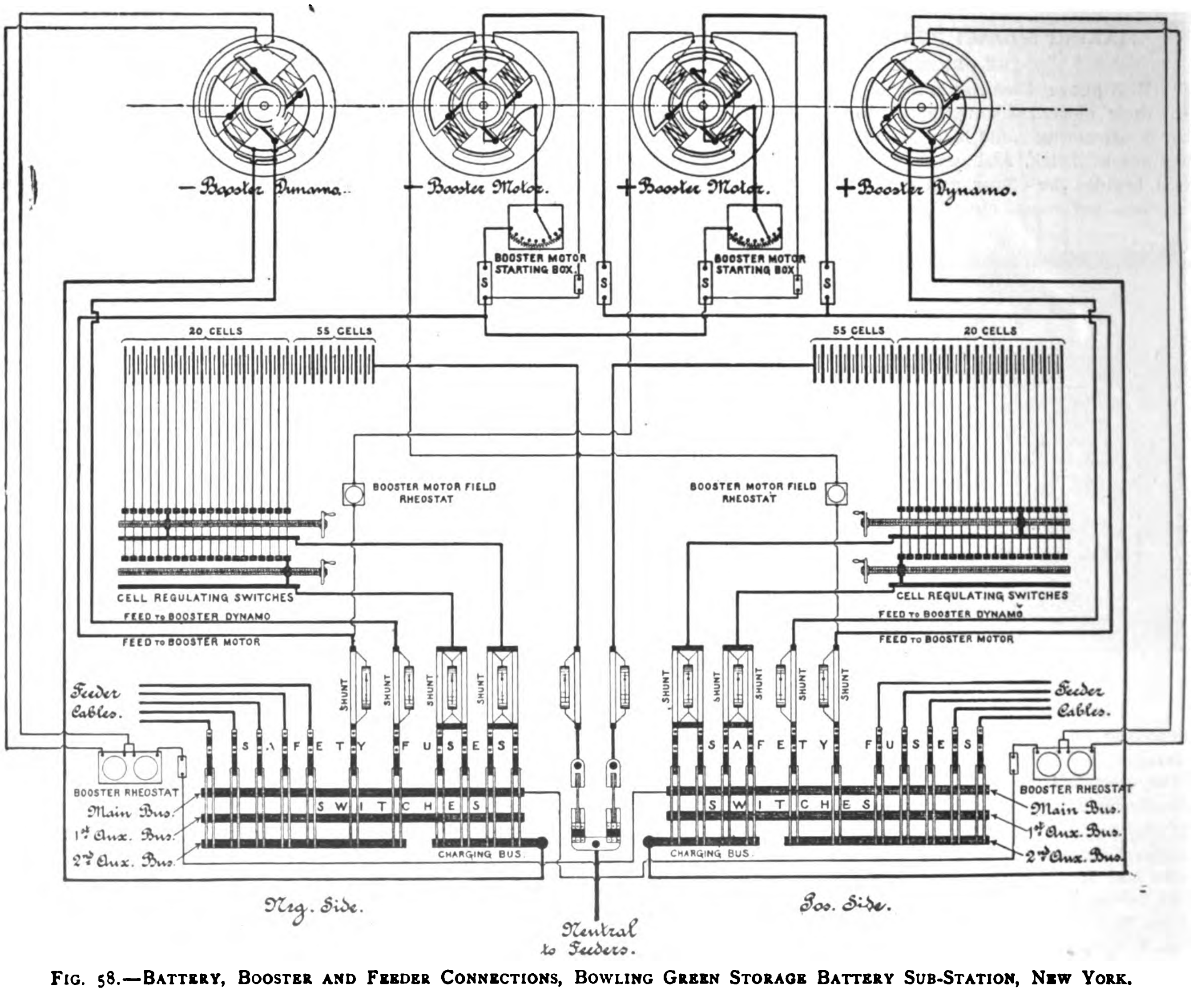


Fig. 58.—Battery, Booster and Feeder Connections, Bowling Green Storage Battery Sub-Station, New York.

which are connected to the regulating switches, the connections being made by means of copper bars 3 x 1½ inches supported on porcelain insulators. Two of these regulating switches are provided on each side of the system so that the battery may be discharged at two potentials or be charged and discharged at the same time.

The battery is charged by means of boosters which raise the bus pressure sufficiently to give the required voltage. These boosters are shown in Fig. 58. They have a capacity of 1,200 amperes and 60 volts, and are driven by compound-wound motors so placed that one or both motors may be used for driving the two boosters according to the load.

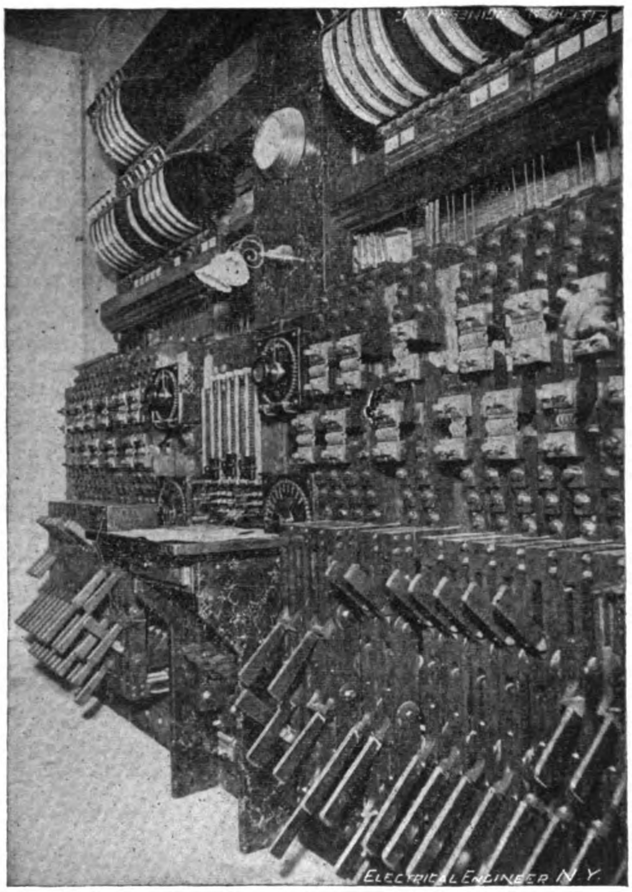


FIG. 57.—SWITCHING AND INDICATING APPARATUS, BOWLING GREEN SUB-STATION, NEW YORK.

Fig. 58 shows the connections and general arrangement of this plant, and Fig. 57 illustrates the switching apparatus.

THE INDUCTION FACTOR, A NEW BASIS OF DYNAMO CALCULATION AND CLASSIFICATION.[1]—II.

(Concluded.)

BY PROFESSOR CHAS. A. CARUS-WILSON.

SECTION V.

When the tractive effort, the speed, the tension of the line and the resistance of the motor are given, we can write

$$\frac{M\ v}{d} = \frac{E}{11.2\ S}\left\{1+\sqrt{\left(1-\frac{8\ R\ T\ S}{E^2}\right)}\right\} \qquad (11)$$

In designing a motor equipment to fulfill certain conditions, we must be able to distinguish between the part played by each of the quantities, M, v and d, in obtaining the desired result.

Example 10. A train and locomotive on the Baltimore & Ohio Railroad weigh 780 tons, and have to mount a grade of 0.8 per cent. at 10.7 miles per hour. The frictional resistance of the track is nine pounds per ton, reckoning at this rate both train and locomotive. The tension of the line is 625 volts. Four gearless motors are used, permanently connected in series, each having an internal resistance of 0.0209 ohm.

Each motor thus has to move 195 tons on a tension of 156.2 volts. The draw-bar pull per motor for the grade is 3,490 pounds; for friction, 1,755 pounds; allowing ninety-five per cent. mechanical efficiency, we get 5,500 pounds as the required tractive effort per motor; inserting this value together with those for E, R and S, in Equation 11, we find the value of $\frac{M}{d}$ to be 2.32, v being unity.

It appears then that whatever size of driving wheel we employ, the induction factor must be 2.32 times the diameter; and that so long as this ratio is maintained, the locomotive will haul the train up the grade at the required rate. For instance, if we take wheels 4 feet in diameter, the induction factor must be 111. If d is 5 feet 6 inches, M must be 153. The current at full speed is 850 amperes from Equation 8, and is unaltered by increasing or decreasing the ratio of M to d, so that we should take d as small as possible, consistent with leaving a clearance for the motor and its attachments. The actual values of M and d for the motors in use on the Baltimore line are M = 144, d = 62 inches.

When running at full speed each of these motors would be doing work at the rate of 158 horse-power, so that the horse-power of the locomotive would be 632. The current from the line would be 850 amperes, as obtained from Equation 8. This current will, not, however, start the train on the grade. We have to find then how much current is required to do this.

If the start is to be effected in forty seconds, since the final speed is 10.7 miles an hour, or 15.7 feet per second, the acceleration must be 0.393 foot per second. Inserting this value in Equation 10, remembering that W is 195, and $\frac{M}{d}$ is 2.32, we find the current required for acceleration to be 810 amperes, making a total current at the start of 1,660 amperes, or a force factor of 239 kilodynes. This agrees with the results obtained in starting a train of the given weight under the given conditions. (See Mr. Lee H. Parker's paper on the "Electric Locomotives Used on the Baltimore Line," published in the "Street Railway Journal" for March, 1896.)

USE OF THE INDUCTION FACTOR IN DYNAMO CLASSIFICATION.

SECTION VI.

Example 11.—Two generators run at the same speed and have the same kilowatt output. A is a generator giving ninety-six amperes at 125 volts, while B gives 9.6 amperes at 1,250 volts. These two dynamos differ radically, but the difference is one that their classification by kilowatt output fails to recognize. They differ dynamically, as can be seen by passing the same current through both, when the one machine will give ten times the torque of the other. This experiment can be made when the machines are standing still, so that the difference does not depend upon that of their induced volts when they are both running at the same speed, but, rather, the difference of volts depends upon the dynamical difference that exists whether they are standing still or whether they are running.

The induction factors of these machines can be found thus:

The low-tension machine has 200 conductors on the armature and 2.5×10^6 lines per pole, p being unity, so we have

$$M = 200 \times 2.5 \times 10^6 \times 10^{-8} = 5$$

The high-tension machine has 3,760 conductors and 1.33×10^6 lines per pole, p being unity, so that the induction factor is given by

$$M = 3,760 \times 1.33 \times 10^6 \times 10^{-8} = 50$$

A comparison of the induction factors indicates the real difference between these two machines. If they are to run as generators at equal speeds and give the same kilowatt output, the current delivered by one will be ten times that delivered by the other. If they are to run as motors at the same speed with the same horse-power output, one must run on a line tension ten times that of the other.

Example 12.—The motors in use on the Liverpool Overhead Railway and on the City and South London Railway are rated at about the same horse-power, but on actual test the Liverpool motor can pull over two of the South London motors when equal current is passing in all three.

The motors on the Liverpool Railway were designed to run in parallel, two motors to each car, while those on the South London Railway were designed to run permanently in series, two motors also to each car.

If the tension of the line, the speed and the drawbar pull were the same in the two cases, the induction factor of the Liverpool motors must be twice that of the South London motors: the values were actually 120 and 60 for 100 amperes in the series winding in each case, the force factor being twelve and six kilodynes, respectively, for this current. Hence, each of the Liverpool motors must give twice the drawbar pull of one of the South London motors for the same current, provided the wheel diameter is the same in both cases. The wheels on the Liverpool cars have a diameter of 33 inches, while those on the South London cars are 27 inches diameter; so that the respective drawbar pulls for 100 amperes would be (taking the values of M as given above), for the South London motors, 630 pounds, and for the Liverpool motors, 1,030 pounds.

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[1] Read before the N. E. L. A.

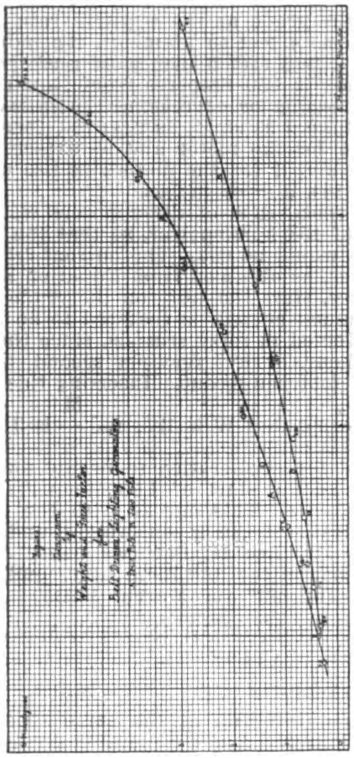

FIG. 1.

We must not infer from what has been said that the Liverpool equipment is necessarily more efficient than the South London equipment when running at full speed, because, although for equal speed and drawbar pull the current per motor in the former would be half that in the latter, yet since the South London motors are in series, the current from the line is the same.

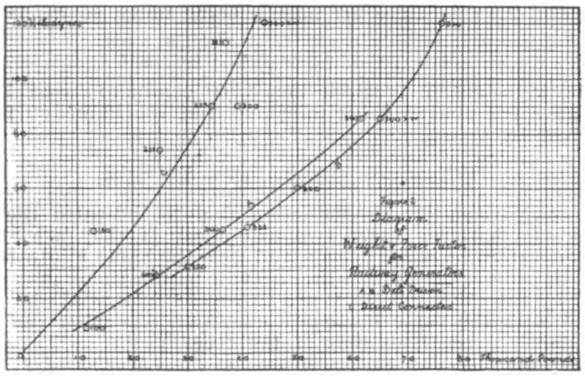

FIG 2.

SECTION VII.

If we take the weights and the force factors of a number of dynamos belonging to the same type and plot them on rectangular axes, we obtain a series of points lying on a curve.

In Fig. 1 this curve[1] has been plotted for two types of dynamos manufactured by the General Electric Company; Type A is a four-pole and Type B a two-pole, belt-driven lighting generator. The vertical ordinates give the force factor in kilodynes, and the horizontal ordinates give the weights in pounds.

The curves afford a convenient way of comparing the two types. The well known fact that the four-pole machines give a greater output for equal weight than the two-pole machines is clearly shown. The numbers against each point show the rated kilowatt output. All the dynamos in this diagram are wound for 125 volts. Equal force factors and equal speeds give equal kilowatt output.

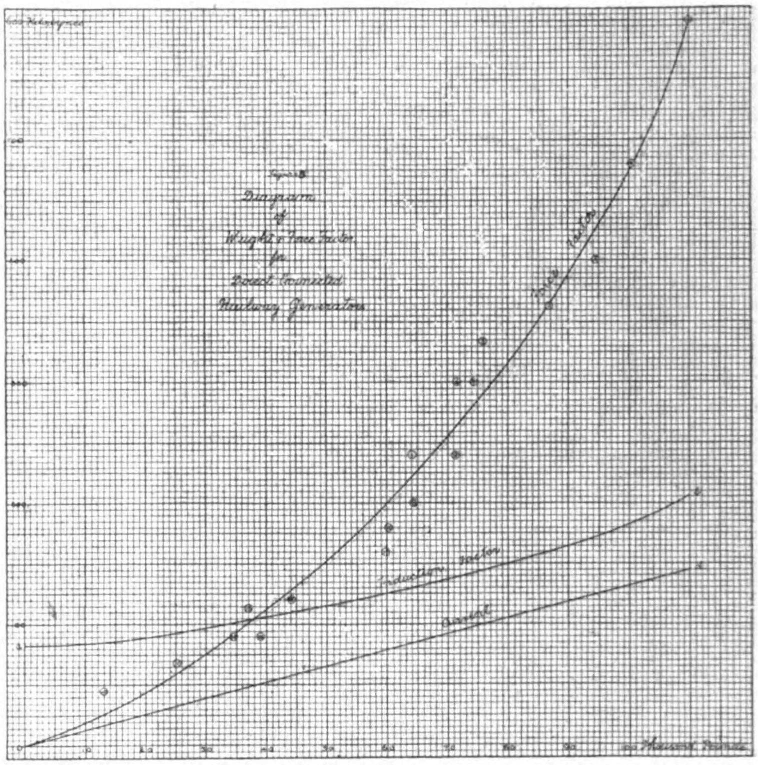

FIG. 3.

The force factor corresponding to any weight may be made up in a great number of different ways, by taking different values of M and C.

For instance, taking a force factor of 2 kilodynes, we may have machines of equal weight with the following differences:

C.	M	MC	Revolutions per minute for 125 volts.	Kilowatts
200	10	2,000	750	25
250	8	2,000	940	31
340	5.9	2,000	1,270	42
400	5	2,000	1,500	50

There is thus a considerable range of output for a machine of given weight, according to the speed at which it is to run. For this reason we may find machines of the same type giving equal output, but of different weights, the heavier machine running slower than it need do, if it occupied its normal position on the force curve.

Thus a dynamo of this type, giving 340 amperes at 125 volts at 1,270, will weigh 3,550 pounds, and have a force factor of two kilodynes. A dynamo of the same type, weighing 4,750 pounds, has a force factor of three, and, if required to give 340 amperes at 125 volts, must have an induction factor of 8.83 and run at 850.

Fig. 2 gives the curves of force factor and weight for different types of railway generators. A and C are made by the General Electric Company, the former belt-driven, the latter direct-connected. B is made by the Walker Company, and is belt-driven; the numbers opposite to each machine indicate the rated kilowatt output, all at 550 volts.

Fig. 3 gives the force factor curve for the complete line of direct-connected railway generators made by the General Electric Company. The particulars of the machines are given in the table. All these dynamos are wound for 550 volts.

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[1] The form of this curve was first noticed by Mr. E. Wilson, in a paper recently read before the Institution of Electrical Engineers in London; the force factor is there spoken of as the mass factor.

The vertical ordinates of the force curve represent the product of the induction factor M and the current C. If both these quantities increased uniformly with the weight, the force curve would be a straight line. The bending up of the curve indicates that either or both of these quantities does not increase uniformly with the weight.

If we plot the induction factors corresponding to each machine as vertical ordinates, the points thus obtained should lie on or above a curve giving the smallest induction factor for a machine of any weight; i. e., indicating the highest speed at which a machine of that weight may be run. The points may lie above this curve, since a dynamo of any weight can be run at a speed lower than the limiting speed, but the points should not lie below this curve. By dividing the force factor for any weight by the corresponding induction factor, we obtain a third curve which gives the variation of the current with the weight.

In Fig. 3 the curve a b has been drawn on the assumption that the current curve o d is a straight line. It is probable that it is not quite straight, but it would seem that the weight varies very nearly as the current. The induction factors are plotted vertically on a scale of one inch equal to one hundred of M, and the currents on a scale of one inch equal to 500 amperes.

As an illustration of the use of the curve, let us find the lightest dynamo of this type that will give 500 kilowatts at 550 volts.

Poles.	No. in Diagram.	Rated kilo watt output	C.	R.P.M.	M.	M. C. kilod.	Weight 1,000 lbs.
10A.	1	500	910	125	264	240	64.0
10B.	2	. .	....	75	440	364	87.1
10B.	3	...	....	90	367	334	76.0
10B.	4	..	....	100	330	300	71.3
10B.	0	800	1,450	80	412	600	110.0
10B.	5	...	....	120	275	400	94.4
10C.	6	...	...	100	330	480	100.9
8A.	7	400	725	80	412	300	74.2
8A.	8	...	....	120	275	200	64.3
8A.	9	...	. .	100	330	240	71.4
6A.	10	150	270	200	165	44.5	13.1
6A.	11	225	410	200	165	67.5	25.1
6A.	12	...	....	150	220	90.0	34.3
6A.	13	...	..	120	275	113	37.0
6A.	14	300	545	200	165	90.0	39.1
6A.	15	...	...	150	220	120	43.9
6A.	16	...	....	100	330	180	60.4
6B.	17	400	725	150	220	160	59.7

The current is 910 amperes, and the weight, consequently, 69,000 pounds. The corresponding induction factor is 270, so that the machine must run at 122 revolutions per minute.

If we look at the list of dynamos in the table, we shall see that the lightest dynamo of this output, actually made, weighs 64,000 pounds, and runs at 125 revolutions per minute, being thus a little lighter than that indicated by the theory.

Note.—The limits of this paper do not permit me to insert the proofs of the equations it contains. These will, however, be found in full in the work on Electro-Dynamics, which I am now preparing, and which will shortly be published by Messrs. Longmans, Green & Co., London and New York.

AN ELECTRICAL EXHIBITION FOR RUSSIA.

W. Toritch & Co., of New York City, have been advised that an electrical exhibition is being planned by the Russian Electro-Technical Society to take place in St. Petersburg the early part of 1899. Everything pertaining to electricity will be admitted. This will give an opportunity to introduce in Russia, they say, a number of American manufactured goods in the electrical line which heretofore were unknown in that market. The exhibition buildings will be put up in the center of the city. In the surrounding canals electric yachts will ply. Different systems of electric railroads, suspended as well as on sleepers, will be built, and also electric elevators and moving platforms. Some of the buildings put up at Nijni Novgorod for exhibition purposes will be taken to St. Petersburg. At the close of the exhibition some of the principal exhibits will be retained to form an electrical museum in St. Petersburg. Several millions of roubles, which will be necessary for the expenses of the exhibition, will be furnished by the Russian Government, the city of St. Petersburg, and by the Electro-Technical Society of that city.

RECENT PROGRESS IN ARC LIGHTING.[1]—II.

BY PROF. ELIHU THOMSON.

There are two ways in which alternating currents may be used to work arc lights in series. We may either take a constant-potential system, such as one with main lines at 1,000 volts and connect between them a series of arc lamps at about thirty volts each and about thirty-five lamps, or we may transform so as to feed the lamps in series with a current of constant value, or with a current which does not vary more than a given per cent, from light to full load—15 per cent., for example. In the former arrangement some provision must be made to allow lamps to be extinguished without breaking the circuit, and this cannot be done by shunting, unless equivalent-resistances be substituted, for the shunting of a lamp or lamps in a series would result at once in a great increase of current in the others and a serious departure from normal working.

By shunting each lamp in the series by a specially constructed and carefully proportioned reactive coil, wound upon a laminated core, the difficulty just pointed out is obviated with but small sacrifice. Another way of accomplishing even a better result, but one which requires that shunt or differential magnets be used in regulating the feeding of the carbons, is to substitute, by a special switch, a proper reactance in place of the lamp when it is to be cut out, and also to cause the lamp, on a failure to feed, to cut in as a substitute for itself this reactance.

When a transformer is so constructed that there may be a considerable magnetic leakage, as it is termed, between the primary and secondary coils, it approximates what is called a constant-current transformer. It will, if connected by its primary terminals across mains at constant potential, give a secondary current which, even at short-circuit, is only a moderate percentage in excess of that given when the secondary is carrying a considerable load. In fact, such a transformer has an analogy, which is unmistakable, to a direct-current arc machine with a drooping characteristic, before alluded to.

For arc lamps in series on alternating current, this constant-current property is perfectly adapted. But in this case the regulation of the lamp must be by a shunt magnet responding to the potential across the arc, and not to the current passing through it, which is constant. The inclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons, or carbons containing little or no ash and particularly free from such metals as iron, the oxides of which are deep black or brown, which would soon obscure the small globe around the arc.

When it is remembered that, to get the best results with arc lamps on constant-potential circuits, the use of rather expensive cored carbons is necessary, the saving of carbon and frequent trimming becomes a very important item and permits the employment of more expensive carbons, provided they last long enough. The high voltage demanded by the inclosed arc was soon seen to be not a disadvantage, but a positive advantage for constant-potential circuits, inasmuch as it permitted the use in one lamp of a larger fraction of the total—generally 110 volts. Hence, instead of keeping down the potential, it could even be raised from sixty-five to seventy-five or to eighty volts with advantage. In fact, it may be that the exclusion of oxygen has the effect of enriching the arc flame itself, in much the same way that a slightly luminous blue flame of a Bunsen burner becomes far more luminous by cutting off the air. There may, in fact, be free condensed carbon particles in the outer layers of the arc stream highly heated and, therefore, strongly luminous. The flat ends of the carbons tend, also, to cause the hot gases to be retained under the positive end, thus extending the heat of the crater and increasing the luminosity. The result of the almost complete exclusion of oxygen is that very little combustion takes place and the life of the carbon is therefore much extended. The function of the small glass vessel around the arc is not only to keep out the air, but, in addition, to act as a diffuser of the light evolved, and in this sense replace, to a considerable extent, an opal outer globe of large dimensions, necessarily thick and highly absorptive. The inner globe around the arc is made thin, to withstand heat without cracking from sudden changes of temperature, and is generally of clear glass with a thin coating, either internal or external, of an opal or alabaster-like glass, which, by the materials employed in its composition, gives a large diffusive effect without undue absorption. The inner globe is often also given a yellowish color or absorptive effect for the disagreeable violet rays, of which the long arc flame is so strong a source.

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[1] Read before the N. E. L. A. Abstract.

Owing to the traverse from side to side of the arc between the square ended carbons, the direction in which light is emitted from the arc most effectively is undergoing continual and very great changes, so that the intensity of light in any given direction may, in a few seconds, vary several hundred per cent., and with a perfectly clear glass inclosing globe this variation would not only be quite noticeable, but in many cases intolerable. The diffusive power of the glass, however, is such, in the case of the opal coating, that the traveling of the arc is, in large measure, compensated, and the general effect is that of a very steady, uniform light. Were it not for the diffusive power, the color of light, as well as the intensity, would change greatly; as when the arc happened to be on the side of the carbons away from the observer, the light would then be in greater proportion from the purple or violet arc flame, and less from the glowing ends of the carbons themselves.

The carbons to be used in an "inclosed arc" should be of the very highest grade as to purity, not too hard or dense, as straight as possible, uniform in diameter and circular in section, and should be obtained of as near a standard diameter as possible, so as to avoid the necessity for adjusting the caps of the inner globes to the size of the carbons. It is necessary that the caps should fit pretty closely around the carbons to avoid leak and consequent reduction of life. Leaks of air into the inner globe must be carefully avoided, if any reliance is to be placed upon a lamp for a given run without recarboning.

The mechanism of an inclosed arc lamp to be run singly in branches from 100-volt circuits is naturally very simple. Since the lamp regulates entirely by variations of current on its circuit, a simple series magnet suffices. No cut-out other than a fuse in the lamp branch is needed. In the use of "inclosed arcs" instead of "open arcs," one does not escape from the necessity of using in the branch with the lamp a choking resistance.

For the purpose of discovering the minimum drop of potential required to exist over a dead resistance in circuit with arcs on constant-potential mains, the writer instituted and had tabulated a series of tests in which the resistance in circuit with arc lamps was gradually cut down along with the line voltage, while the current and voltage of the arcs were maintained the same. A set of tests was made with two Thomson '93 lamps in series, using at one time plain National carbons, and at another a cored upper of one-half inch diameter, and solid lower carbon of one-half inch diameter. Also a set of tests was carried out with eighty-volt inclosed arc lamps adjusted for currents of different amount at different times. During each test the line voltage was lowered and resistance cut out until instability of arc and current resulted, while up to that time the current and voltage of the arc were kept the same during the particular test.

The general result of these tests was as follows:

Two '93 Arc Lamps in Series, with Variable Resistance.—One-half inch National Carbons: With 45 volts at each arc and a current of 9.6 amperes in the lamp branch, line voltage could not be reduced below 110 volts. This would give a drop of 20 volts over resistance and lamp magnets; with 45 volts at arcs and 7.9 amperes, the limit was reached at 108 volts on the line; with 46 volts at arcs and 6 amperes, the limit was 108 volts on the line.

Two '93 Arc Lamps in Series, with Variable Resistance.—Carbons, ½ inch cored upper; ½ inch solid lower. With 46 volts at arcs and 15 amperes current, the limit was 106 volts on line; with 46 volts and 12 amperes, the limit was 104 volts on line; with 46 volts and 9.4 amperes, the limit was 108 volts on line; with 45 volts and 7.3 amperes, the limit was 104 volts on line; with 42 volts at arcs and 6 amperes, the limit was 98 volts on line.

Test of 80-Volt Inclosed Arc Lamp, with Variable Resistance in Its Circuit.—Solid upper and lower 7-16-inch "Electra" carbons: With 75 volts at arc and 7 amperes, the limit of line voltage was 88 to 90; with 74 volts at arc and 6 amperes, the limit of line voltage was 92 to 94; with 75 to 76 volts at arc and 5 amperes, the limit of line voltage was 92 to 94; with 78 volts and 4 amperes, the limit of line voltage was 98 to 100; with 76 volts and 3.2 amperes, the limit of line voltage was 100. (Carbons, ⅝-inch "Electra.")

The above tests are, doubtless, sufficiently accurate to show the main point very clearly. This is that a certain line voltage as a minimum is absolutely necessary in working arc lamps on constant-potential lines, whether they be open arcs or inclosed arcs. Thus, two 45-volt arcs in series, with uncored carbons like the brand known as "National," cannot be safely worked below 110 volts on the line with resistance in series with them. More than 110 volts should, of course, be maintained for safety of the service. The tests show, also, that, with a cored upper carbon, the limit is lowered several volts on the average, and it is known that the voltage of the arcs may be safely reduced somewhat when cored positives are used.

It is also shown that a 75 to 80-volt arc, run upon a constant-potential line, is stable at considerably less line voltage than the open arc. It would appear, also, that, with either open or inclosed arcs at ordinary current strengths of from five to ten amperes, the steadying resistance in the branch is required to cause a drop of about 15 to 20 volts, or waste energy at the rate in watts of fifteen to twenty multiplied by the amperes of current used in the lamp.

What the development of the art would have been if the voltage of our incandescent circuits was, as originally set, say, 90 volts, instead of 115, is a subject for meditation.

The running of single alternating-current arc lamps on constant-potential circuits is facilitated by the ease with which, by a transformer or compensator, the potential required for the lamp may be obtained.

An alternating arc is peculiar, and different from the continuous-current arc in a number of important particulars. The fact that the arc is extinguished between successive alternations at the zero points of the current wave, and at a rate equal to double the periodicity, results in the musical sound of the arc, which may become a source of annoyance. The same cause gives rise to difficulty in starting the arcs without having them chatter, for until the carbons get strongly heated the arc is not re-established after extinguishment with the carbons separated. With cold carbons, the carbons must touch each other after an extinguishment at the zeros. Hence, the carbons must be separated very slowly, while a large current flows so as to strongly heat their ends, or a higher potential than that to be used in running the lamp after starting must be applied at first. Another way is to employ a resistance, or, better, a reactive coil in circuit with the arc lamp, so as to change the character of the potential at the lamp terminals, which then becomes less than that of a constant potential, and, in fact, begins to approach, in a measure, constant-current supply. But in the use of a resistance or reactance in circuit with the lamp, it is, of course, necessary to increase the potential of the line accordingly, so as to give the proper potential to the arc; while both expedients involve a loss of energy. It is found not to be practicable to run alternating arc lamps on circuits much below forty cycles; the common rates of sixty and 125 are well adapted to the case.

The efficiency of the alternating arc as a source of light has been shown by Prof. A. E. Blondel, in a recent paper, to be quite variable. It depends on the length of arc used with the particular carbons employed, and on the diameter of the carbons, as with continuous current. It also depends on the form of the wave of the alternating current. It was found that, with a rectangular wave alternating current, such as may be produced by reversing a continuous current by a commutator, the light given out was as seventy-nine to fifty-nine in the case of sine wave currents. This should follow from the fact that the extinctions, as Blondel pointed out, were instantaneous in the first case, and lasted for about one-quarter of an alternation in the case of the sine wave.

The writer takes occasion to express the opinion that, with very flat-topped waves, or waves approaching closely to rectangular waves, the limit of periodicity would be found far below forty per second, as regards the maintenance of an arc. If the reversal or passage through zero is quick enough, almost any reduction of periodicity would become possible. There are, however, practical considerations which set the limits in such a case.

Soft carbons, or those best suited to readily furnish considerable volatile matter, seem to be best adapted to alternating-current arcs, and they are frequently cored. The color of the light suffers some in consequence.

THE AMERICAN LIGHTING COMPANY FOR BANGKOK, SIAM.

One of the most important and probably remunerative concessions that has been granted in Siam for some time past was signed on Saturday night by the minister of finance, says the Siam "Free Press." The concession in question grants to Mr. L. E. Bennett, an American engineer, the exclusive right to work the concern known as the Siam Electric Light for a period of ten years, with the option of holding the concession and all exclusive rights for an additional ten years, at Mr. Bennett's pleasure. The terms of the contract give Mr. Bennett the exclusive right to light Bangkok and suburbs.

The palace authorities guarantee to patronize the lights and to take double the candle-power now in use for the palace, public departments and streets. At the present time the estimated quantity in use is 30,000 candle-power, which the Siamese will increase to 64,000.

For the above purposes a local company has been formed with a capital of 100,000 ticals, to make necessary repairs and alterations, and increase the efficiency of the concern. This sum was promptly taken up in a few hours on Saturday night by a few local business people, and, judging by the eagerness to obtain shares of 1,000 ticals each, ten times that sum might have readily been covered locally. There is not a business house in Bangkok that will not patronize the new venture, and we may safely assume that a great and rapid development will take place in Bangkok in the manner of lighting public offices, streets and private residences with electricity. For all concerned, the concession is a sensible departure, and one which will prove as advantageous to the Siamese treasury as to the concessionaire and those persons fortunate enough to have obtained interests in the company.

THE WELSBACH INCANDESCENT GAS LIGHT FOR UTILITY AND ECONOMY IN STREET LIGHTING.[1]

BY H. WILKIEMEYER.

On the thoroughfares of great cities, where the business blocks and factories stand on the inner edge of the pavement, there can be no more powerful agent in turning night into day, brilliant as when the sun hangs high in the heavens, than the electric arc. The vigilant eye of the night watch can scan the entire length of street and alley and the thief and midnight prowler, the thug who seeks the dusty shades will, like Othello, find his occupation gone.

But go with me to the side streets of the village or the suburbs of the great city where the houses stand back from the street, the pride and glory thereof being the spacious and well-kept lawn, where the pavements are shaded with rows of trees that meet almost in the middle of the street and lend a sylvan beauty to the scene.

What is needed to make safe an avenue of this kind, the pride and glory of the place? Is it the arc electric light hung high in the air and throwing its light in the heavens? No, it is not calculated for such use.

There can certainly be no claim that the electric arc lamp is of any practical use in the residence portions of towns, cities or villages, where trees line the streets.

My personal experience is that the public is better pleased and receives better service from the use of the Welsbach than the arc electric. In my own city the Board of Public Works which had displaced the use of gas in 1882, in accordance with the law of the city charter prior to the expiration of the contract made in 1882 and 1885, and which expired in 1895, advertised for bids to supply 400 electric lamps of the nominal 2,000 candle-power. The Welsbach burners having proved satisfactory, the Board awarded us the contract, stipulating the placing of 250 arc lamps and an indefinite number of gas posts fitted with the Welsbach burner.

We now have in nightly operation somewhat more than 400 street gas lamps with Welsbach burners, and they are so universally popular that up to this time we have not yet erected the full complement of 250 arc lamps provided for in the contract, by a considerable number.

For this burner, the price received from the city is $20 per year, every night all night, or $1.66 per month for each gas post. The 2,000 candle-power electric arc lamp costs the city $95 per year, or about $8 per month, and does not give the police protection afforded by a very few Welsbach lamps.

January 1, 1896 we had 155 lamps in operation.

The following table shows the cost of renewals:

	Mantles.	Chimneys.
In January connected 105 posts, renewals required.	3	2
In February ....renewals required.	26	2
In March connected 56 posts, renewals required.	25	4
In April connected 2 posts, renewals required.	62	7
In May connected 11 posts, renewals required.	54	2
In June connected 12 posts, renewals required.	79	3
In July connected 9 posts, renewals required.	96	4
In August connected 2 posts, renewals required.	80	8
In September	80	7
In October	92	4
In November c'n'c't'd 26 posts, renewals required.	65	5
In December con'ct'd 2 posts, renewals required.	63	2
Tot. No. of lamps 380; renewals, all lamps in use.	724	50

The total cost of breakage and renewals during the twelve months of the year 1896 was only $276.75.

But what is being done in the way of improvement in outdoor lighting in the great cities of this and other countries? In Boston, New York, Baltimore, Buffalo, Providence, Richmond, Chicago and Philadelphia the electric light is being superseded by the Welsbach gas burners.

DISCUSSION.

Mr. Ferrier.—I find, especially in the South, that we have trouble with flies and bugs in the Welsbach burner.

Mr. Highlands.—It is hardly necessary to say that the article just read, with its inferences and deductions, is a somewhat surprising one to present to a body of gas engineers, men whose sole ambition is to make gas cheap, and sell plenty of it. In the first place, the gentleman states that, on the thoroughfares of cities which are lined with business blocks and factories, the arc light is undoubtedly the best for street illumination. What a position this is in which to put the poor gas man who has no electric light plant. He must surrender the streets where he has large mains and an unlimited supply of gas to the electric light company, and on the outskirts of town, where he has no mains, he must surrender it to the man who is furnishing gasoline lamps. Thus you have him between Scylla and Charybdis, and he is continually harrassed, on the one hand, by the electric light man for more territory, because forsooth there has been another factory or another business block built a little further out, and some parts of several streets either have very few trees, or those they have are little ones, and, as a consequence, from this gas man's standpoint, the electric arc is certainly the best. On the other extremity, the gasoline man insists in pushing his lights a little further into the territory, because he is furnishing a much cheaper light; but it is not from this standpoint I especially wish to draw your attention. I cannot see how the gentleman can justify himself to his company in recommending the use of the Welsbach lamp instead of the arc lamp, when he had the opportunity of furnishing either one. Let us see how it figures out. He says he has erected about 400 gas lamps with Welsbach burners, for which he is receiving $20 per year each. With an estimated consumption on those lamps of, say, 4 feet per hour, and running 4,000 hours per year (which is a fair average), we find he is furnishing, through his 400 lamps, 6,400,000 feet of gas, for which he is receiving $8,000 per year, or exactly $1.25 per 1,000. Now, suppose he had gone to my friend, Mr. Lloyd, and bought a gas engine to use for running a dynamo for supplying arc lights. The accepted rating of power for a 2,000-candle arc light is 1 indicated horse-power for each arc light, and any good gas engine will furnish 1 horse-power with 18 feet of gas per hour, which would mean 72,000 feet of gas per year for each arc lamp, on the same basis as we have already figured the Welsbach light. Now, on this basis, the 150 arc lamps that he has displaced would use 10,800,000 feet of gas per year, and at the price he names, of $95 per year, he would have received for this gas $14,250, or $1.31 per 1,000 feet. Now, if these deductions are correct, what has he done? He has deliberately thrown away a chance of selling 10,800,000 feet of gas to be used on his own premises for $1.31 per 1,000, and accepted one of selling 6,400,000 feet of gas, to be distributed all over the city, at $1.25 per 1,000 feet, and I question whether the attendance on the arc lamps would be any more expensive than it would be on the Welsbach street lamps.

Several members inquired as to methods for keeping out bugs, and the adoption of a screen was recommended as having proved efficacious.

As regards chimneys, Mr. Wilkiemeyer said he used mica chimneys, as they did not break so easily as glass. The experience at Windsor, Conn., had shown both glass and mica to be defective and now no chimney was used in that town. The breakage of mantles by jarring due to passing vehicles was also discussed and several remedies suggested.

Mr. Prendergast stated he had had experience with 2,000 Welsbach lamps during the year and pointed out the different requirements for an indoor and outdoor Welsbach lamp; also the precautions necessary and device to prevent explosions and shattering of the mantle when lighting the lamp. He employed a vibrator to take the jar of passing vehicles, and advocated the use of a chimney in order to get the best efficiency from a Bunsen burner.

Mr. Prendergast then read a communication to Mr. Martin Mahoney, president of the Welsbach Street Lighting Company, from Mr. C. C. Simpson, of the Consolidated Gas Lighting Company, of New York. In this letter Mr. Simpson details the several unsuccessful experiments tried with Welsbachs as far back as 1894, and to their final successful employment on the Boulevard, where there were now 304 double lights. Recently 157 Welsbachs had been ordered for lighting

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[1] Abstract of a paper read before the Pacific Coast Gas Association.

Twenty-fourth and Twenty-sixth streets from Sixth avenue to the North River. A letter was also read from Mr. S. McCormick, Superintendent of Lamps, of New York, giving similar information regarding the use of Welsbachs in New York.

In response to Mr. Highland's criticisms Mr. Wilkiemeyer stated that he had to meet certain conditions. In his case the city wanted 400 lamps instead of 200, but did not want to spend any more money than it had done before.

MUNICIPAL GAS NOT A FAILURE.

BY W. C. DODGE.

As a reader of The Engineer I have noticed for a long time the various articles, editorial and otherwise, against the idea of municipal ownership of gas and electric lighting plants. If I ever get the time I propose to furnish some facts bearing on this subject, but just at present I want to say a few words in reply to an article in The Electrical Engineer of May 19, entitled "Municipal Gas a Sad Failure."

That article was based, as stated, upon a report of a committee of the Pennsylvania Legislature. It is stated that one of the witnesses estimated the loss to the city by its investment in its gas plant at "not less than $700,000 per annum;" that the cost of the labor in the works was about three times what it ought to be; the production of gas was but one-third of what it ought to be, and that the city does less than half its own lighting, buying part of its supply from a private company at 37 cents per 1,000 and so on.

It is a very easy matter for hired or interested experts to figure out for investigating committees almost any result that the committee, for political purposes, may desire, or that interested parties may require. We have had an illustration of that fact in a recent investigation of the gas company in Washington, D. C., by a Congressional committee, in which the most ridiculous and absurd statements were made; but of that hereafter.

Instead of the gas plant being a great loss to the city of Philadelphia, the official report for 1894 shows exactly the opposite. According to that report, from 1891 to 1894, inclusive, there was expended "for material, maintenance, labor, supplies, coal, etc., $10,858,910.58, and for extensions and permanent improvements, $1,050,248.81; a total of $11,909,159.39. During those four years there was turned into the city treasury, as receipts from the gas bureau, the sum of $14,790,404.25, or almost three million dollars in excess of the entire expenditures ($2,881,244.86). In the mean time the price of gas had been reduced from $1.50 to $1.00. But that is not all, for during the same four years there had been furnished free for lighting the streets and municipal offices 2,407,308,398 cubic feet of gas, which, at the same rate that citizens were charged, would amount to $3,299,122, thus making in four years a net profit to the city of $6,180,366.86.

This shows that instead of a loss of $700,000 per annum, as estimated, the city made a clear profit in cash per annum, averaging $1,545,091.71. Surely this is anything but a sad failure; and this, bear in mind, is based upon the official figures—the money actually paid over, and the gas actually furnished for municipal use, and not upon the estimate or guess of interested parties.

It is true as stated that private parties have been seeking to buy the city plant, it being stated that in February of last year a Philadelphia syndicate had offered $20,000,000 for it. They could well afford to pay much more than that, for at the same rate of profit that it has paid the city during those four years, the works would pay for themselves in less than thirteen years, even if there was no increase in the consumption of gas, but which increases constantly.

It is but fair to presume that the estimate and statements made before the committee were so made in the interest of these very parties or others who seek to discredit the city management and compel it to sell that they may get control of the gas works, and in the interest of the contending political mongers, who, as is well known, have long been charging each other with fraud in the management of city affairs.

No doubt the present works, built years ago, could be duplicated at less cost, but so could the gas works of every city in the country. That is no reason why the city should deprive itself of over a million and a half of revenue per annum, and enable a syndicate to take that much or more from the public and put in into its own pockets. The fact that a private company has for the past seven years furnished a portion of the gas for 37 cents per 1,000, shows how profitable the manufacture of gas is, especially water gas, which is now generally furnished, and what an outrage it is to charge the public the prices usually paid.

The reason why the city buys a portion of its gas, is simply because the city works could not supply all that was required for the city and its outlying suburbs. The question of increasing the plant was being considered when this company came in and offered to furnish gas for 37 cents, which offer the city accepted, and made a contract for five years. When that expired the question again arose, but the company had sufficient influence with the city council to prevent anything being done to increase the city plant, and their contract has been continued; but they furnish but a small portion of the entire quantity of gas used, not near one-half, as stated.

I have no doubt that a private company would manufacture gas cheaper than the city does, but the city or citizens would not be benefited a penny; on the contrary, they would be injured to just the amount of the profit now made by the city, as every one can see; but, even if a fact, that does not justify giving to corporations or trusts a monopoly of supplying the public with one of the necessities of life, at a price far above what it ought to be furnished for, as is now done in most of the cities of the country.

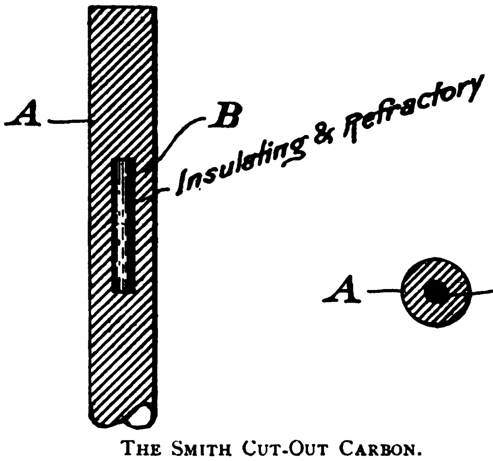
Washington, D. C.

SMITH'S CUT-OUT ARC CARBON.

In spite of the fact that arc lamps are provided with automatic cut-outs, to protect the lamp in case the carbons burn too short, the fact remains that carbon holders are frequently destroyed owing to the failure of the cut-outs to operate. This is especially the case with enclosed arc lamps or single carbon lamps used for interior lighting since these lamps are apt to be trimmed irregularly.

In order to make the cutting out of the lamp absolutely positive, independently of the lamp mechanism, Mr. James D. Smith, of Washington, D. C., has invented a type of carbon which contains within itself an automatic cut-out, as it were. This is accomplished by incorporating in the carbon a piece of insulating and refractory material, such as burnt fire clay, to interpose itself in the path of the arc and extinguish it.

The accompanying engravings show the new carbon, in longitudinal and cross section, A being the carbon proper and B the refractory insulating material. The position of the cut-out is between the place where the carbon is grasped by the carbon-holder and the arc end of the carbon. When the lamp is in operation, the arc consumes the carbon as far as the cut-out, which then interposes itself in the path of the arc and extinguishes it.



The Smith Cut-Out Carbon.

It will be evident that there is no need to make positive and negative carbons of this kind of certain lengths when trimming, for they will automatically cut out the lamp before the arc reaches the carbon-holders. As a result also the carbons can always be entirely consumed, which effects considerable economy.

We understand that the Baldwin Electric Meter Company, of Washington, D. C., is interested in this new cut-out carbon.

BEMENT, ILL., ELECTRIC LIGHT AND POWER COMPANY say: "Your paper is good and instructive and thoroughly up to date."

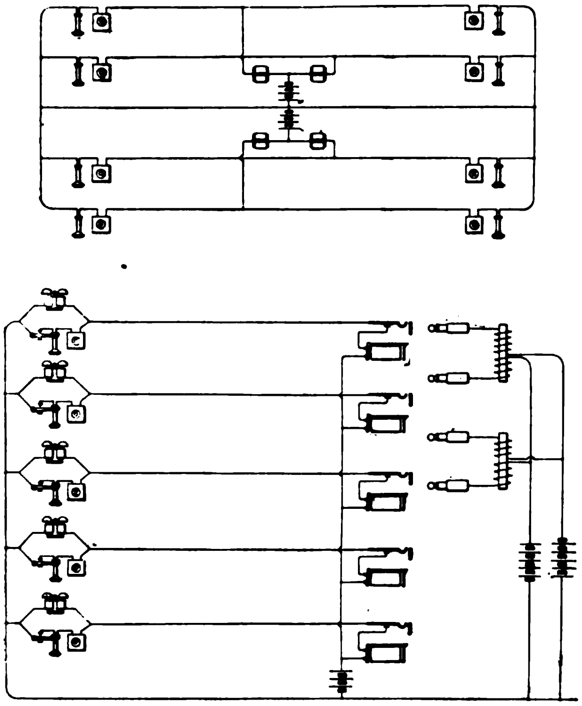
WARRENSBURG, N. Y., ELECTRIC LIGHT WORKS write us with regard to electrical papers: "For us there is none better than The Electrical Engineer."

TELEPHONY AND TELEGRAPHY

THE McBERTY COMMON RETURN TELEPHONE SYSTEM.

ON the so-called common return system of telephony it has been of course impracticable to reduce the resistance of the cross-wire to a very small amount on account of the cost of metal for the conductor. Hence such systems have been subject to cross-talk between different lines simultaneously in use, one line or group of lines acting in joint with the return-wire as a return for another line.

In a system recently devised by Mr. F. R. McBerty, of Chicago, the inventor aims to attain the equivalent of a reduction of resistance of the cross-wire by connecting to the different lines sources of current of opposite polarity, the lines being separated into suitable groups for this purpose, whereby in a considerable group of lines in use at the same time a tendency to produce a condition of no potential at their common junction with the return-wire may be created.



FIGS. 1 AND 2.—THE McBERTY COMMON RETURN TELEPHONE SYSTEM.

In this system the ideal condition would be that shown in Fig. 1, in which the lines are connected together for conversation in pairs, whose inner ends are connected to the different sources of current, the currents being equal in the two members of each pair. Under such a condition no difference of potential would exist between the two ends of the return-wire, and the resistance of the wire would be perfectly eliminated.

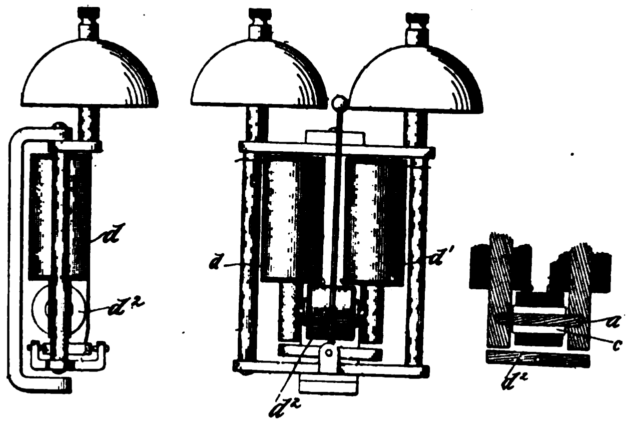
Under more usual conditions of a telephone exchange the different lines are not normally connected with sources of current for the supply of their substation transmitters, but become connected with such sources through the plugs and plug circuits for uniting different lines. Commonly a repeating coil is included in each plug circuit to effect the conductive separation of the lines in order that the line of lower resistance may not divert the current from its mate of higher resistance. In such a system Mr. McBerty contemplates the use of sources of current in the manner before described, one pole of each battery being connected to one member only of each pair of plugs. Then of two united lines one derives current from one pole of one of the sources, while the other derives current from the opposite pole of the other source as shown in Fig. 2. Thus in such a system also the connection of lines in pairs by means of plugs and plug circuits would result in a tendency toward a condition of no difference of potential between the terminals of the return-wire of the lines.

In ordinary exchange practice it would not be practicable to run a single return-wire to all the stations of the system, nor to have the points of connection of the line wires and return-wire identical. The proper grouping of lines likely to be used in connection with each other with a common return-wire for attaining the best results with Mr. McBerty's system would be a matter of judgment.

SCRIBNER'S TELEPHONE BELL MAGNET.

ON a recent patent issued to Mr. C. E. Scribner, of Chicago, that inventor describes a polarized signal-bell for telephone lines which remains undisturbed by current continuously flowing through it, but is sensitive to alternating signaling currents.

The essential novelty of the bell, shown in the accompanying engravings, Figs. 1 and 2, consists in adding to an electromagnet a bridge or magnetic shunt a, Fig. 3, between the poles of the electromagnet and a magnetizing helix upon the bridge, d^2, adapted to nullify the polarity of the magnet poles, or, in other words, to create a condition of no difference of magnetic potential between the poles. The armature, b, is by this device perfectly shunted by the bridge while continuous currents traverse the magnet helices.



FIGS. 1, 2 AND 3.—THE SCRIBNER TELEPHONE CALL BELL.

For the purpose of making the magnet responsive to alternating currents this bridge is surrounded by a closed conducting circuit, as by a tube of copper, c, by which rapid fluctuations of the induction in the bridge are obstructed, so that when the magnet coils are traversed by rapidly varying currents the null condition of the magnet poles is not attained, and the poles act upon the armature in the usual way to effect its movement.

Coils d, d^2, and d' are connected in series. The coils d and d' may be of the usual size and resistance—say of one thousand ohms. Coil d^2 may be of any suitable resistance, but should have a magnetizing effect with relation to coils d and d' such that it may produce in the bridge a' an induction equal to that produced by coils d and d' in the core a, and in the same direction in the circuit.

INDEPENDENT TELEPHONY IN DETROIT.

A SPECIAL dispatch from Detroit, Mich., of June 9 says: The Detroit Telephone Company, now well established as a rival to the Bell, is meeting with most remarkable success. More than 3,000 telephones are connected and in running order, and 4,000 are promised to subscribers by July 1. Thirty days after that all of the 4,700 'phones contracted for will be in place, and the Bell people will find themselves in an inferior position in the telephone business in a town where they have long ruled supreme at exorbitant prices.

The Detroit company has made a uniform price of $25 for residences and $40 for business places, and has taken three-year contracts in every case. Metallic circuits over copper wires are furnished to every one, and the boxes are of oak, large and handsome. The Bell has met the competition only where there are six people on a line, prices for independent wires remaining the same. The 'phone used by the Detroit company is largely the invention of its own engineer, who has patents pending that he declares will make them absolutely independent of the Bell people. President Holmes, however, says the granting of this patent seems to him of small importance, as in the first place he does not believe the Bell company can be forced into commencing suits, and that if it does it is as sure to be beaten as the sun is to shine.

For a time there were complaints of poor service, owing to the confusion of rushing such a vast number of wires in on a new switchboard, but for some weeks the service has been nearly if not quite equal to that of the old company. The switchboard in use is a marvel of convenience, and is also the invention of the company's engineer.

In connection with the Detroit company there has been formed the State Line Telephone Company, which is rapidly pushing copper toll lines into the State. The only one completed is to Mt. Clemens, with a cut of 60 per cent. in the tolls. Big gangs of men are now placing poles between here and Monroe, for use on the Toledo line, and an equally large force is pushing for Jackson via Ypsilanti and Ann Arbor. Every line built will connect with the Detroit line and furnish a fine income under traffic agreements. The new system is an unqualified success.

The contracts the Detroit company now has, if it got no more, insure it a handsome surplus for the coming year, after paying running expenses, interest on bonds and a very fair dividend on stock, so President Holmes declares.

POLE CLIMBER AND POLE SINKING TOOL ON THE U. S. MILITARY TELEGRAPH LINES.

BY CAPT. W. A. GLASSFORD, U. S. A.

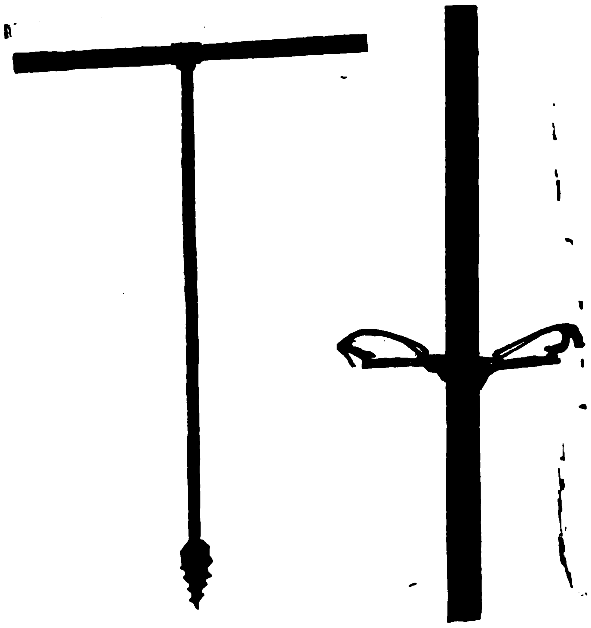
THE military telegraph lines of our army have been factors of no little importance, not only in the administration of the army, but in assisting to develop the mining and other interests of the frontier. Formerly, two systems of military lines extended from the Missouri River to the Pacific, almost paralleling the northern and southern boundary lines. Branches from these and from the commercial wires along the Union Pacific Railway reached about every army post from the Gulf of Mexico to British Columbia. The moving wave of emigration to the frontier settlements and the principal mining camps has been overtaken by the building of other trans-continental railroads and branches with commercial telegraphs.

With this construction of the better means of transportation and of communication of intelligence, the military lines, which were mostly of a semi-permanent nature, have largely given way. Yet, with many of the army posts, especially those near Indian reservations, the military telegraph remains as their only means of rapid communication. These military lines of telegraph are usually built along routes or trails over which few pass except the Indian, the freighter, and occasionally officials of the government. The country thus traversed is mostly desert or prairie plains, and forest covered mountain passes. In both, the prairie or forest fires would be destructive to wooden poles, while in the desert, wooden poles are tempting fuel for the camping freighter. To provide against the liability of such consuming fires, the supports for the military lines are of tubular iron. These iron poles are 22 feet long and 2½ inches in diameter, and each weighs about 75 pounds. Such poles are lighter than wooden ones and much less bulky; they are easily transported on cars and wagons and readily "snaked" along trails up mountain passes.

But in building and repairing, both of which are done by soldiers, it is necessary to climb these slender and smooth poles—a somewhat difficult operation. Various means to accomplish this have been improvised, such as utilizing wooden and rope ladders, which are attached to the iron cross-piece that passes through a hole in the pole, about 4 feet from its top, and which serves the purpose of a foot-rest. These permanent foot-rests, while serving the requirements of a support for the builder or repairman when attaching the wire to the insulator, have to be reached, if not by climbing, by means of a ladder; and they offer a tempting object to the half wild Mexican vaquero or the festive cowboy of the region through which the line passes, for testing his skill with the lariat and the strength of his horse in bending the pole. It was to overcome these objections that the Signal Officer when constructing a line along the Arizona-Mexico border last autumn, described in The Electrical Engineer of December 30, 1896, conceived the idea of a pole climber which would do away with the foot support as well as with the difficulty in climbing.

Such a climber is shown in the accompanying engraving, and consists of a collar of wrought iron, in two semi-circular halves; two steel foot pieces, two bolts for holding the collar and foot pieces together, and two toe straps. All the parts can be readily made by any blacksmith. The wrought iron collar is held close to the pole by two bolts which pass through the ends of the halves, at the same time passing through the two steel foot pieces. The foot pieces are about 7 inches long and bent at the inner end which is serrated to form a dog; these foot pieces are fulcrumed upon the bolts, and when in a horizontal position, the serrated ends clutch the pole, but when lifted, permit the whole device to be moved up or down the pole readily. The toe straps can be made of wire or leather and enable the toe to raise the foot pieces and thus release the grip of the dogs upon the pole. A convenient locking bolt permits the device to be readily and quickly placed about the pole and secured in position.

The lineman inserts his feet within the straps, and grasps the pole, holding himself to it, then raising the feet by bending the knees he lifts the device upward on the pole, and as soon as he throws his weight upon the foot pieces the dogs clutch the pole and the climber then raises himself erect, regrasping the pole from the new and higher position. By successive movements of this kind he ascends as far as may be desired, and standing upon the device he places the wooden plug into the top of the pole, screws on the insulator and ties the line wire thereto. The lineman can stand on one or both feet as may be desired, shift his position to any side of the pole at pleasure, and, when through, by drawing his feet toward the pole, thus raising the levers slightly, the grasp of the latter on the pole is released and the lineman slides to the ground. This device has been issued to and tested with invariable success by operators and repairmen on the Signal Corps lines in the Military Department of the Colorado, which includes Arizona, New Mexico, Utah and California. The illustration shows these climbers attached to the pole ready for the lineman to ascend.



AUGER AND POLE CLIMBER, U. S. MILITARY TELEGRAPH LINES.

In the construction of military lines, rapidity of erection is often a desideratum, and various means have been employed for the rapid sinking of the poles in the ground. When alluvial soil, free from gravel, is met, the well known post hole auger is usually employed. It is, however, objectionable with a pole of small diameter, because the pole is so small as to prevent the insertion of rock around the pole as well as tamping when filling the hole. A device for boring into alluvial soil was made for this work in Arizona, and used in the flats of the Sulphur Springs Valley.

This new device consists of a steel cone, into the base of which is secured an iron shaft about 3½ feet long, the other end of which is provided with a cross-handle similar to that of an auger. The cone, resembling a gimlet, has a steel worm or leading screw beginning at the point of the cone, the threads of which are about an inch apart along the cone, which forms the grooved body. By screwing this cone into the ground the earth is compressed about it, and so a clean hole is made without bringing to the surface any dirt. Into this hole, a trifle larger than the diameter of the pole, the latter is placed, and the pressing outward of the soil by the tool takes the place of tamping. In suitable soil this borer can be used, and a hole 3 feet deep made very rapidly. The tool is shown in the illustration.

AUTOMATIC TELEGRAPHY.—I.

BY PATRICK B. DELANY.

RECENT discussion of the relative merits of automatic telegraphy and the Morse system, and the necessity, from an economical standpoint, for a change in the direction of larger utilization of the carrying capacity of telegraph wires seems to call for more conciseness of claims for the Morse in its various adaptations, and for the automatic system in use, as well as the one proposed.

One would suppose that the speed of simplex, duplex and quadruplex Morse would be reliably ascertained by this time, and that as old and well established a system as the Wheatstone would afford but small range for discussion as to its working, but it seems that the estimates of all these methods vary according to the bias or prejudice of those contending, until there is much the same definiteness about speed estimates as there would be in describing a distance by saying it was "as long as a piece of string."

Unfortunately in this country no one in authority seems to be willing to average up an average day's work with average operators. We have sending tournament records by the Morse which show that 52 words per minute have been transmitted by hand for five minutes. This top notch record was made nearly ten years ago and stands to-day unbeaten, but in justice to other operators who took part in the contest, it must be admitted that the manipulation of this record breaking operator was of a very doubtful quality, and would not have stood the test of accurate reproduction by a recorder.

At the last trial, 1893, with more careful arrangements for proving the quality of the work, five operators reached a speed of 248, 239, 242, 236 and 248 words respectively in five minutes, or an average of over 48 words per minute. An analysis of the words, however, show that they averaged but a small fraction over four letters to the word, while the average for words is fixed at five letters. This would make the actual speed, including punctuations, 41 words per minute, which is certainly a remarkable performance, for on the basis of three impulses to a letter, it calls for over ten impulses per second, or 20 movements of the key, ten down and ten up, and considering that about two-thirds of the impulses were dashes, equalling in time about three dots each, it seems indeed a wonderful achievement. It may appear strange, but it is nevertheless a fact, that an expert operator can make more impulses per minute writing regular Morse with the average number of dots and dashes than when making dots alone.

It seems that expertness in key manipulation and penmanship are equally balanced. No sender can send so fast but some receiver will be able to write it out legibly, and no penman can write so fast but a sender will be found to push him to his utmost. When it comes to typewriting from a sounder it is quite a different matter. The expert typewriter receiver can take his ease with the fastest sender, and can only be pushed by abbreviation of words according to the custom of operators when conversing or transmitting press dispatches or other matter admitting of considerable latitude from the absolute accuracy required in regular messages, and where the text guides the receiving operator. Indeed, it is impracticable for any operator to follow a sounder for any considerable length of time at over 40 words per minute fully spelled out. The strain of concentration would not permit it, while with abbreviations a speed equal to 60 words per minute may be translated by ear and typewritten in full.

Taking 41 words per minute as a well ascertained maximum for the Morse, it does not follow that it is easy to estimate the average speed, for there are no figures on the minimum side. There are no "booby prizes" in telegraph contests. Any sound reading operator can, however, get a fair idea of the expertness of the inexpert by lingering a moment within the sound of an ordinary branch office outfit, or if, while waiting for a train at a suburban station, he lends his ear to the struggle going on over a "way" wire. The fairest deduction from meager facts, observation and speculation on the subject places the average Morse simplex speed at 15 words per minute. As the maximum proves, the system with good wires and expert operators is equal to a higher average, perhaps 25 words per minute, but apparently the telegraph companies do not think that circumstances warrant either one or the other in the majority of cases.

Polar duplex Morse will average about 18 words per minute for each circuit, inasmuch as it not only works quite as well, if not better, than simplex with single current, but because only competent operators are as a rule assigned to these circuits. The quadruplex is also generally manned with able operators, and notwithstanding its lame leg and many other infirmities will probably average 15 words per minute for each circuit.

Taking the quadruplex as the highest development of Morse telegraph in use in this country, and fairly assuming that this system would be used between points where automatic telegraphy would be warranted, 60 words per minute with eight first grade operators over the best wires, for distances not exceeding 500 miles, without repeaters, is a liberal basis for comparison with machine or automatic methods of working.

At present the Wheatstone is the only automatic system in use, extensively in England and to a limited extent in this country, France and Italy. But, as it is not the intention to discuss foreign methods and conditions, the operation of the Wheatstone system in America should, as in the case of the Morse, be alone dealt with.

In the "Telegraph Age," December 16, 1894, Mr. Wm. Finn gives the speed of the Wheatstone duplex between New York and Chicago for 17 days at intervals between May and October, 1893, as 356 words per minute total both ways. As these 17 days were selected from 120, it is fair to presume that they bear about the same relation to the ordinary average speed as 41 words per minute, highest Morse rate, bears to the average of 15, or a little more than double the ordinary rate. One hundred words per minute each way between New York and Chicago is a liberal allowance for the duplexed Wheatstone. Mr. Maver in his excellent work, "American Telegraphy," places it at from 150 to 200 words, very creditable work, considering that it is done through a repeater in the middle of the line. One hundred words per minute on the basis of 5 letters to a word and 3 impulses to a letter requires 25 complete excursions of the relay armature per second in each circuit.

It may be said that best speed attainable with the Wheatstone under most favorable circumstances is 300 words per minute simplex and 400 words per minute duplex. Two impulses, marking and spacing, are necessary for each dot and dash. At 300 words per minute the relay receives 150 impulses per second and its armature must make 75 excursions in the same time. The armature must also do work, either in relaying the signals into a local circuit for operation of the ink recorder, or in making the record direct. In either case the movement of the armature must be considerable to prevent sticking at its contact points, or smudging of the signals on the tape. On circuits without repeaters the average working speed of the different systems in use in this country may be stated as follows:

Simplex Morse	15	words per minute.
Duplex Morse	36	" "
Quadruplex	60	" "
Simplex Wheatstone	125	" "
Duplex Wheatstone	200	" "

The use of a repeater would impair these speeds probably ten per cent. Repeaters are only used to improve the working, but it is for the improvement of a bad condition, or when the wire is too long for direct working.

To some, these estimates may seem low, but they include all the stops and delays, with exception of an actual breakdown to the apparatus or interruption of the line. The Morse sender is stopped and sent back by the receiver. The Wheatstone machine must be fed with tapes.

The proportion of time taken up in this way is difficult to estimate, for as in most things much depends on the man. One incompetent operator on a quadruplex, like a clumsy dancer in a set will demoralize the entire performance, while an inexpert handler of the Wheatstone machine will waste much valuable time.

There can be no question, however, that on the basis of relative speeds there is, owing to "breaks," much more time wasted message for message with the Morse than the Wheatstone.

The methods of timing telegraphs have always been very inexact. Sometimes the number of messages sent in a given time is stated, sometimes the number of words. Neither way affords more than the roughest kind of basis for calculation. One message may be as long as a dozen others. All may be unusually long or unusually short. Words have almost the same degree of variation. Land telegraphy employs words averaging about five letters, while cablegram words average seven. Counting by impulses and spaces on a perforated tape is the nearest approach to accuracy, but not until the spaces between the component elements of a letter are reckoned will true records be available.

The feed row of holes in a Wheatstone tape affords an excellent means of timing, but here the trouble is absence of a uniform basis of calculation. Neither the impulse nor the feed row method answer alike for all systems of automatic transmission. The regular Wheatstone system sends two impulses, positive and negative for each signal whether it be dot or dash, while cable transmitters use but a single impulse. In the regular Wheatstone the time elapsing between the beginning and the end of a dash is represented by blank tape equivalent to the room taken up by three dot perforations, the feed row of perforations being maintained in their unform regularity of distance from each other. From an economical standpoint of utilization of time the system employing a single dot or impulse alike for dots and dashes has an advantage of nearly four to one.

Indeed, it is hard to conceive of any more efficient utilization of the signalling capacity of a line than by the use of a single impulse for a dot or dash. No improvement is possible by the dot and dash code, nor can it ever be approached by any single impulse to the letter sytem, owing to the time required in the span between selections of letters, such as occurs in sending the word "Aztec" for instance; the time required for the gamut of the entire alphabet is consumed in sending the first two letters. The word "bay" by this or any other revolving type wheel system would require the time of 50 impulses or letters to print, while with the dot and dash single impulse plan, it could be transmitted in the time of twelve, allowing the time of one impulse for spacing the letters. Although the dot and dash code averages three impulses to the letter for one impulse for the printer, no time is wasted in rotative selection by the former, and when it comes to the duration of the impulses, the time necessary for operating the electro-magnetic and mechanical parts of the printer is, at 120 revolutions of the type wheel per minute, about twice that required for recording an impulse by the Wheatstone system, and this rule as a matter of course, applies to all the impulses represented by letters interposed between those utilized.

THE BURKE SYSTEM OF CABLE TELEGRAPHY.

AMONG the patents recently issued is one to Mr. Charles G. Burke, of this city, which is so radical in its departure from present methods that it cannot fail to excite keen inquiry on the part of all who are interested in telegraphy. Mr. Burke's invention has for its principal object the adaptation of Morse work to long submarine cables and other telegraph lines where large static capacity is an obstacle to the use of ordinary Morse signals. It also enables messages to be automatically relayed from cable to cable thus doing away with the translation and retransmission of signals now a necessity whenever messages are required to pass over two or more cables.

According to the Burke system, the signals recorded at the receiving station are not caused by the electrical impulses which are transmitted over the line, nor do they correspond with them, but they are made by and result from the action of local mechanical means, which becomes operative only during the intervals between the passage of impulses over the line and after such line impulses have ceased. The impulses are all of uniform duration and need occupy no longer time than the accomplishment of their purpose, which is to momentarily make and break the local circuit which controls the recording mechanism. The impulses simply define the beginning and ending of time, periods which are predetermined to correspond with the dots and dashes of the Morse code. An inked record is made by the recording mechanism of these time periods between impulses, and since they correspond with Morse dots and dashes, so also must their record.

Fig. 1 illustrates a telegraph or cable line with sending and receiving instruments at either end organized to be operated by hand. The keys have front and back contacts and normally the key lever rests upon the front stop, leaving the line free from battery contact. Thus organized, the operation would be as follows: The operator wishing to send would raise his key momentarily from the front contact to the back, thereby sending a current to line which would energize the magnet of the recording mechanism, and momentarily interrupt the ink line normally being made on the receiving tape; in other words, a break would be made in the ink line. The operator would then manipulate the key in the ordinary way. For example, if the letter "I" is to be sent, the operator after lifting the key lever would simply make two dots or two short down and up movements of the key lever, allowing the time of an ordinary dot between the movements. In this way the current is withheld from the line for two short periods occurring between the three up strokes of the key, and the recording mechanism would note these two periods by imprinting on the tape two dots, which would be the letter "I."

If the next letter is to be "N," which consists of a dash followed by a dot, the operator, after letting the key remain down for the time of a space between letters, would again raise it momentarily, and then depress it and leave it down for a time corresponding with a dash, another momentary raise of the key would follow, and then a depression for a dot period followed by a final rise and fall of the lever.

This manipulation of the keys would, of course, at first be attended with some difficulty and would need more or less experience, consequently automatic operation which involves no operative skill is preferable. In Fig. 2 is shown a form of perforated tape for automatic work, together with the record as it would appear in the receiving office. In this form of perforation, the spaces between letters and words are indicated by inked marks readily distinguishable on account of their extra length from dashes. This form of isolation of letters and words secures absolute accuracy, because no misleading combination of the parts of any two approximate letters can be made, and the end of completed words is made unmistakable. In code and cipher messages this form of separating the letters and words would be very valuable.

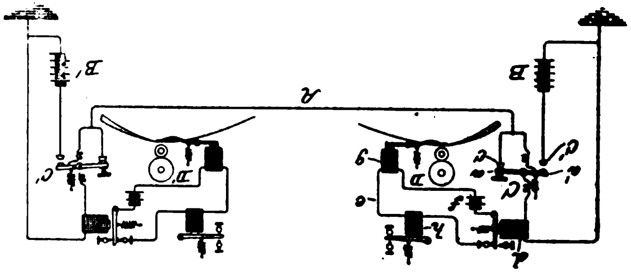


FIG. 1.—BURKE'S SYSTEM OF MORSE CABLE SIGNALLING.

Mr. Burke has devised a perforator specially adapted for preparing this automatic transmitting strip. It is arranged so that the touch of one key will produce a perforation required to transmit a dot, while the touch of a second key produces a dash perforation; a third produces the perforation for spacing between letters and words. Any one familiar with the operation of mirror or siphon recorder keys can operate this perforator without any further experience whatever, the speed being limited only by the operator's skill.

For those who are not familiar with telegraphy or who do not understand the combinations of the Continental Morse code, Mr. Burke has provided a lettered keyboard to be used in combination with his perforator.

An examination of the perforated strip and record illustrated in Fig. 2 will show that the dots and dashes in the record do not correspond with the holes in the transmitting tape, but with the blanks or spaces between them, and since these holes in the tape produce the impulses over the line, the spaces between them must cause breaks in the contact of the battery with the line corresponding with these spaces. The blanks in the record will be found to agree with the holes in the perforated strip and they indicate the impulses over the line. If the line impulses were recorded they would appear as shown at "T," and in such case the blanks between them would constitute the signals. Thus, it will be seen that in this method under no circumstances do the impulses over the line ever become a signal or part of the record, but that in all cases the signals consist of recorded periods of time corresponding with the elements of the Morse code and during which the battery has been withheld from the line.

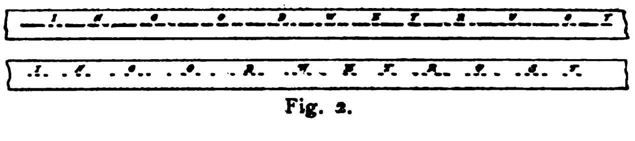


Fig. 2.

As the preparation of the transmitting tape involves no previous experience and since its operation through the transmitter is purely mechanical and automatic, the only actual knowledge required for telegraphing under this new system is sufficient acquaintance with the Morse code to be able to construe the recorded signals.

A complete set of perforating, transmitting and recording instruments adapted to this new system are now being shown at Mr. Burke's office, 48 Broad street, and in combination with one of Mr. Burke's latest improved cable relays they are being operated over an artificial line, presenting and exhibiting the full retarding and characteristic effects of a line of equal resistance and full static capacity of the longest cable now in use. To any one interested in this branch of work a visit to Mr. Burke's office cannot fail to be interesting.

HERTZ WAVE TELEGRAPHY BY THE MARCONI SYSTEM.

(From our London Correspondent.)

At last the truth about the "Marconi mysteries" has been revealed. In a lecture at the Royal Institution on June 4, Mr. W. H. Preece told us what the Marconi invention really is—and a great many other things as well which we knew before. The sensational articles in the lay magazines and in the daily papers ascribed to Marconi the discovery (or invention, as it was perhaps more appropriately termed) of a new kind of electrical radiations which had quite different properties to Hertz rays, which would penetrate anything from a brick wall or a few hundred yards of solid hill to iron plates a foot or so in thickness and blow up the powder magazine of an enemy's ironclad, and do several other truly remarkable and characteristic feats. Marconi has actually devised a very sensitive and seemingly reliable form of coherer, which can detect Hertz waves generated by a Righi radiator several miles distant.

Marconi no doubt deserves great commendation for having worked out an ingenious and efficient apparatus, and having brought us a step nearer to the practical utilization of Hertz waves; but the fact of his abstaining from stating in the interviews and articles that have been published that his work has been nothing more than modifications in the details of apparatus devised by his more illustrious predecessors, has entirely prevented him from receiving that genuine tribute of praise, which almost amounts to veneration, usually accorded so freely to successful workers in the realms of science.

The Marconi coherer consists of a small glass tube four centimetres long, into which two silver pole-pieces are inserted, separated from each other by about half a millimetre. This thin space is filled with a mixture of nickel and silver filings—96 per cent. of nickel, 4 per cent. of silver and a trace of mercury. The tube is exhausted to a vacuum of 4 mm. and sealed. It forms part of a circuit containing a battery cell and a sensitive telegraph relay. Normally the resistance across the powder gap of the receiver is several thousands of ohms, but when the Hertz wave falls on it, it is reduced to about 5 ohms.

Mr. Preece did not say whether the increased sensitiveness of the relay was chiefly due to the composition or the finely divided state of the metal filings, or to the use of a vacuum. In other respects the coherer does not differ very much from that devised by Lodge some four years ago; the principle was first shown by M. E. Branly in 1890. The main defect in the Lodge coherer was that after receiving a wave it did not "decohere" without being shaken or tapped. Marconi gets over this difficulty by putting in the "local" circuit of the relay a small electrically worked hammer, so that on the reception of each signal the glass tube is lightly tapped. The sound made by this little hammer upon the glass is sufficient to read Morse signals from, but, of course, a Morse ink writer or any other instrument can be put in the local circuit.

The transmitter is, as already stated, Prof. Righi's form of Hertz radiator. Two spheres of solid brass, 4 inches in diameter, are fixed in an oil-tight case of insulating material, filled with vaseline oil, so that a hemisphere of each is exposed, and the other hemisphere is immersed in the oil bath. The oil seems to maintain the surfaces of the spheres clean, thus obviating the frequent polishing required in the original apparatus of Hertz. Mr. Preece also stated that it impresses on the waves excited by the sparks between the spheres a uniform and constant form. Two smaller spheres are fixed close to the opposite sides of the two larger spheres, and these smaller ones are connected to the secondary of the induction coil. Morse signals are made by a key in the primary circuit of the coil. The waves produced by this apparatus are very short, generally about 120 cm. long. With a 6-inch spark coil, signals were transmitted to a distance of four miles; for greater distances sparks up to 20 inches were used. Mr. Preece has succeeded in transmitting signals over a distance of eight miles across the Bristol Channel with the Marconi apparatus.

For shorter distances the poles of the coherer are connected to two "wings" of copper, each in series with a small retardation coil. When signalling over longer distances the wings are removed, one pole of the coherer is connected to earth, and the other extended to the top of a mast or by a kite connected with aluminum wire to the coherer. It seems that during the experiments signals were actually received through hills. Mr. Preece explained this by a diagram in which the electric ray was depicted curving round the top of the hill in a very accommodating way. It would seem more probable, however, that, as the beam is naturally somewhat diffused, some rays may be reflected round the sides of the hill by other conducting obstacles, or perhaps the hill was actually not a good enough conductor to absorb the rays, and was to a certain extent transparent to them. Another "apparent anomaly" was that Marconi's relay acts even when enclosed in a metal box. During the lecture Mr. Preece put the instrument in a galvanized iron dust bin, and yet it received the signals transmitted from another room. He also assured his audience that he had performed the same experiment in a hermetically sealed box. This would only prove, however, that the coherer is extremely sensitive and that the intensity of the waves transmitted is so great, that they are not entirely absorbed by the fraction of an inch of metal.

Besides intending to employ this system of telegraphy to signal to lightships and lighthouses from the shore, Mr. Preece intends to use it for a regular public telegraph service to the island of Sark, in the English Channel, as this island is at present not connected to any submarine cable.

When Marconi's patents have been published an interesting question will be whether they have any commercial value. We believe that the use of a vacuum in a coherer has been proposed and even used before. The combination of a coherer with a relay is no new idea, and Lodge proposed in 1894 the employment of an electric vibrator to act as what Mr. Preece calls a decoherer. Moreover, without wishing to lessen the credit due to Marconi, we cannot but think that had the British Telegraph Administration given one of the great English physicists like experimental facilities, the same, or even better, results would have been obtained.

TESLA'S TELEGRAPH TO MARS.

Discussing methods of telegraphing to Mars, Mr. Nikola Tesla says: "The inhabitants of the planets, Mars, for example, must have intelligence. Their life must be made up of events. They must have a conception of time. And therefore they must have means of measuring time, of recording events. Without that they could have no history.

"Thus upon a mathematical basis I believe a system could be founded which in the course of time could be developed into an intelligible code, capable even of conveying the most intricate communications. There is no limit to the possibilities of its development.

"It is upon the result of that calculation that I base the declaration of my belief that a serious attempt at transfer of intelligence to Mars will be made within a short time. Of course, I mean 'short' in the scientific sense. But I would not undertake to say how short or how long that time will probably be."

MUNICIPAL TELEPHONE PLANT NOT WANTED AT SAGINAW, MICH.

Several weeks ago the council at Bay City, Mich., passed a resolution looking toward the establishment of a municipal telephone system jointly by the Saginaws and the two Bay Cities. A committee of five aldermen and five prominent business men was appointed to confer with like committee from the other valley cities. This committee never got together simply because Rep. Donovan frowned on such a municipal plan and had stricken out in the charter bill the section which gave Bay City the right to go into such a deal. The Saginaw council and Board of Trade took the matter up, however, and the following is the report:

The joint committee of the Saginaw common council and the board of trade to whom was referred the question of constructing a municipal telephone plant, respectfully report that we have fully considered the matter, and are of the opinion that it would not be advisable for the city to construct, own and operate a public telephone system. In the first place, the building of such a system would cost about $100,000, and this would have to be borrowed on bonds of the city. There are other reasons which make the scheme inadvisable and which will readily suggest themselves to business men generally.

In thus deciding we do not wish to be understood as discouraging the independent telephone movement, which now seems to be spreading over the country, but, on the contrary, we would recommend to our citizens careful consideration of the merits of the new Valley Telephone Company, recently organized to construct a telephone system in Saginaw, Bay City and West Bay City. This company is now duly incorporated under the laws of Michigan, with some of the prominent business and professional men of Saginaw and Bay City as officers and directors, and it is entirely a home enterprise. It would seem that this organization is the more properly designed to construct and operate an independent telephone system, and it also affords a field for investment by those of our citizens who have the capital, and serves to keep this capital invested at home.

TELEGRAPHY AND THE INCREASE OF WESTERN UNION STOCK.

THE application to the New York Stock Exchange to "list" an additional amount of $2,000,000 of the Western Union Telegraph Company's stock was the first intimation the financial or speculative public received that such action was contemplated by the company. It is stated that the entire amount of the new stock has been sold to Messrs. J. P. Morgan & Co., though the price is not stated, and the further information is given out that the proceeds are to be applied in liquidation of the floating debt, resulting from large expenditures for betterments and additions to the property in the last three or four years.

It will be recalled, says Bradstreets, in discussing the situation, that in October, 1892, the company increased its authorized share capital by $13,800,000, making the total $100,000,000. Of this increase $8,620,000 was distributed in the same year just named as a 10 per cent. stock dividend to the shareholders to represent net earnings which had been devoted to the extension and improvement of the property. A further amount of $550,000 stock was since issued to pay for the American Rapid Telegraph Company's property, and these amounts, with the $2,000,000 more just sold, bringing the outstanding stock of the Western Union up to $97,370,000.

In the explanation of the new stock issue it is stated that the company since 1892 has made additions and betterments to property costing something like $4,000,000, a large part of which was, of course, been provided from net earnings, the surplus over dividends in the last four years ($2,687,000) being mainly applied to such purposes. Among the details of the new construction it is stated that there have been added to the plant 2,681 miles of poles, 88,238 miles of wire, at a cost of $3,133,000, and a new building in the city of Chicago, purchased and owned by the company, the expenditure for which was $1,666,000. It is understood that the company has built a good many new extensions in the West during the period under consideration, and hence the creation of a floating debt, which it is the purpose of the new stock issue to extinguish.

These developments are interesting, coming as they do just after what would seem to have been some internal friction in the company's management in regard to the dividend policy. On the day the new stock issue was announced the executive committee of the company recommended the declaration of the regular 1¼ per cent. quarterly. This was fully expected, though a few weeks back the "Street" generally believed that a reduction from a 5 per cent. to a 4 per cent. annual dividend basis was altogether likely. During the period of business depression the traffic and business of the Western Union Telegraph Company had necessarily suffered, while the threatened refusal of the New York Stock Exchange to renew the contract for the distribution of its quotations by the Gold and Stock Telegraph Company, a concern controlled by the Western Union, would cut off a very important source of revenue from the latter. It will be recalled that the action of the Stock Exchange in this connection is part of the general programme of warfare on the bucket shops, "syndicates" and other speculative pests, and the charge was freely made that the Western Union's policy has been to furnish quotations to all applicants, or, in other words, to consult only its own financial interests. Hence the loss of the contract and the determination of the exchange to regulate the quotation service in a much stricter manner. Furthermore, it will be recalled that the position of the Bell Telephone Company in regard to telegraph service was the object of some doubts, since the system of long-distance wires that organization controls could be utilized for the establishment of regular telegraphic service throughout a large section of the country. The rumors in this connection proved, however, to be exaggerated and unfounded, the management of the Bell Company indicating no disposition whatever to enter the telegraph business. On the other hand, it is to be remembered, that the competition of the Postal Telegraph Company becomes more effective from year to year, as that company's system of lines is steadily extended, and secures a growing proportion of the general business of the country, the latest move, by which the land lines of the Postal Company were consolidated with the Commercial Cable Company, making a still stronger organization. At the same time the Postal and the Western Union have for some years gotten along in complete harmony, and no rate cutting has taken place. It would now seem that the "Street," indeed, took an exaggerated view of the troubles to which the Western Union was exposed, and that any internal divergencies of views have been adjusted by the transaction that was made public this week, the effect of which would be to leave the company's surplus earnings free for the maintenance of dividends.

MEETING OF INDEPENDENT TELEPHONE [illegible] IN BOSTON, JUNE 17.

PURSUANT to a circular sent out from the office of Whitman & Couch, manufacturers of Swedish telephones, on May 25, a meeting was held June 17 at the office of that firm, 196 Summer street, Boston, Mass. The call was for a meeting of the independent telephone interests of the East with a view of ultimate organization for mutual protection in case of a suit being brought by the Bell Telephone Company, and also for the purpose of sending delegates to the meeting of the national organization which is to be held at Detroit, June 22, 23 and 24. While no organization was perfected at the meeting this morning, considerable business was transacted, and the views of the representatives present were thoroughly aired. It was the unanimous opinion that the time was ripe for concerted action on the part of the independent telephone interests, and it was thought that it would be better to await the action of the national organization before taking steps to form an association in the East. Two delegates were selected to represent the meeting at Detroit and funds were subscribed to defray their expenses. About two hundred replies have been received from independent exchanges and manufacturers in the East and South, and with but a single exception, they express their pleasure at the proposed movement and offer their support when an organization shall have been formed.

Mr. Raymond L. Whitman called the meeting to order and explained the nature of the business to be considered. There were about twenty representatives present. "The time is ripe," said Mr. Whitman, "for the formation of some sort of a combination where we can go into the field with a solid and substantial backing. I do not think that any one company should be forced to bear the brunt of a suit. The Bell Company has the capital and the best talent to represent it, and we should stand together. At a time like this, independent machines and companies should be thrown aside, for there is plenty of time for competition when this thing is settled."

Mr. Whitman was elected chairman of the meeting, and Mr. Spofford, of the Haverhill Telephone Company, was chosen as secretary. Mr. Whitman then continued his explanation of the movement, saying that the exchange people are much hampered in rentals and in getting subscribers and also in getting capital interested; and as for the manufacturers they cannot protect buyers. He proposed that a subscription be started and the funds placed in the hands of a board of trustees, the funds to be devoted to defending any suit that may be brought; it would be, in fact, an insurance. In answer to a question he stated that it was his idea to have the delegates elected to attend the meeting in Detroit to represent the members of the association in the East. He called upon J. D. Leatherbee, representing the National Telephone Company. Mr. Leatherbee detailed at length the position of his company in the suit instituted by the Bell Telephone Company in August, 1895. He said that it was the old story of David and Goliath. It has been the desire of the company to prolong the litigation as far as possible in order to secure united action. He said that he had felt from the first that the Government suit was a farce. He found that the lawyers versed in telephone philosophy were unreliable. In the selection of lawyers loyalty was the first requisite—ability the second. "I desire to say," he continued, "that I am in hearty accord with any body of men who possess sufficient stamina, mentally and physically, to compel the Bell Company to come down from its high perch and let us alone. This meeting is on the right track and should send two delegates to Detroit. The Western and Southern people feel differently in this matter. We are inclined to be conservative and will submit to a great deal before we take action. I believe that this infamous, so-called patent—the Berliner—can be beaten."

W. C. Watts, representing the Stanton Mutual Telephone Company, of Stanton, Va., said that he had come to the meeting for information and wanted to hear further discussion. Secretary Spofford made an address. J. Merrill Lord, representing the Maine Rural Telephone Company, said that he did not believe that the time was ripe to form a permanent organization. He believed that the action of this organization must, in a large measure, depend upon the action of the national association. The method of raising money, he thought to be a secondary matter.

After some further discussion the following-named delegates were elected to attend the meeting at Detroit: J. D. Leatherbee, of the National Telephone Company; and S. H. Couch, of Whitman & Couch. Mr. Leatherbee said that he did not think that the delegates should go to Detroit and say that they represented an Eastern organization. It would be better that they go as individuals representing the individuals who had gathered at the meeting this morning. The meeting was then adjourned to await the report of the delegates after the meeting at Detroit.

TELEPHONY ON THE NEW YORK STATE CANALS.

Superintendent of Public Works G. W. Aldridge, of Albany, N. Y., is taking active steps in establishing a system of telephonic communication on the canals, for which purpose the Legislature has appropriated $100,000. The scheme is entirely original with the department of public works and was suggested by the difficulty which is often experienced by the department at Albany on reaching various parts of the canal with which immediate communication is imperative. Superintendent Aldridge advertised for bids for the work as soon as the appropriation was available, with the intention of completing the same to the extent of the appropriation.

The proffers received from this advertisement embraced two separate plans for the system, differing in details only, and they indicated that the entire work would cost $150,000. No bids were accepted at that time on account of the smallness of the appropriation. The recent Legislature appropriated an additional $50,000, and it is Superintendent Aldridge's intention to advertise within a month for new bids for the work, and as soon as they are received the contracts will be let and the work commenced. He hopes that the Legislature of 1898 will appropriate the third $50,000 so that the work can be completed.

LIMITING DEAD HEAD TELEPHONY IN PITTSBURG.

A special dispatch from Pittsburg of June 11th says:—The saloon-keepers and restaurant proprietors are also aroused over the recent order of the Bell telephone people, forbidding patrons of such places the free use of telephones. The stand taken by the hotel men to order out telephones has encouraged them, and it is probable that some similar action will result after they have thoroughly sized up the situation.

The Bell Company has thrown tempting bait before each one in the hope of disarming opposition. Each saloon-keeper and restaurateur has been told that he must place an automatic call instrument and pay $60 for 600 calls, or sign an ironclad contract, agreeing to use his telephone strictly for his private business. The bait thrown out is the offer of a commission of 10 per cent. on each call made on the automatic instrument by strangers, or when the regular instrument is used a commission of 15 per cent. is offered.

Some of the saloon-keepers have taken the instruments on these terms, as they claim the contracting agent of the Bell Company told them that all saloon-keepers would be compelled to take automatic call instruments.

President D. F. Henry, of the telephone company, in talking with a reporter on the subject, said that the rule is nothing new or arbitrary, but an enforcement of the contract under which every instrument is taken, as specified above.

"It is to prevent an abuse of the telephone privilege," said President Henry. "We have a number of letters on file from hotels complaining that they cannot get the proper use of their telephones on account of the number of non-subscribers who come in to 'borrow' them, and who consume the time and labor of both the hotel and telephone people. The contract explains itself. It is nothing new, and only seems so because there is an agitation of the matter. The general public has no right to use the instruments. If they have a desire to use them it is only fair to all parties that they go to the booths provided for the purpose and pay 10 cents for the privilege.

"If a person has a hydrant and is paying water rental, would they say to their neighbors, who have no hydrant and are paying no water rental, 'come in, use my hydrant and get your water supply free.' They would not, and there are very few people who would ask for water under those conditions. The cases are similar."

President Henry continued that if a subscriber is going along the street and wants to use a telephone he is entitled to the use of any in the neighborhood. If he tells "central" that he is a subscriber there is no trouble.

"There seems," said the president, "that an impression has gotton abroad that if a subscriber is not at his own individual telephone, the company is going to cut him off from conversation, and make him use the nearest pay station. That is all a mistake, the subscribers and their employés who are counted as subscribers, can talk to subscribers.

"The order now being enforced is simply one to prevent the general public abusing the privileges."

Mr. Henry said the case of a department store that hires a telephone exclusively for public use is different from that of a hotel. In other cities he said the pay stations are used, and he thought there was no use in doing otherwise in Pittsburg. He called attention to the following "caution" which is printed in every telephone directory:

"The use of the telephone by any person not a subscriber to the telephone exchange shall terminate the contract at the option of the company, and shall authorize them to take away the instrument, fixtures and apparatus connected therewith. Subscribers are respectfully requested to notice the above conditions, and to bear in mind that while they are allowing the unauthorized use of the instrument, everybody is cut off from communicating with them. In many instances subscribers have lost important business by allowing the wires to be used improperly. Our patrons are requested to assist us in protecting them from such consequences."

"These rules, which have been in force for years, seem to explain the whole matter," he said in conclusion.

NO LANDING FOR THE FRENCH CABLE.

A special dispatch from Washington of June 17th says:—The President has refused the French Telegraph Cable Company permission to land its lines on Cape Cod or any other part of the New England coast on the ground that similar requests made before by other companies for like privileges have been refused by the Government. One of the last appearances of Mr. Blaine at the Capitol was to submit an argument before the Senate Commerce Committee against granting the right of a French cable line to land on any part of the Carolina coast.

THE STANDARD TELEPHONE COMPANY TO BEGIN SERVICE IN PHILADELPHIA.

A special dispatch from Philadelphia of June 17 says: The Philadelphia Standard Telephone Company, which secured a franchise to operate an independent telephone service, is reported to have entered into a contract with a New York banking firm to raise the capital to complete the work of construction in this city. The work was begun months ago, with capital furnished by a construction company, but it was suspended on account of the business depression. The company, it is understood, intends to enter into rivalry with the Bell Company and let the courts determine the validity of the patent rights it claims. The attorney for the company said to-day that the enterprise would shortly begin operating a local service.

TELEPHONES IN POSTAL SERVICE.

An improvement about to be introduced into the postal service in Boston is that of establishing independent telephones in the central building and at the several stations and substations. For this purpose the department at Washington has granted $4,184, which will be available in time to have the service in operation by July 1. Two trunk lines will be built between the central post office and the telephone central and instruments will be put in in the divisions, stations and substations, so that these places may establish connections with each other and with the outside public, the same as other subscribers.

TELEPHONY AT NELSONVILLE, O.

Mr. L. B. Engle writes us as follows from Nelsonville, Ohio: I have franchises both here and at Logan, Ohio, and will erect telephone exchanges in both places, and connect them with a toll line, the distance being about twelve miles.

The construction work is now under way at Logan and is being pushed as rapidly as possible. That exchange will be started with 100 subscribers; Nelsonville will have about 150. The rates are, for private houses, $18; for business houses, $24, per annum, payable monthly in advance. Long distance telephones will be used, and will be supplied by the North Electric Company, of Cleveland, Ohio.

UTICA, N. Y.—The Standard Telephone Co., of Utica, is to go ahead with the construction of its independent system.

INDEPENDENT STATE TELEPHONE ASSOCIATION OF MICHIGAN MEETING, JUNE 21, 1897, AT DETROIT.

IN connection with the larger gathering for national purposes, of the independent telephone interests, and as a precedent step to co-operation therewith, the anti-Bell companies in the State of Michigan met on June 21, at Russell House, Detroit, and organized a State body for mutual defense and support. It was quite largely attended and the spirit manifested was a good evidence of the feeling prevalent in general.

In calling the Michigan gathering to order W. L. Holmes, of Detroit, briefly outlined the purpose, saying they had come together to get better acquainted and form a State organization. He then called for nominations for temporary presiding officers. For chairman there were two names, that of Mr. Holmes and J. B. Ware, of Grand Rapids, the latter insisting on withdrawing his name in favor of Mr. Holmes, but the convention would not have it that way and Mr. Ware was elected presiding officer by a unanimous vote. Alexander I. McLeod, of Detroit, was chosen secretary. In taking his seat, Mr. Ware made a short address, touching on the importance of the independent telephone movement and the necessity for organization as against their powerful opponent, the Bell Co.

At the suggestion of Secretary McLeod the delegates present handed in their credentials, and the list disclosed the following, forming, as it were, the charter members of the new association and the local exchanges they represent: Charles Flowers, Detroit; Capt. C. Gardener, Dearborn; J. B. Ware, Grand Rapids; C. P. Collins, Wayne; H. C. Hedges, Lansing; Hugh O'Connor, Plymouth; W. C. Sterling, Jr., Monroe; Geo. N. Connor, Mt. Clemens; John T. Holmes, Port Huron; Dr. J. Williams, Jr., Adrian; Justin R. Whiting, St. Clair; George A. Beaton, Jackson; William H. Blake, Cheboygan; H. H. Hatch, Pontiac; E. H. Parker, Flushing; Frank A. Vernor, Memphis; J. H. Fildew, St. Johns; G. A. Weed, Lake Odessa; E. S. Rogers, Owosso; W. O. King, Toronto; J. N. Starkweather and V. O. Whipple, Northville; A. I. McLeod, W. L. Holmes and T. F. Ahern, Detroit; G. D. Bouton, Ann Arbor and Ypsilanti; W. H. Gilbert and S. G. Higgins, Saginaw.

Messrs. Blake, of Cheboygan; Parker, of Flushing; Vernor, of Memphis, and one or two others, reported that they were present as proxies by request.

Judge Hatch made a short address, saying: "The present movement has for its object the organization of the many different local telephone companies of Michigan into an association, so that the people of Michigan can be provided with a serviceable telephone system at reasonable rates. It is not the intention of the organizers to form an association for the purpose of going into court and fighting the Bell Company. That matter will be attended to at the national meeting, which begins to-morrow. What we want to furnish our subscribers, in order to combat with the gigantic monopoly, is a long-distance service. That is one difficulty confronting us, although it has been partially overcome by inter-town communication already established by many of the various State exchanges and the inter-State exchanges are assisting in extending this service. This committee, just named, should discuss and adopt some system of rates and prices, both for local service and for long-distance telephoning. This is the main business before us, also to settle the social questions, the reception of the visiting delegates to the national convention, and to make preparations for their entertainment. The independent telephone companies are now in their infancy, but I am confident, from the interest displayed here and elsewhere, that the time is not far off when our telephones will be in every residence in city and village, and not only that, but no intelligent farmer anywhere in the rural districts will be without a 'phone when it can be given him at a nominal cost of $5 or $6. I understand that in Norway and Sweden this system of farm telephones already exists at a very low rate. The time is coming, I tell you, when all America will have this cheap service extending to even the most remote farm houses. While without doubt all of us here have some individual ends to serve, the fact remains that we are all interested in fighting the Bell Telephon Company and in establishing cheap rates for a good telephone service. In the end I am sure the telephone will entirely supplant the telegraph service. It ought not to take the committee very long to prepare the by-laws and constitution that such an organization as this requires."

The officers of the new organization of Michigan selected are as follows: President, J. B. Ware, of Grand Rapids; vice-presidents, first, W. L. Holmes, of Detroit; second, James E. Davidson, of Bay City; third, George W. Finch, of Escanaba; secretary, Alex. I. McLeod, of Detroit; treasurer, J. H. Fildew, of St. Johns; and executive council, comprising the preceding officers and the following six members: Dr. J. Williams, of Adrian; S. J. Higgins, of Saginaw; F. B. Johnson, of Lansing; Hugh O'Connor, of Plymouth; Hugh Park, of Muskegon; and George Weed, of Lake Odessa.

What one member objected to as "raising the bloody flag against any railroad company," was adopted by the newly-formed association in a report prepared by the Committee on Resolutions, composed of Messrs. John T. Holmes, W. C. Sterling and F. G. Ihmsen, of Three Rivers. Their report censured the Michigan Central, the Grand Trunk and the Flint & Pere Marquette Railroad Companies for entering into a contract with the Michigan Bell Telephone Co., whereby they agree not to use any other telephone or to allow any other than Bell telephones to be used upon their premises, and this works to the disadvantage of the independent companies and their customers. The report came in for discussion, but was adopted overwhelmingly. Similar conditions were reported elsewhere; but at several points, the Grand Trunk and Lake Shore, it was said, were permitting the connection of independent telephones. The resolve to insist on no discrimination was very emphatically asserted.

The constitution and by-laws of the association were prepared by the following committee, elected early in the session: Charles, Flowers, chairman; J. H. Fildew and ex-Congressman Whiting. The object of the association, as stated in Article 2 is: "Mutual protection and connection of all local telephone exchanges and toll line companies in Michigan, and to endeavor to bring about a system of toll line connections with adjoining States." The remaining articles provide for officers and define their duties. Regular meetings are to be held on the second Tuesday of June of each year, with a provision that special meetings may be called by the president.

The annual dues are fixed as follows: Each exchange having 50 or less telephones, $5; 51 to 100, $10; 101 to 200, $15; 201 to 300, $20; 301 to 500, $25; 501 to 1,000, $30; and 1,000 or more, $35. The subject of an initiation fee provoked considerable debate, one member holding that where the exchange embraced farming communities it would be difficult to collect an initiation fee, and this was settled by providing that all dues shall be paid in advance. The president is to receive a salary of $100 and the secretary a salary of $300, while the treasurer is without stipend, although required to give bond.

Just before adjournment Charles Flowers was elected chairman of the Michigan delegation to represent them as spokesman in the convention of the National Independent Telephone Association, to meet on Tuesday afternoon.

Shortly after the convention first met it was deemed advisable to hold an executive session, at which the representatives of the press were excluded. This meeting was devoted to a general discussion of business affairs of the independent companies of the State and in which the methods of the Bell Company were exploited, and condemnation of them was not spared. Mr. Ware, the newly elected president of the association, gave an interesting review of the situation in Western Michigan, especially in Grand Rapids. He stated that the net profits of the Grand Rapids telephone company, known as the Citizens', was $13,000 the first year. He also gave a comparison of the number of subscribers in both the new and the Bell companies, and the mileage of each, together with the class of instruments and the systems used. The methods of the Bell people in cutting rates and in putting in free telephones in residences, following the birth of the independent company, were also dilated upon, and many other operations of the older company were told of. Mr. Ware closed with a statement, giving figures to verify his words, that the independent companies were now running the Bell a close race in Western Michigan, both as to service in small towns and in long-distance telephoning.

The Executive Committee of the Michigan State Association held its first meeting on Tuesday morning, the proceedings being conducted, of course, behind closed doors.

HYPNOTIZING BY TELEPHONE.

THE wonders of the telephone never cease. The latest brought to our attention is the hypnotizing of a young boy through the medium of the telephone at Houston, Texas. It is needless to surmise that the subject was a pronounced cataleptic, but the facts brought to light would seem to indicate more strongly than ever the necessity for a stringent law against the promiscuous practice of hypnotizing. We do not imagine that many persons could be influenced hypnotically over the telephone, yet it will be just as well to guard against such practices by prompt and effective legislation.

JUDGE R. S. TAYLOR.

CHAS. FLOWERS.

JUDGE J. M. THOMAS.

E. H. ANDRESS.

J. E. KEELYN.

MEETING OF INDEPENDENT ANTI-BELL TELEPHONE INTERESTS AT DETROIT, JUNE 22 AND 23, 1897.

FIRST DAY.

THE convention of the independent telephone companies of the United States was called to order at 2:30 p. m. on Tuesday, June 22, at the Harmonie Hall, Detroit, by Hon. Chas. Flowers, of the Detroit Telephone Co., and well known as the Public Prosecutor, who introduced Mayor Maybury, in behalf of the city of Detroit. About 200 were present.

MAYOR W. C. MAYBURY made a brief address of welcome and congratulated the delegates upon their achievements, one being the modern telephone girl, a lady heard but not seen, and whose message ever inculcated patience. The world was continually growing smaller, chiefly by its multiplied means of intelligence, and the telephone had proved itself to be the mightiest among the agencies for bringing men and peoples together. As to the objects of the meeting, they were well understood, and the hearts of the people were with the convention because they knew that their aim was better service and cheaper service.

MR. FLOWERS then made a brief address of welcome as the representatives of the Detroit Telephone Co., one of the largest independent telephone companies in the State and in the country. He remarked that there was continual evolution, and in everything they witnessed changes due to the effort of stubborn, restless and persistent minds, ready to apply themselves to every new task. When the hour came there were men who recognized the fitness of the season and who were prompt to answer the roll call. It had been so in the development of independent telephony, and the men present had shown themselves able to meet the call for an advanced telephone service. They of the Detroit Telephone Co. were justly proud of having, through some tribulation and straits, and in face of many difficulties, established the largest independent telephone system in the United States and put it in successful operation. As representatives of that system, he and his colleagues welcomed the delegates to the city of Detroit and asked their earnest co-operation in the effort to make the independent movement successful.

JUDGE JAMES M. THOMAS, of Chillicothe, O., the president, then acknowledged in a few felicitous remarks the welcome that had been extended, and remarked that the companies gathered had withstood a great deal. Their friends had all questioned their sagacity and business ability in going into the independent telephone movement, to which many things had impelled himself and others. But time and the march of events were justifying them, and the closer they stood together the more successful their campaign would be.

JUDGE R. S. TAYLOR, of Fort Wayne, Ind., one of the Government counsel in the Berliner suits, was then asked to address the meeting and was very warmly received on doing so. He rehearsed the familiar facts with regard to the Government suits to annul the Berliner patent, and urged that the decision of the United States Supreme Court had simply left things as they were before, it having merely declined to cancel the Berliner patent on the ground of fraud. He compared the attempt to extend the life of the Bell telephone monopoly to the action by which, according to Scripture, Jacob, after working seven years to get one daughter, was made to work another seven before he could get her. The American Bell Telephone Co. had been like Jacob's father-in-law, and was the most successful stockraiser that ever sheared lambs; and in the same way it now expected the people of the United States to work for it another seventeen years after having already done so for a full term. The history of this affair he regarded as one of the most extraordinary things in history. The telephone was unmatched in the art of invention during the last fifty years, for nothing came so close to the people. But it had been fully paid for. More dollars might have been spent on other elaborate electrical apparatus, but the American people, in view of the cheapness and simplicity of the mechanism, had paid more for the telephone than for any other invention of the last half century.

As to the objects of the convention, it had been stated in some of the newspapers that the main or sole idea was to fight the Bell Telephone Co. Well, he did not know what the convention as such had to do about it. If some very strong denunciatory resolutions were offered, they would probably receive a very cordial support, but the convention as such was powerless to affect the legal situation, interesting as it doubtless was. The Berliner patent, as it stood, expires in 1908, but he was ready to express his opinion, though it might not be sustained, that the patent was of no intrinsic value and would be declared against on intrinsic grounds of demerit, as it was already by Judge Carpenter. That was not disturbed by any action of the Supreme Court, which simply held that if the Government had been lax in the Patent Office, the Bell Co. ought not to be blamed, but should make the best it could for itself out of the situation. In other words, an applicant in the U. S. Patent Office was entitled to get all the good he could out of the delay of his application.

Judge Taylor said he was sorry for the decision, and did what he could to prevent it, but he was not surprised, as he had intimated some time in advance of the fact that such a decision might be reached. The proposition to the Court was one without precedent, as no patent had ever been set aside upon that ground. It showed again that a plea that is unequivocally morally right and just is not always the law. Besides being the first case thus brought forward by the Government to set aside its own patent, he did not risk very much in saying it was the last they would see. The decision of the court that no question would be entertained by it at all which can be raised by a private citizen in a suit for infringement restricts the ground practically to one, which is that of fraud. Further, the decision that the fraud must be proved by the same kind or amount of evidence which will set aside a horse trade, makes it impossible to make the proof. The patent sharps who control matters of this kind were not such awkward fellows as to make that kind of exposable blunder. The law was now that any sort of indirection in the Patent Office by which you got a patent didn't count if you were not caught at it—and that meant you would not be caught at it. Hereafter, therefore, it will be left for the people themselves to fight out these questions which arose upon the validity of patents.

As to this particular patent the decision of the Supreme Court left it exactly where it was when the patent issued. It is now the fact that the validity of this patent is to be tried in exactly the same way and upon exactly the same proceedings as the validity of patents in general is tried. But nothing which has been said or done by the Supreme Court puts any obstacle whatever to the full and thorough and complete trial of all the questions which can be raised, or have been, against the validity of the Berliner patent, as on the suit of a private citizen in regard to any infringement.

He would say that this attempt to protect themselves and get the patent out of the way in short order had been of ad-

(Continued on page 720.)

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. O. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill.
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - per year. $3.00
Four or more Copies in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies - - - - - - - - - - - - .10

[Entered as second-class matter at the New York Post Office, April 9, 1888.]

VOL. XXIII. NEW YORK, JUNE 23, 1897. No. 477.

WELSBACHS AND FUEL GAS.

THE recent meeting of the National Electric Light Association found its time so much engrossed with matters of rates and other questions that bare mention was made of the Welsbach burner. This no doubt was a matter of regret among many of the members, who would like to have heard more on this timely subject. There is no need of disguising the fact that electric light companies are watching closely the introduction of the Welsbach burner, and wideawake members of the fraternity are keeping themselves informed as to the progress of this new form of light, the most serious competitor they have had to meet since the introduction of electricity as an illuminant. But what the National Electric Light convention failed to give them in the way of information is supplied by some of the recent meetings of gas associations. That of the Pacific Coast Gas Association afforded an opportunity for the reading of a paper on Welsbach lamps, an abstract of which, together with the discussion, will be found on another page. From the results shown by the author of the paper, it would appear that the Welsbach lamp may be assumed to have arrived to a stage of commercial operativeness, but in the discussion which arose, a very curious point was brought out, which has not probably been so fully considered as it may be in the near future, and that is, the paying qualities of the Welsbach light so far as gas companies are concerned. It is evident that a 2½ or 3-foot burner in lieu of the customary 5-foot tip may be a good thing for the consumer, but we doubt if the gas companies look upon the innovation with the same smile of satisfaction. In other words, we believe it will not be denied that the general introduction of Welsbach burners will mean a serious loss of income to the gas companies. It is, therefore, probably fair to assume that the Welsbachs will not be pushed to the front by gas companies, who can only see in it a curtailment of their profits. So far as street lighting is concerned, the author of the paper above referred to admits that the Welsbach cannot compete against arc lights on streets comparatively free from trees, but assumes that the Welsbachs are better adapted to thoroughfares thickly studded with trees. We do not, by any means, admit the truth of this proposition. Where the streets are actually so heavily shaded that arc lights cannot be advantageously used we believe that a series incandescent lamp system can meet all the requirements of the companies and the public, and can be operated easily in competition with Welsbach, or any other system of gas lighting. Such systems have been, and are still, successfully operated, and with lamps of between 25 and 50 c. p. a result can be obtained which leaves nothing to be desired. This is little else than the old Edison municipal system of direct current incandescent lighting, which, we are sorry to say, has been somewhat neglected. The point we desire to make is that if electric light companies would only study the situation carefully they can furnish any community with exactly the amount and kind of illumination that it desires, and by giving strict attention to the quality of their service, they will be enabled to secure street lighting contracts to the exclusion of gas of any kind.

Looking at another side of the cheap gas question and its possible influence on electric central station supply business, we would call attention also to the paper read recently by Mr. F. H. Shelton before the Western Gas Association, at Cincinnati. This gentleman took for his theme the failure of the commercial attempts to supply fuel gas in the United States, and we must admit that he accomplished his object in a most thoroughgoing manner. Of the twenty-seven enterprises actually built and operated for distributing fuel gas to the public in the United States from 1880 until 1896, it would seem that twenty-two have utterly collapsed. Of the other five, two (Bridgeport and Rapid City) are trying to get out of the fuel gas business, and three (Framingham, Cottage City and Tacony), after six years' operation each, now show less output or fewer customers than before, and never a dollar of earnings returned to stockholders from commercial fuel gas sales. The reason for this, as shown by Mr. Shelton, is not far to seek, since heat in gas form has not, as a whole, been sold any cheaper in the shape of "fuel gas" than it was already sold in the shape of illuminating gas. Hence, the public has been no better off. In other words, the "fuel gases" had an average heat value of between 300 and 400 heat units, while the illuminating gas generally distributed in the cities of the United States ranges between 625 and 750 heat units. It is, therefore, safe to say that fuel gas has seen its best days, so far as its general public conditions of distribution are concerned.

Apropos of the relative economy of electric incandescents and Welsbachs we have before us a report of the performances of the electric lighting plant at the Government Hospital for the Insane, at Washington, D. C., by Chief Engineer G. W. Baird, U. S. N., in which the author makes a particular comparison between gas and electricity. Without going into details this shows that taking lamps at 3.2 watts per c. p. the current employed gave 16,800 c. p. hours for $1.50, or reduced to a dollar basis, 11,200 c. p. hours for $1. Gas at $1 per 1,000 feet would give only 3,200 c. p. hours for $1. That is to say, the ratio is that of 11,200 as against 3,200 in favor of electric light.

As Chief Engineer Baird points out, the gas output might be doubled per unit of gas by using the Welsbach burner; but even this it will be seen would not bring gas up to the economy of the electric light; while he remarks that the cost of replacing the mantles would probably be half the price of the gas saved.

ELECTRIC MOTORS IN FACTORIES.

AT a recent meeting of the American Society of Mechanical Engineers, Prof. D. C. Jackson read a paper on electrical power equipment for general factory purposes, in which he discusses the various cases which arise in practice, and gives the results of the use of power transmission in ten typical plants employing each over 1,000 h. p. in capacity of electric motors, as well as in a similar number using from 100 to 500 h. p. He sums up by saying that in constructing new manufacturing plants the extra first cost of a complete system of electrical transmission is negligibly small, except under exceptional circumstances, compared with the actual saving effected by this means, when its advantages are properly utilized. In certain industries the advantages of electrical transmission outweigh the first cost of making a change from mechanical to electrical transmission in established plants, while in many plants where these conditions would not commonly exist the arrangement of buildings or the growth of the plant is frequently of such a character, with reference to the prime power plant, as to place electrical transmission upon an advantageous footing, either as an auxiliary to the main transmission or as a rival to existing mechanical transmission. Perhaps no better argument in favor of electrical transmission could have been brought forward by Prof. Jackson than his quoting of a letter received in reply to his inquiry from the owner of an establishment which had introduced electrical transmission. The reply reads: "In these days of active competition we do not feel it is wise to make public the savings or advantages derived by introducing various economies." Prof. Jackson says he has not been able to decide whether the experience of the writer of the letter was favorable or unfavorable to electrical transmission, but we venture to believe that the electric motor was found to be a paying investment, and that the experience of the writer of the letter agreed with the experience of that of the majority of Prof. Jackson's correspondents, which was in favor of the electrical plant to a most marked degree.

THE INDEPENDENT TELEPHONE CONVENTION AT DETROIT.

THE meeting of the "independent" telephone companies, held at Detroit this week, was one of unusual significance and importance, justifying us, we think, in the delay of one day in the publication of this issue of The Electrical Engineer in order that we may present the results with promptness to our readers, many of whom, in every field, have been watching the development of the telephone situation. We present elsewhere in this issue a copious report of the work of the convention in such form that anyone can reach his own conclusion as to what is likely to be the outcome of the whole matter. A few remarks consequent upon observations made on the spot, will not, however, be out of place, as they may assist in getting at the significance of what was said and done.

It is, to begin with, surprising that the elements of opposition to the Bell regime should so rapidly have come into union and be able now to present a combined front of active workers. There are, it is true, nominally 1,200 of these independent concerns, some of considerable magnitude, with an estimated total of 150,000 instruments and 2,500 miles of toll line; but many of these companies are very small and many others are not yet in operation. Still, that the number should already be so large is striking, and if it should double in the year, the fact would not be remarkable. Some of the new plants, as at St. Louis, Saginaw and other cities will vie in proportions with the best of the "old line" Bell organizations. Now, one of the facts holding this industry together is the effective cement of a common cause against the American Bell system, and, it would seem, a common fear of both open and insidious attack from that very formidable quarter. On the floor of the convention itself the historic warning that if they did not hang together they might all hang separately was caught up with quick intuition of its deep meaning. In spite of the most violent extremes of opinion on moot points, there was shown a general keen desire and intention to cohere as closely as possible for common measures of defense and offense alike.

The main differences of opinion arose, as will be noted from our report, upon the fundamental questions of representation and taxation. There was, as there always has been in associations of local companies, a strong desire to keep out the "parent company" influence and to prevent it from control, especially with bunches of proxies from owned plants; but the impossibility of barring out manufacturers as individual operators of exchanges was evident, for whatever be the conditions, the ownership of the plant will count in some way and will direct the casting of its vote as a local company. Another incidental question was that of State Association membership, but this is neatly met by the Federal Executive Committee with two representatives from each interested State. Upon the matter of taxation the fight was hot, and was forced particularly by the larger exchanges, such as Detroit, whose dues under the new constitution would obviously run up into thousands of dollars, and be a fund that it would much rather spend for itself in case of litigation on patents. Here again, however, the necessity of standing together came out, for mutual protection is the first necessity of the hour for these intruders on the jealously-guarded Bell domain; and there is no doubt that the membership will be large enough to afford a handsome fund as a basis for work of the defensive kind. It seems to us that there was a little too much crying "Wolf!" in the convention, or at least, too much publicity given to their dread on the part of many members that the opponent might soon and suddenly pounce down on the fold. One knotty problem hinted at but not discussed was how to espouse the cause of companies not joining the association. It might not be quite safe to leave them to their own devices.

Political work was the chief care of the convention, rather than the strictly commercial and technical aspects of the subject; and there were certainly several skillful politicians on the floor. In fact there were, it might be said, three groups of men pretty clearly defined: the manufacturers building the new exchanges and often deeply interested in their financial success; the outside investor who believes in the new business and the greater popularity and profit of the telephone; and the plain politician, who sees in the situation and the genuine feeling on the part of the public in many places against the Bell Company, a chance for deals and legislation that has not hitherto presented itself. On the whole, the quality of the attendance was very high. It is true that one operator of a modest exchange is at home a "director of funeral ceremonies" who had come to help bury arrogant Cæsar, but his associates are, many of them, men of weight, wealth, reputation and influence of the highest grade, and their power is going to be felt.

The events of the year that must elapse before the next association meeting are sure to be full of interest and excitement. Where will the Bell Company strike and how? If ever there were a set of men spoiling for a fight, they will be those in the association with a fund of twenty or thirty thousand dollars behind them to start with; and probably they could not ask an easier object of attack than the Berliner patent, whose existence offends the moral sense of the nation. But while the Bell Company may be vulnerable, it has rights and legitimate patents, and a great business organization built up through long years that can only be equaled by the same amount of study and investment. Here, perhaps, may lie the Bell strength, after all, hotly as the patents it owns may necessarily be pushed as controlling factors. Some of us remember the hurrah days of the Bell beginnings, when with generally low rates it seemed as though income alone had to be thought about. Then came the trying times of system reconstruction, and the rates began to go up. While the Bell rates of late years have often reached the one extreme, those of many of the new independent companies are ruinously low and cannot last. In fact, it may be found that in large numbers of cases, the Bell rates governing before this fight began were such as the conditions of the art fairly dictate; and if this be so, some opposition companies must even in a short time come up to them or be wiped out by their own burden of expense and debt. For the public, meantime, there seems assured a period of cheap universal telephony such as it has never known before.

BEAUTIES OF THE THIRD RAIL.

THE discussions upon the third rail trolley system have been limited of late to the economic advantages as compared with steam locomotive methods and much has been said about the relative chances of survival of competing trolley and steam roads. The "Springfield Republican" comes forward, however, with a formidable tirade against the steam locomotive, and makes a strong case for the third rail on the æsthetic side. It speaks of the roadbed as a sahara of gravel and cinders. It describes the engines as cyclopean monsters belching masses of smoke and grime. It asserts that each road has its attendant black belt of desolation; that the houses near the track are spoiled; and that the stations are the "foulest and dingiest places known to man." The traveler for a hundred miles is delivered at his journey's end in the condition of a chimney sweep and ready for a Turkish bath.

All this is very savage and severe, but it is doubtless true that the third rail, dispensing also as it does with poles and overhanging wires, has its advantages in the shape of superior comfort, cleanliness and beauty. The steam roads are hardly likely to even things up by adopting the new plan of the Camden and Atlantic R. R., which lays the dust by deluging its track with heavy oil of low cost! The "Springfield Republican" wants grass to be grown all over the trolley track, a thing which is already done, and it believes that in various ways the third rail will make life more endurable for the passenger. "The railroads have an advantage in point of speed," it says, but it is not wise in thinking that the trolley cars "apparently never can approach the same rate." Indeed there is no good reason why, even now, for all ordinary travel, they should not go faster than the average locomotive.

LARGE CENTRAL POWER PLANTS.

IT was foreseen that the effects of the great Niagara power plant would not be wholly confined within the local limits of that borough, nor even of a zone of twenty-five or fifty miles, but we hardly expected to see so early a fruition of the main idea, if we may use the phrase, for which Niagara stands. With only a small part of the ultimate capacity of its works in operation the Niagara Power Company, already finds its example emulated, or in progress of emulation, in various quarters. But, curious to say, several of the projects called into life are not based on favorable water powers, but on cheap coal. We have already noted the inauguration of a scheme of this nature at Leavenworth, Kan., and now we observe that a similar plant is advocated by Mr. L. B. Stillwell for supplying power to Pittsburg, in a paper read before the Engineers' Society of Western Pennsylvania. As a matter of fact the society is now busily engaged in gathering statistics as to the cost of power in Pittsburg at the present time, and has submitted a series of questions to power users to enable it to obtain the desired information. The plan, of course, is to build a large central steam power plant and to distribute power electrically and thus displace the numerous steam engines in and about Pittsburg. There seems to us to be nothing chimerical in this scheme, and we trust the society having the work in charge will proceed in the collection and tabulation of the data in order to determine whether the plan may be practically carried out.

(Continued from page 717.)

vantage in various ways, although a failure. It had kept the Bell Company at bay for some time, giving the independent companies time to organize a nd get on their feet. It had allowed the independent movement, supported by the people, to get fairly started. It had also allowed important evidence to be secured of the utmost use by its value and significance to those who might desire to defend themselves against infringement suits. Witnesses had been examined in that case whose testimony was now on record so that they could never go away from it, and that evidence would be of the utmost value in the hands of those defending any such suits under the patent.

As to what would happen, it was impossible for himself or any one to say. He had confidence in justice and truth and in the final victory of that which ought to be. He knew a great deal about the patent, and without any sort of question it was the most unblushing, bare-faced, thinnest, inexcusable, abominable fraud that ever received the sanction of Government. (Tremendous applause.) It had not one single redeeming feature about it. It had not given the world one single idea about the telephone. It had not advanced the progress of the world one minute. The telephone art was to-day just exactly where it would have been if Mr. Berliner had never been born. There was not underlying the patent one single particle of merit. Nobody had ever said there was, not even the counsel for the Bell company. No court had ever decided that it had any merit. The only court that had ever said a word about its intrinsic merit and its legal validity was the U. S. Circuit Court for the District of Massachusetts, and that had decided it was void. The Supreme Court of the United States had not undertaken to pronounce on the validity of the patent. It went no further than to say that for the particular reason of alleged fraud in its issuance, the court saw no reason to interfere, and would not. Everything else was left out of consideration.

That the patent application had been nursed in the Patent Office from year to year for nine years, on purpose to extend its life, was a thing which he believed nobody who had ever looked into the record doubted for a moment, and neither the U. S. Supreme Court nor the Circuit Court of Appeals had decided that that was not so. No one had ever said so except the counsel of the Bell company in their argument, which they immediately knocked out by saying it was no matter, and had no effect on the case if they did delay.

Judge Taylor said he was unable to believe that when they got at it, the courts of the United States would sustain and enforce this patent for the long period of years which it had nominally to run. Such a monstrous wrong upon the people, he did not believe possible, although he did not want them to take his word for it or anything at all. He was excusing and explaining his presence there, and what he had said to people who had asked him questions. A good acquaintance of his, interested in independent telephony, who had recently bought some telephones, had asked his advice about putting them in. He had told him to have faith and courage and to go right ahead and put them in and he would come out all right.

Judge Taylor said that he regarded this talk as probably outside the proper business of the convention. But he had alluded to it simply because it was in their mind, because it had been talked about, because there had been misunderstandings in regard to it, and because it was desirable they should have the truth—at least, as he understood it.

They were met together as a representative commercial convention of a great business, and they had done wisely in coming together and organizing. It wás the American instinct of self-government to do so, and when several hundred men embarked in a business of a given character got together, they quickly adopted laws and elected officers and set up a system of government among themselves. They could now exchange ideas, experience and facts, and disseminate to each other information needed in the conduct of the business. It was to the interest of every one of the local exchanges to be represented, and there were none of them with antagonizing interests or rivalry. The subscriber to the independent system in Detroit would use that in Fort Wayne, as he did, and it would do the subscribers good to feel that they had their mouth to that kind of a hole. (Laughter.) The telephone business, moreover, was one in respect to which very much had still to be learned, in the handling of the staff, the traffic, the lines and other details, and that alone was enough to justify the existence of such an association.

In conclusion Judge Taylor emphasized the influence they might have on legislation and on the improvement of the patent law and system, if they would take the matter in hand, and urged them to proceed with their great work of popularizing the telephone everywhere, and thus of lengthening life, as benefactors to the whole American people. (Great applause.)

JUDGE THOMAS, of Chillicothe, O., president of the convention, said:

It is an honor to preside over the temporary deliberations of so large and intelligent a body of men, gathered together from all quarters of the greatest country in the world. We come together to promote the interests of a just cause and on behalf of the people of this great nation. We know no party, no creed, no State, no North, no South, no East, no West; but the motive that brings us together is pure, is just and right, and is as broad as the expanse of our great territory, having one common object, and that object being pure and right—we have no room for disagreement and I sincerely hope that during the whole course of our deliberations we will keep this fact clearly in mind. While we may not all agree as to details, we hope that long and tedious discussions of minor matters will be obviated so that the work of the convention may proceed with due speed and an organization be formed before we adjourn, that will make still stronger the confidence of the people in this movement. There will be no room for obstinacy here, there will be no demand in this convention for motives either selfish or spiteful. If any came bringing to this meeting motives other than to help take up this great work with zeal and unselfishness, dispel those motives at once and place yourself in the ranks of the great army which will win in a short time the greatest commercial victory that this country has ever seen.

We are told in some of our journals that the telephone business is and must of necessity be a "natural monopoly." We answer that by saying that the people of this free country abhor either a natural or an artificial monopoly, as does Nature a vacuum. It is strange that the American Bell Telephone Company has spent so many millions of dollars in trying to maintain a monopoly when Nature has been so kind as to give it natural protection. If these journals are right, old Mother Nature must have been away from home the past two years and has forgotten to instruct the boys to look after this natural monopoly in her absence.

We are told again in these same journals that the independent telephone movement has been a failure and they cite us to a few instances where persons or corporations without capital have been so unfortunate as to have executions levied upon their property and the same offered for sale by the sheriff. Of course one would infer from these paid articles that this is the only business where this state of affairs has existed. They apparently forget that more than 1,000 independent telephone companies are to-day doing a successful and profitable business. It seems to one after studying the situation and watching closely the movements of the American Bell Telephone Company and its lessees that those companies have not fully comprehended the vast territory of this country. When we stop to consider that up to two years ago there were only comparatively a few people in the United States who felt themselves able to pay for telephones on account of the exorbitant charges made by these companies, and, at the same time, think of the progress that has been made in the telephone enterprise in other countries, it seems that they have taken a very narrow view of the subject.

There is no country in the world where there is such a great demand for rapid communication as in the United States. Our people are quick to act, always energetic when engaged in any business, and have not the patience to await slow communications. There is always a demand for faster mail trains—there is always demand for quicker telegraph and more rapid telephone communications, and since it has been demonstrated that the price of the telephone can be reduced to a point where the common people can afford not only to use them in their business affairs, but also in their domestic affairs, the desire for quick communications has been increased to a very great extent. In fact, the people demand this as their right, and any action of the American Bell Telephone Company under a pretense of still owning fundamental patents will be met with a very decided opposition by the great masses of the people.

The people have looked forward to the time when, under our patent laws, this invention would be open to fair competition. The people fully believe that this time has arrived. We have been taught to believe that our Government, under our patent laws, protected an invention for a period of seventeen years and no more. We know that the microphone has been in use more than that time and that the owners of patents upon that invention have had their full protection under the law. Men all over the country who have studied the patent situation know that the rights of the American Bell Telephone Company under their fundamental patents have expired. We claim now the right under our Government to use those inventions for the public good.

Why should these rights be denied us? Or why should the capital invested by men who are well aware of these rights be jeopardized and their business threatened by a company whose rights have long since expired to hold a monopoly under those patents? Why should we longer be annoyed by notices and threats made in newspapers to refrain from using this invention. We are unable to explain to ourselves why this state of affairs should go on, and knowing that the great masses of the people are in harmony with this movement we meet to-day for the mutual purpose of forming an organization for the mutual protection of those who invested their money in this enterprise as well as the protection of the rights of the great masses of the people in this country.

If we are wrong as to our understanding of the law of this country, the American Bell Telephone Company still has a right under the Berliner patent of 1891 to a monopoly of the microphone, and we will abide the decision of the courts of this country; if we are right we demand as a matter of right that we be allowed to enjoy the privilege of the use of this invention without further annoyance. I have never been able to explain why a great corporation should be so short sighted as to insist upon something that neither reason nor law guarantees them in trying to hold.

It would be far better for them to concede what might be a right than through even a technicality of the law to attempt to rob the people of that which in reality and fairness belongs to them. There is plenty of room in the United States for every manufacturer of telephones, for every company that is operating a telephone system or toll line, and if we were all as industrious for the next twenty-five years as the independent telephone people have been the past two years, our territory would not then be half covered. It would be a long time before this country can say that there is one telephone in operation for every eleven inhabitants within municipal districts. Holland can now boast that in that country the telephone business has reached that point. How has it been brought about? Simply from the fact that since the invention of the telephone prices have been moderate.

If we look into the telephone business in a few other countries certainly we will find every encouragement to proceed with renewed energy to build up a complete system in this country. The history of the independent telephone movement in the countries of Norway and Sweden certainly furnishes great encouragement to those who have undertaken this enterprise in the United States. We are told that in these countries there is in operation one telephone for every seventeen inhabitants within municipal districts. The Bell Telephone Company was the first to enter the field in these countries. They followed their policy of high prices and independent management, heeding not the demand or the desire of the people, and as the result of that policy were enabled to place only a few telephones in operation. The opposition telephone company came into being, established an exchange in the city of Stockholm at moderate prices and adopted a policy of accommodating their patrons. In a short time the independent company was operating nearly five times as many telephones as were operated by the Bell Telephone Company at the time they entered the field. This was followed in other cities in these countries, and in a short time the Bell Telephone Company was compelled to retire from the city of Stockholm, sold its property to the independent company for what it could obtain, and the same result followed in the other important cities of the countries, until to-day the telephone system of these two countries is owned and in the control of the people who in no wise are connected with the Bell Telephone Company. This will certainly be encouragement enough, and it is safe to predict that unless the Bell Telephone Company changes its policy, the same result will follow in this country from the fact that there are hundreds of cities throughout the United States where the lessees of the Bell Telephone Company do not receive enough income to pay their employés.

It is a remarkable fact that for more than two years the independent telephone exchanges in hundreds of cities throughout this country have continually increased their patrons, when the lessees of the Bell Telephone Company were furnishing telephones free to anyone who would allow them to place one in his residence or place of business. This is certainly a true indication of the feeling of the people. I have often wondered if the American Bell Telephone Company fully realized this state of affairs. If they do, it certainly affords them food for thought. There is always some reason when a man will pay for something that he has an opportunity to receive for nothing. There has been more than $20,000,000 invested in the independent telephone enterprise in this country, but a greater capital stock than all this money is the fact that we have the sympathy of the people and have in every locality where a successfully managed independent telephone exchange exists a local influence which can never be taken from us so long as we do our duty, give good service and subserve to the wishes of the citizens.

It was predicted by every important journal in this country in the early days of the telephone that it would succeed and do away with the telegraph. The Western Union Telegraph Company must have believed that this prediction would come true, for we find them in the great lead to get control of patents. It seems that they risked their fortunes with Edison while Bell, Blake and Berliner were gathered in by the American Bell Telephone Company. Then after a brief struggle for the telephone field, we find an agreement was made between these two great corporations in which it was provided to the satisfactory arrangement of both that one should retire from the telephone field and should receive the consideration of a few million dollars. So the prophets' prediction failed. The telegraph business continued as before. The telephone was conducted so quietly that the people never dreamed of the immense fortunes which were being accumulated under these patents and under these arrangements until their attention was called to it by this independent telephone war. We believe that the contract made between the Western Union Telegraph Company and the American Bell Telephone Company has done more to retard the universal progress of quick communication than anything that has ever happened since the invention of the telegraph and the telephone. So soon as this battle is over the people will be surprised at the growth which rapid communication will make. Messages will be transmitted over telephone wires and recorded at the receiving end, delivered to the party addressed, and the answer returned, recorded and delivered without causing people to wait for lines and to get parties to the 'phone. Time will be saved, more words will be transmitted at the same expense and the commercial world will feel the advantage of this form of communication.

It will not be long until the telephone is a very essential feature of our Post Office Department. So much letter writing is burdensome, and with all the advantages of our fast trains we are impatient with this manner of communication. We would be better pleased and time would be saved if for a reasonable sum of money we could talk to those with whom we have business or with whom we desire to communicate. Taking then the vast territory, our great population of 70,000,000 of people, this great and growing demand for quick communication, and the probability that it may in the near future be adopted as the greatest department of our postal system, the field is so great that it seems folly for one company or one corporation to stop progress by giving time to quarreling, contention and litigation. There is still room for more to enter this great field, and one need have no fear of competition in the next half century.

If, however, there is not in this view of the case, sufficient to exact peace, then let the war go on. The American Bell Telephone Company will find that this battle is their Waterloo. They will find that others have been thinking while its officers have been scheming to make money. They will find, too, that our courts will uphold the law if brought under the state of facts proven. They will find, also, that it will not be trying the suit of the Government for the cancellation of a patent. They will find that evidence exists which, when the proper time comes, will be shown to the courts, and they will find that the courts will decide as the judges presiding over them are bound to do under the oath according to the law and the facts. And while they boast of their victories and say nothing of their numerous defeats recently; and while they boast of their great technical lawyers, of their many millions of money and their numerous expert witnesses which have been retained, still they will find that in this great country there are others equally as learned who are ready and willing to espouse the cause of this movement, knowing that a great victory will reward their efforts. It remains then for the American Bell Telephone Company to say what policy it will pursue, but it should understand whether in peace or war, we will meet them, and in peace will greet them, in war will surely defeat them.

The following committee of five on credentials was then appointed: Alex. I. McLeod, Detroit, chairman; W. L. Crisman, Cedar Rapids, Ia.; E. H. Andress, Lafayette, Ind.; Peter E. Blow, Knoxville, Tenn.; and William Hoyle, Cambridge, O., and a recess was taken while the committee prepared its report.

A hot discussion started over the report of the Committee on Credentials. Briefly, the committee had decided that four delegates from Pennsylvania, West Virginia and Eastern Ohio, representing the twenty-seven exchanges in the Inter-state-State Telephone Exchange Association could not vote for any other than the individual companies they represented, although they had been elected to vote as proxies for the other twenty-three companies. The same decision affected five delegates from Indiana who had been elected to cast the votes of thirty-eight telephone exchanges in that State. The committee decided they were entitled to only their five individual votees.

That started a debate that continued for nearly an hour, all the delegates from Pennsylvania, headed by Mr. A. Dively, and those from Indiana making energetic protests at what they considered deprived over fifty companies from being represented in the convention. A. B. Coon, of Marengo, Ill., moved an amendment to the committee's report that would permit the nine delegates from Pennsylvania, Ohio, Indiana and West Virginia to vote for all the telephone companies from which they had credentials. James Jamison, of Newcastle, Pa., supported the amendment. He stated that at a meeting of the Interstate Association, of which he is a member, to elect delegates to the present convention, it was understood that only two or three delegates would be allowed. Accordingly no more were sent. Another delegate from Pennsylvania spoke in favor of the amendment, declaring that the question ought to be settled at once, so that all accredited delegates could participate in the proceedings of the temporary organization.

Alex. I. McLeod, of the Detroit Telephone Company, who was chairman of the Credentials Committee, made a very hot speech against the proposed amendment.

"There can be no legal proxy in this convention during its preliminary organization," asserted S. A. Harper, of Madison, Wis. "There is nothing as yet authorizing me to represent anyone. No permanent organization has been formed, no constitution has been adopted."

A motion to have laid on the table the report of the Committee on Credentials was lost and then the convention adopted the report.

After adjournment, A. V. Dively, of Pennsylvania, and E. H. Andress, of Lafayette, Ind., and others spoke bitterly against the action of the convention in refusing to allow the few delegates from each State to represent all the independent telephone companies in their State which provided them with credentials. They threatened to withdraw from the convention, and some intimated that Mr. McLeod only fought the amendment because he wanted to get support for himself as secretary of the permanent national organization. This, however, Mr. McLeod emphatically denied.

"The three delegates here will withdraw from the convention if we are not allowed to represent all the independent telephone companies that belong to the Pennsylvania association," said Delegate A. V. Dively, of Pittsburg. "Having been instructed to represent our entire association, I cannot isolate any one company and represent it. We propose to fight this thing to a finish. I understand a slate has been fixed up which includes A. I. McLeod for secretary of the permanent organization."

FIRST DAY, EVENING SESSION.

The Executive Committee through its temporary chairman, which had been in session nearly all day, reported a constitution and by-laws. Secretary Critchfield read the report. The name of the association was given as "The Independent Telephone Association of the United States of America." The association's object is to mutually protect the interests of independent telephone companies; also to bring about a complete system of inter-municipal independent telephone exchanges. The membership fee was to be $10 and a delegate to the association shall be a member of any independent telephone exchange. Each exchange should pay 50 cents per subscriber and 25 cents per mile of toll line. Each delegate shall be entitled to one vote only, barring those representative concerns engaged in the manufacture of telephones or telephonic apparatus for sale in the general market. There shall be an advisory board to direct the finances of the association, to call special meetings, to levy assessments when necessary, to contract for the association and to generally supervise the operations of the organization. When the executive committee is not in session the advisory board shall direct the officers of the association. The salary of the president of the association shall not exceed $2,500 a year, that of the secretary $1,000, and that of the treasurer $700, all to be allowed actual expenses on presentation of proper vouchers to the advisory board. Ten members of the executive committee shall constitute a quorum, and a majority of the members of the advisory board.

A motion was made that all those who had not submitted credentials to the committee do so and that those who were not provided with them should be entitled to vote in the convention. This was done and the Credentials Committee retired to an ante-room with the delegates whose credentials had not been passed upon. The committee reported in favor of admitting twenty-two more delegates, and their report was adopted.

On motion of Mr. Alex. I. McLeod, it was decided to adopt each section seriatim where there was no objection. Delegate I. A. Lumpkin, of Mattoon, Ill., suggested that a representative of the Bell Company, or someone else almost as objectionable, might be present and moved that a roll call be taken. It was found that five exchanges were represented by two men each, and as only one could vote, the extra representatives were excluded from active participation in the proceedings of the convention. Similar disposition was made of two extra representatives of manufacturing concerns.

The article of the constitution providing for the levying of an assessment not to exceed 50 cents for each independent telephone in actual use and another of 25 cents a mile for each toll line was considered. Delegate Holmes moved an amendment that each telephone be assessed not to exceed 10 cents and each toll line not to exceed 5 cents.

Mr. Critchfield, of the Executive Committee having the report of constitution in charge, strenuously objected to the proposed reduction in assessments. He insisted that it might be necessary to raise from $150,000 to $200,000 to fight the association's common enemy, and deplored the manifestations of dissension among the delegates at both the afternoon and evening sessions. Ex-Judge Hatch, of the Detroit Telephone Co., declared the recommendations of the committee for assessments were exceedingly extravagant.

MR. W. L. HOLMES of Detroit, rose and said: "The Detroit Telephone Company is not prepared to enter any association that contemplates a law suit. We do not fear any litigation with our own apparatus now in operation. We have been running two years and the Bell Company have not made the slightest intimation of any kind as to infringement."

At the suggestion of Chairman Thomas, a motion was made that the convention go into executive session for the purpose of excluding the reporters, but it was voted down. A motion to lay on the table was lost, as also was a motion to fix the amount at 25 cents. This left the assessment at 50 cents on each independent telephone concern, and 25 cents a mile for each toll line, which was according to the committee's report.

Mr. Critchfield estimated the number of independent telephones in use at 150,000 to 175,000, and the amount of toll line at 2,500 miles. Much toll line was carrying business free of extra charge to the independent subscriber.

MR. H. A. TAYLOR, of Madison, Wis., manufacturing telephones and owning telephone exchanges, made a strong plea for the granting to manufacturers the right to vote on all questions in the conventions. Secretary Critchfield, of the committee, said that the provision excluding manufacturers from participation in the association's proceedings was recommended because they were considered provokers of dissension. He admitted in answer to a question from Charles Flowers, of this city, that in cases where one man owned nine-tenths of the manufacturing plant of a telephone company and another man a one-tenth interest in the exchange, the latter would be entitled to represent the company and vote in conventions of the association. The committee's report excluding manufacturers was then adopted.

Article V. was adopted with little debate. It provides for an executive committee of two members from each State.

Articles VI. and VII. defining the duties and salaries of the various officers were adopted, but with objections as to the $2,500 salary voted the president. An Indiana delegate wanted it reduced to $1,000, urging that the office was honorary, times were hard, and the independent telephones were in a critical position. Other amendments were to cut the salary to $1,500, and a third wanted the question of its amount left to the executive committee. All the amendments were voted down by a storm of noes, and the president's salary stood at $2,500. The salary of the secretary was left to the discretion of the executive committee, not to exceed $1,000 a year, and a suitable allowance for expenses, also to be fixed by the executive committee. One man wanted the salary fixed at $1,500, the secretary to also assume the duties of treasurer. Several delegates objected to joining the two offices, saying it was a temptation to a man's honesty. The amendment was defeated by a unanimous vote, and the section was adopted. The treasurer's salary was fixed at $750, a motion to reduce it to $500 being lost.

The remaining article of the constitution defined the duties of the executive committee and advisory board, and the qualifications of members of the association. One clause of Article VIII. shut out manufacturers and dealers in telephone apparatus from active membership. They are entitled to honorary recognition only. There was more objection to this, one delegation holding that it was assessing taxation without granting representation, as manufacturers and dealers were supposed to contribute the funds of the association. He wanted this clause referred back to the executive committee and it was so ordered by a vote of 48 to 31, the committee to report on Wednesday morning at 9 o'clock.

A motion made to adjourn when 12 o'clock struck was defeated, on a statement that ten minutes more would dispose of the constitution, and the adoption of the remainder of its provisions was proceeded with.

At 12:20 o'clock a. m. the convention adjourned until 9 o'clock Wednesday.

Mr. Peter E. Blow, Knoxville, Tenn., stated as the convention rose, that if the constitution was adopted as a whole as read the Tennessee delegation would withdraw from the association.

SECOND DAY.—MORNING SESSION.

JUDGE THOMAS called for the report of the committee on Article 8. After discussion, Mr. Critchfield said the committee had decided to recommend one extra vote for every 500 telephones or the major fraction of such number of telephones.

MR. RYAN suggested that a certain proportion of toll line represent so many telephones—one mile equal to one instrument.

MR. W. C. STERLING, JR., moved as a substitute that each exchange be entitled to one vote for each 100 telephones in use, no exchange to have less than one vote. Substitute was lost.

JUDGE HATCH brought up the question of manufacturers representing exchanges in any way. This referred to Article 3, changing it to allow manufacturers in if they had the exchange qualification.

MR. BLOW supported the motion as to actual voting, but not as to proxies for exchanges in which such manufacturer had no stock interest. He cited the case of a man who has built three exchanges, but had bought some timber land for his pins, etc., and is now shipping them all over the country. He should not be excluded because he was a manufacturer.

JUDGE HATCH withdrew his first motion and moved to refer back to the committee with instructions to remove all disqualifications against manufacturers if they had the regular exchange qualifications.

MR. CRITCHFIELD said that not a single manufacturer had been found who was not also interested in one or more exchanges.

MR. HARPER wanted the limitation that a manufacturer should have anyhow but one vote. That would meet the fear of a manufacturer swamping them with his proxies.

MR. DOUGHERTY pointed out that this movement would not limit the manufacturer, who would be represented by his own appointees even if he had only one vote for himself.

A motion to lay on the table was carried.

Articles 3 and 8 were then referred back to the committee for immediate action.

Article 3 was reported back as changed to limit to $10 the only present payment.

Article 8 was amended by striking out the objectionable features as to exchanges being represented by manufacturers, who could now speak for their own exchanges. The disqualification was thus removed.

A motion was made to adopt the constitution as a whole.

MR. HOLMES, representing the Detroit Telephone Co., said there were many objections among his associates to the constitution as it stood as a whole. They objected to joining a body organized for litigation. They believed in a commercial association co-operating to extend toll lines and to secure legislation favoring their purposes. The independent companies were popular and could get the legislation needed. What was really wanted was legislation, not litigation. Mr. Holmes objected strongly also to the charges per instrument and per toll mile and to the heavy salaries. The proposed constitution was on the wrong path. It was foolish and suicidal. They should not give out, moreover, that they feared or expected litigation. If sued, they could attend to that when it came. The Grand Rapids exchange had met the agents of the Bell Company three times on litigation and had downed them.

MR. CRITCHFIELD remarked that his Detroit friends had laid off 200 men right after the Berliner decision. What did they fear?

MR. HOLMES denied any stoppage or restriction of work.

MR. C. M. ZION reminded them of the old revolutionary saying that if they did not hang together they would hang separately.

The question was asked but not answered as to what would be done if the Bell Company sued a company not in the association.

The constitution was then carried by a large majority vote.

MR. D. A. REYNOLDS then urged that the membership fee be collected before a resolution to name and elect the executive committee of the new association or its advisory board.

MR. HARPER insisted that they must now act under the new constitution, the temporary organization having done its work.

MR. VESEY was elected as temporary secretary of the new organisation.

MR. McLEOD moved that the States get together at once during a recess of twenty minutes and choose two members each for the executive committee. Agreed.

On resumption a rising vote of thanks was given to the temporary Executive Committee for its work.

An Executive Committee was then formed based on two members for each State represented in the convention. About twenty-one States were put in nomination, and others will be added from time to time.

MR. CRITCHFIELD moved the election of these gentlemen.—Agreed.

It was agreed that the Executive Committee meet on the boat that afternoon.

Adjourned till 7 p. m. Wednesday evening.

WEDNESDAY.—EVENING SESSION.

The Executive Committee elected at the morning session made its report.

Mr. Harper made the report. Mr. Savidge had been elected president; himself secretary, and as seven members of the Advisory Board had chosen Messrs. Savidge Critchfield, Dougherty, Marshall, Duncan, Miller and Higgins.

JUDGE THOMAS said that the manufacturers had met and had appointed a committee to confer next week with the Advisory Board.

The meeting then proceeded to the election of officers.

JUDGE THOMAS was elected president by acclamation and returned thanks briefly, stating how deeply he felt the responsibility at this vital moment. The work accomplished and closing in harmony meant victory for the independent telephone cause in the United States. He closed by appealing to them all for active co-operation.

The following officers were then elected:

First Vice-President, H. C. Young.
Second Vice-President, E. K. Himes.
Third Vice-President, T. Fricker.
Secretary, W. J. Vesey.
First Assistant Secretary, Z. W. Beers.
Second Assistant Secretary, D. C. Dow.
Treasurer, L. A. Carr.

The other nominees for the treasurership being D. A. Mossman and F. W. Hoyt.

A very hearty vote of thanks was given to the Detroit Telephone Company for their lavish hospitality.

We give below the complete text of the constitution as adopted:

ARTICLE I.—NAME.

The name of this organization shall be the Independent Telephone Association of the United States of America.

ARTICLE II.—OBJECT.

The objects of this association shall be:

1. The protection of all independent telephone interests of common concern to the members of the association.
2. The protection of subscribers to telephones and apparatus operated by members of this association.
3. The bringing about a reasonable charge for tolls and the rental of telephones, so that the telephone may be within the reach of the masses of people.
4. The bringing about a complete system of intermunicipal communication and long-distance trunk lines.

ARTICLE III.—MEMBERSHIP.

Any corporation, partnership, or individual engaged in the operation of an independent telephone exchange, toll line, or system, may become a member of this association by complying with the following conditions:

1. The payment of a membership fee of $10 and the first assessment levied as hereinafter provided; provided, however, that the payment of the membership fee and signing the constitution only shall entitle the member so paying to vote in the election of officers, upon the adoption of this constitution, but not thereafter.
2. The payment, from time to time, of such further assessments as the association, through its proper committee, may levy, not to exceed in any one year fifty cents for each telephone in use by any exchange or toll line company, and fifty cents per mile of pole lines, carrying a wire or wires, over which paid messages are transmitted.
3. Any corporation, partnership or individual engaged in the manufacture or sale of apparatus or materials used in the construction, operation or maintenance of an independent telephone exchange, toll line or system, may be called upon by the Advisory Board for such voluntary contribution as in the judgment of said board may be equitable and necessary, and upon payment of the same, shall, at the option of the contributing party, be made an honorary member of the association. The secretary shall make monthly report to the president, the Advisory Board and the Executive Committee, and an annual report to the association, of the persons, firms, or corporations entitled to honorary membership under the provisions of this article, and the amount contributed by each. The receipt of the secretary shall be the certificate of such membership, but honorary members shall have no voice in transacting the business of the association, as a matter of right.
4. By subscribing to the constitution and by-laws of the association.

ARTICLE IV.—OFFICERS.

The officers of this association shall be a president, three vice-presidents, a secretary, two assistant secretaries, a treasurer, and an Advisory Board, consisting of nine members, two of whom shall be the president and secretary of this association, together with seven members who shall be selected by the Executive Committee. The president and secretary of the association shall be ex-officio chairman and secretary of the Advisory Board and Executive Committee, respectively.

ARTICLE V.—COMMITTEES.

The association shall elect an Executive Committee, which shall consist of two members from each State; each State, through its delegates, to suggest the names of the members of said committee to represent such State. Should any State be without representation in the convention, the convention shall then select two members from such State, who shall act until the vacancy shall be properly filled under this article. The Executive Committee shall, with the consent of the Advisory Board, select such sub-committees as it deems expedient and necessary, and shall fully empower such sub-committees to carry out the objects for which they were created.

ARTICLE VI.—ELECTION OF OFFICERS.

The officers herein provided for, except the Advisory Board, shall be elected as provided in Article 14 hereof, on the adoption of this constitution, and thereafter at the regular annual meeting of the association, to be held in June of each year. The time and place of holding such annual meeting shall be fixed by the Executive Committee. The officers so elected shall serve until the next succeeding annual meeting, or until their successors are elected and qualified.

ARTICLE VII.—DUTIES OF OFFICERS.

1. The president shall preside at all meetings of the association, Advisory Board and Executive Committee. He shall, under the direction of the Advisory Board, conduct a bureau of information for the benefit of members of this association, and shall, with the assistance of the Advisory Board, collect all data and information relating to the welfare and promotion of independent telephone interests. He shall procure facts and evidence tending to the protection and promotion of such interests. He shall have power to call to his assistance for consultation the officers, committees and members of this association. He shall approve and countersign all orders drawn on the treasurer of the said association; shall approve and sign all contracts and bonds made by this association; shall approve all bonds made to this association, and be custodian of the same, and shall perform such other duties as naturally devolve upon his office. He shall receive such salary, not to exceed $2,500 per year, as the Executive Committee shall fix; shall have an allowance for expenses, to be paid upon approval of the Advisory Board on presentation of properly executed vouchers. His salary shall be paid at the end of each quarter by draft made on the treasurer. He shall give bond in such sum as the Executive Committee may require, with such security as may be approved by the Advisory Board.

2. VICE-PRESIDENTS.—The vice-presidents shall rank first, second and third, according to the choice of the association, to be designated at the time of their election, and shall, in their order, perform the duties of the president so far as they relate to meetings of the whole association only, in the absence or inability of the president to act, and shall have an allowance for actual expenses, while performing said duties, upon the approval of the Advisory Board.

3. The secretary shall keep the minutes of the association; he shall collect all moneys, receipt for the same, and turn the same over to the treasurer promptly, and take his receipt therefor. He shall keep an accurate account of all receipts and expenditures of money, and make a report at each annual meeting of the association, and to the Executive Committee and Advisory Board whenever called upon so to do. He shall issue and mail all official calls and perform all other duties required of him by the association. He shall receive such salary, not to exceed $1,000 per year, as may be fixed by the Executive Committee, and shall have an allowance for expenses, to be paid upon the approval of the Advisory Board on presentation of properly executed vouchers. His salary shall be paid at the end of each quarter by draft upon the treasurer. He shall give bond in such sum as the Executive Committee may require, with security to be approved by the Advisory Board.

4. The assistant secretaries shall rank first and second, according to the choice of the association, and shall, in their order, perform the duties of the secretary in his absence or inability; and perform such other duties as the secretary may require of them, but shall not be members, nor act as secretary of the Advisory Board. They shall have such compensation as the Advisory Board may designate, and an allowance for actual expenses while performing the duties of their office, to be approved by the Advisory Board upon presentation of properly executed vouchers.

5. The treasurer shall receive from the secretary all money by him collected, acknowledge receipt thereof, and pay all properly executed orders and drafts, provided for in this constitution, and all other orders signed by the secretary and countersigned by the president, under the direction of the Advisory Board. He shall keep an accurate account of all moneys received and disbursed, and make an annual statement of the same to the association, and an itemized statement thereof to the Advisory Board at any time when he may be called upon so to do. He shall receive such salary, not to exceed $750 per annum, as may be fixed by the Executive Committee, and shall have an allowance for his actual expenses, after the approval of the Advisory Board upon presentation of properly executed vouchers. His salary shall be payable at the end of each quarter, by draft upon himself as treasurer. He shall give bond in such sum as may be required by the Executive Committee, with security to be approved by the Advisory Board.

6. ADVISORY BOARD.—The Advisory Board shall have full power to determine all questions, transact all business of the association at all times when the association or the Executive Committee are not in session; but shall carry out the policy adopted by the association, or the Executive Committee, unless in the opinion of the Advisory Board circumstances make a change of policy desirable. The Advisory Board shall direct the finances of the association, shall have full power to levy assessments whenever necessary, subject to the limitations contained in Article 3, and to appropriate money in the general fund to such use as, in its judgment, is essential to the welfare of the association. It shall create two funds in the hands of the treasurer, first, a fund for salaries and expenses of officers and committees; second, a general fund; and shall have power to transfer money from one fund to the other without interfering with existing obligations. It shall contract for the association, and shall at all times, except when the association or Executive Committee is in session, direct the other officers of the association to carry out the intention of this organization.

7. The Executive Committee shall have all the power of the association, except when said association is in session, not herein especially delegated to the officers and Advisory Board, and shall have an allowance for their actual expenses incurred in attending meetings of the Executive Committee, after presentation of properly executed vouchers, upon approval of the Advisory Board.

ARTICLE VIII.—REPRESENTATION.

Each member of this association shall be entitled to one vote for each 500 telephones or less, or for each 500 miles of toll line or less, in actual use, and one additional vote for a major fraction of 500 telephones or miles of toll line in actual use; and no more, on the election of officers or as to any question voted upon by said association.

ARTICLE IX.—QUORUM.

A majority of all members present shall constitute a quorum for the transaction of business of this association, twenty days' written notice of the time and place of holding the meeting having first been mailed by the secretary to each member of the association.

ARTICLE X.—EXECUTIVE COMMITTEE QUORUM.

Ten or more members of the Executive Committee shall constitute a quorum for the transaction of business, ten days' written notice of the time and place of the meeting having first been mailed by the secretary to the address of each member of the committee.

ARTICLE XI.—ADVISORY BOARD QUORUM.

A majority of the members of the Advisory Board shall constitute a quorum for the transaction of business.

ARTICLE XII.—SPECIAL MEETINGS.

The Advisory Board shall, whenever in its opinion the same is desirable, through its president and secretary, call special meetings of the association or the Executive Committee, as such times and places as it shall designate and a special meeting of the Executive Committee shall be called by the secretary upon the written request of three members of said committee, stating the object for which the committee is called, filed with the secretary at least twenty days prior to such meeting. The secretary shall thereupon notify each member in writing of the time and place of holding the meeting, and shall mail to each member a copy of the request for the same. A special meeting of the association may be called upon a written request therefor, stating the object for which the meeting is called, being filed with the secretary, when signed by not less than 100 members of the association. The secretary shall give ten days' written notice of the time and place of holding such meeting and shall mail to each member of the association a copy of the call for the same.

ARTICLE XIII.—SPECIAL SERVICES.

Any member of this association who shall perform special services under the direction of the association, Executive Committee or Advisory Board, shall be allowed such compensation and allowance for expenses as shall be approved by the Advisory Board

ARTICLE XIV.—ELECTIONS.

The election of officers shall be by ballot, whenever two or more names are presented for the same office, and shall be conducted by three judges and two clerks, to be selected by the presiding officer. The presiding judge shall announce the name of the voter before the ballot is deposited in the ballot box, and should any member challenge the vote, the judges shall then proceed to hear the objection and shall determine the rights of the voter. Members may vote by written proxy, duly authorizing another member or representative of a member to cast the ballot.

ARTICLE XV.—AMENDMENTS.

This constitution may be amended at any regular meeting by an affirmative vote of a majority of all the members of the association, and at any special meeting called for that purpose, the object having been stated in the call, upon the vote of two-thirds of the members present, the proposed amendment or amendments having been first signed by not less than twenty-five members, and filed with the secretary at least thirty days before said meeting, written notice of such proposed amendment or amendments having been mailed by the secretary to each member of the association at least twenty days prior to such meeting.

The following is a list of those in attendance, exclusive of manufacturers and supply men, whose names will be found in the notes on exhibits. All told about 300 persons participated in the convention.

Hugh Dougherty, Bluffton, Ind.: United Telephone Co., Bluffton: United Telephone Co., Portland; United Telephone Co., Huntington Ex., and Montpelier Telephone Co.

J. L. Stone, Rushville, Ind.: Rushville Co-Op. Tel. Co. and Shelbyville Tel. Co.

Joseph S. McKee, James M. Thomas and C. D. Duncan, Chillicothe, O.: The Home Telephone Co.

James M. Thomas, Marysville, O.: The Marysville Telephone Co.

C. D. Duncan, Chillicothe, O.; Chillicothe and Clarksburg Tel Co.; Londondery and Vigo Tel. Co.

Columbia Telephone Co., Waverly, O.

Londondery and McArthur Tel. Co., Allensville, O.

Dr. I. A. Lumpkin, Mattoon, Ill.: Mattoon Tel. Co.

Dan. A. Mossman, Huntington, W. Va.: Huntington Mutual Tel Co.

H. K. Cole, Owensboro, Ky.: Owensboro-Harrison Tel. Co.

Elmer E. Summey, Utica, N. Y.: Auburn Tel. Co.

D. C. Dow, Cobleskill, N. Y.: Cobleskill Tel. Co. and Cobleskill and Sharon Telephone Co.

Frank L. Beam and H. D. Critchfield, Mt. Vernon, O.: Mt. Vernon Telephone Co.

W. B. Seaton, Ashland, Ky.: Citizens' Tel. Co.

Tom A. Marshall, Keithsburg, Ia.: Tom A. Marshall Tel. Co.

W. B. Seaton, Ashland, Ky.: People's Tel. Co., Cattletsburg, Ky., and East Fork Tel. Co.

W. C. Sterling, Jr., Monroe, Mich.: Monroe New State Tel. Co.

William H. Blake, Cheboygan, Mich.: Cheboygan Tel. Co.

H. C. Young, Columbia, Pa.: Adrian Tel. Co.

H. C. Young, Columbia, Pa.: Columbia Telephone Co.

Dr. J. Williams, Jr., Adrian, Mich.: Adrian Telephone Co.

L. A. Carr, Durham, N. C.: Interstate Teleph. and Teleg. Co.

W. H. Gilbert, Saginaw and Bay City, Mich.: Valley Telephone Co.

George W. Finch, Escanaba, Mich.: Finch's Telephone Ex.

Louis Feder, Lima, O.: Lima Tel. Co. and People's Telephone Co., Leavenworth, Kan.

S. T. Slade, Oskaloosa, Ia.: Home Telephone Co.

A. C. Savidge, Sunbury, Pa.: Snyder County Telephone Co.

J. C. Duncan, Oak Grove, Tenn.; C. C. Cochran, Clinton, Tenn.; G. K. Hartwick, Harriman, Tenn., and Peter E. Blow, Sweetwater, Tenn.: People's Tel. and Telegraph Co., Knoxville, Tenn.; Morristown Tel. Co., Morristown, Tenn.; Newport Tel. Co., Newport, Tenn.; Watauga Tel. Co., Elizabethton, Tenn.; Nolyclinchy Tel. Co., Jonesboro, Tenn.; Clinchy River Tel. Co., Clinchy, Tenn.; Oak Grove Tel. Co., Oak Grove, Tenn.; Clinton Tel. Co., Clinton, Tenn.; Harriman Tel. Co., Harriman, Tenn.; Sweetwater Tel. Co., Sweetwater, Tenn.; Cleveland Tel. Co., Cleveland, Tenn.; T. J. Long Tel. Co., Athens, Tenn.; Maryville Tel. Co., Maryville, Tenn.; Bristol Tel. Co., Bristol, Tenn.; Columbia Tel. Co., Columbia, Tenn.; Hiawasse Tel. Co., Hiawasse, Tenn.

Harrisonville Telephone Co., Illinois.
A. Y. Gordon, Massillon, O.: Farmers' Telephone Co.
W. N. Gladson, Fayetteville, Ark.: Fayetteville Tel. Co.
R. F. Blount, Wabash, Ind.: Home Telephone Co.
George A. Weed, Lake Odessa, Mich.: Co-Operative Tel. Co.
Peter White, Marquette, Mich.: Marquette County Telephone Co.
Thomas W. Gannon, Cairo, Ill.: Cairo Telephone Co.
Thomas Fricker, Ashtabula, O.: Ashtabula Telephone Co.
W. W. Graham, Norwalk, O.: Norwalk Tel. Co.
E. C. Pierce, Barberton, O.: Magic City Telephone Co.
Evan J. Evans, Justus, O.: Youngstown Telephone Co.
R. F. Weaver, Wadsworth, O.: Wadsworth Gen. Elec. Co.
D. A. Reynolds, Jackson, Mich.: Jackson Telephone Co.
C. P. Collins, Detroit, Mich.: Detroit Telephone Co.

REPRESENTATIVES OF THE INDIANA MUTUAL TELEPHONE ASSOCIATION—38 COMPANIES: E. H. Andress, chairman, Lafayette, Ind.; John McGregor, secretary, Madison, Ind.; L. A. Frazee, Connersville, Ind.; George W. Beers, Fort Wayne, Ind.; C. M. Zion, Lebanon, Ind.; C. M. McCabe, Covington, Ind.

Charles E. Phelps, Jr., Wilmington, Del.: Delmarvia Telephone Co.
Edward H. Parker, Flushing, Mich.: Flushing Telephone Co.
C. Gardner, Dearborn, Mich.: Dearborn Telephone Co.
Joseph Waltz, Waltz, Mich.: People's Telephone Co.
W. F. Marshall, Tarkio, Mo.: Northwest Missouri Telephone Co.
Jesse W. Weik, Greencastle, Ind.: Greencastle Telephone Co.
N. H. Rust, Bowling Green, O.: People's Telephone Co.
A. B. Burkholder, Ashland, O.: The People's Telephone Co.
William H. Blake, Cheboygan, Mich.: Cheboygan Telephone Co.
Oscar Wise, Butler, O.: People's Telephone Co.
John McGregor, Madison, Ind.: Madison Telephone Co.
D. M. Niffin, Detroit, Mich.: Detroit Telephone Co.
A. A. Adams, Columbia City, Ind.: Home Telephone Co.
George W. Beers, Fort Wayne, Ind.: Home Teleph. and Teleg. Co.
L. A. Frazee, Connersville, Ind.: Frazee Telephone Exchange.
E. A. Croll, Iron Mountain, Mich.: Menominee Range Tel. Co.
Morrison & Maxwell, Steubenville, O.: Steubenville Phoenix Tel. Co.
C. M. Zion, Lebanon, Ind.: Lebanon Telephone Co.
A. V. Dively, Altoona, Pa.: Altoona Phoenix Telephone Co.
D. Jameson, New Castle, Pa.: New Castle Telephone Co.
T. J. Shufflin, Butler, Pa.: People's Telephone Co.

These gentlemen also representing the 27 INTERSTATE EXCHANGE ASSOCIATION COMPANIES in Pennsylvania, Ohio and West Virginia:

L. R. Heath, Mercer, Pa.: Mercer Tel. and Teleg. Co.
H. B. Hanford, Norwalk, O.: Norwalk Telephone Co.
T. H. Johnson, Sioux City, Ia.: Home Telephone Co.
G. L. Hardwick, Cleveland, Tenn.: Cleveland Telephone Co.
A. Button and F. A. Searl, Painesville, O.: Painesville Tel. Co.
William G. King, Chardon, O.: Chardon Telephone Co.
A. B. Coon, Marengo, Ill.: The McHenry Tel. Co. and Oak Tel. Co., South Haven, Mich.

INTERSTATE TELEPHONE AND TELEGRAPH CO., OPERATING EXCHANGES AT—Durham, N. C.; Wilmington, N. C.; Greenville, N. C.; Goldsboro, N. C.; Winston and Salem, N. C.; Roanoke, Va.; Salem, Va.; Charlottesville, Va.; Gordonsville, Va.; Orange, Va.; Frederick, Md.: L. A. Carr, president, Durham, N. C.; Edgar L. Miller, general manager, Durham, N. C.

F. C. Manning, Camden, S. C.: The Camden Telephone Co.
The Wapakoneta Telephone Co.
Charles E. Bell, Evart, Mich.: Evart, Mich., Tel. Exchange.
M. Donelly, Napoleon, O.: Wauseon, O., Tel. Exchange.
Ohio Tel. Cons. Co., Wauseon, O.: Napoleon, O., Tel. Exchange.
J. S. Brally, Wauseon, O.: Elyria, O., Tel. Exchange.
J. S. Brally, Jr., Wauseon, O.: Clyde, O., Tel. Exchange.
Ed. L. Barber, Wauseon, O.: Conneaut, O., Tel. Exchange.
J. Williams, Jr., Adrian, Mich.: Adrian, Mich., Tel. Exchange.
N. W. Ohio Toll Line.
Ohio and Michigan Toll Line.
A. J. Little, Battle Creek, Mich.: Independent Tel. Exchange.
G. W. Risser, Ottawa, O.: Ohio Telephone Co.
C. F. Heidley, Leipsic, O.: Leipsic Telephone Exchange.
J. H. Fildar, St. Johns, Mich.: Carley Telephone Exchange.
J. B. Ware, Grand Rapids, Mich.: Citizens' Telephone Co.
John T. Holmes, Detroit, Mich.: Port Huron Harrison Tel. Co.
George M. Conner, Mt. Clemens, Mich.: Mt. Clemens Exchange.
W. C. Sterling & Son, Monroe, Mich.: New State Tel. Exchange.
W. L. Crissman, Cedar Rapids, Ia.: Cedar Rapids and Marion Telephone Co.
Samuel A. Harper, Madison, Wis.: Dane County Telephone Co.
H. C. Hedges, Lansing, Mich.: Lansing Telephone Exchange.
Dr. W. W. Tobey, Danville, Ill.: Danville Telephone Co.
J. W. Douda, Barnesville, O.: Barnesville Telephone Co.
C. D. Terrell, Meridian, Miss.: East Mississippi Tel. Co.
W. M. Ryan, Hampton, Va.: Hampton Telephone Co.
T. A. Rockwell, Oshkosh, Wis.: Oshkosh N. W. Tel. Co.
S. G. Higgins and W. H. Gilbert, Saginaw, Mich.: Valley Tel. Co.
F. F. Spencer, Sandusky, O.: Sandusky Telephone Co.
William L. Holmes, Detroit, Mich.: New State Tel. Co. of Michigan.
Frank A. Vernor, Detroit, Mich.: Memphis, Mich., Exchange.
C. R. Savidge and A. C. Savidge: Shamokin Valley Tel. Co.
D. S. Olmstead and M. M. Herroy, Millersburg, O.: Millersburg Telephone Co.
Hugh O'Connor, Plymouth, Mich.: Plymouth Tel. Co.
G. D. Bouton, Ann Arbor, Mich.
Charles Flowers, Detroit, Mich.: Detroit Telephone Co.
George A. Beaton: Jackson Telephone Co.
George W. Finch: Finch's Telephone Exchange.

CONVENTION NOTES.

EXPECTING SPIES. A curious feature of the convention was the unmistakable dislike and suspicion entertained in many quarters towards the American Bell Company, not merely as an opponent, but as a very bad and wicked entity. In one case, where the good faith of the delegate was suspected, a telegram was sent to his home making inquiries. The result vindicated him, but the incident left a rather disagreeable impression. It was gravely suggested by one or two ultra rabid independents that perhaps the arch enemy had spies concealed in the nooks and crannies of the hall. Another noteworthy feature was the zeal with which the delegates stuck to business. They seemed to read neither the local daily papers nor the various technical journals of largest circulation with which they were plied in the proportion of ten copies per delegate. They would talk all night, but reading at that juncture had no charms for them.

OLD BELL TELEPHONE MEN were to be found here and there in the throng, showing that after all the principle of heredity and continuity plays some part even in the most emphatic independent movements. It has been wondered where the opposition companies would find their talent. They have found it all right, and some very genuine advances and innovations may now be confidently looked for.

MR. J. D. LEATHERBEE, the fighting treasurer of the National Telephone Company, of Boston, was a personality of intense interest among the delegates when they learned that this quiet, earnest, reticent man was the center of the litigation with the Bell Company. It is only telling the bare truth that though Mr. Leatherbee went to the convention unknown to many Western delegates, his dignified conservatism and entire attitude won him great admiration among them. The efforts of the local papers to draw him out were not less numerous than amusing, but his confidences were courteously reserved for those entitled to them. It is gathered that the case in which Mr. Leatherbee's company is concerned will soon be in shape for argument, the evidence now approaching its close. It was generally recognized that Mr. Leatherbee has been fighting not for himself alone, but for the cause that the association as a body now represents.

THE ASSOCIATION was too young to have a button. Young Hercules choking a b—ll was suggested. For the present it wears as badge a tiny knot of baby pink ribbon, typical of the dawn of its career and the rosy nature of its hopes. Curiously enough, some of the delegates came wearing their N. E. L. A. buttons, showing how easy the step from electric light to telephony has been. One delegate had an N. E. L. A. badge that dated back to the Kansas City convention.

GETTING ACQUAINTED was in reality one of the features of the occasion. In the debates on the floor, the fact that the men did not know each other often came out in the amusingly periphrastic way in which they spoke of each other. "The gentleman over by the wall," or "My friend, I believe, from Indiana," and little things of that kind were very noticeable at the beginning. But after the boat ride on the St. Clair Flats that was all changed, and short, Christian names were in order.

JUDGE THOMAS made an admirable presiding officer. Indeed, there was a curious contrast between his nonchalant equanimity in the very hottest periods of cross-talk and the scathing indignation of his assault on the Bell policy. The task assigned him is no small one as president, and novel as the payment of a salary to such an official is, he is the man to earn the last cent of it. As usual, the presidency went to Ohio, for the Judge hails from Chillicothe.

THE DETROIT TELEPHONE COMPANY did the honors of their city in a very thorough and hospitable manner. All the delegates were welcomed to their splendid new exchange, where they could see a board no less than 173 feet long in one stretch, some 50 operators at work, and about 3,000 drops in actual service. Before the year is out the company expects to run up to 5,000 subscribers. Engineer-in-Chief Ahern and Mr. C. L. Zahm, the manager, did the honors very ably. Mr. Ahern has done some very fine work of an inventive and engineering character for the system, and is deservedly proud of his boards, operating room, subways, cables, etc. He is rapidly extending toll lines, and has already found it necessary to lay out a fine sub-exchange up Woodward avenue. For $40 or $50 a year the company is giving good service, as could be easily ascertained by casual inquiry around town. Messrs. Holmes, Hatch and McLeod, of the company, were also active everywhere in paying attention to visitors and friends and in participating in the work of the convention, in which they showed the utmost interest.

A DELIGHTFUL SAIL on the Detroit River and St. Clair "flats" was given by the Detroit Telephone Co. on Wednesday afternoon, when about 300 delegates and friends embarked at 1:30 on the steamer "Sappho." An excellent lunch was served with several "self-restoring drops," and the utmost good feeling prevailed. For several hours the boat cruised around, sounding once in a while for submerged Bell mines or torpedoes, as a measure of precaution. A band played appropriate airs of an "independent" character, and the pleasure of the trip was also enhanced by the relief afforded from the muggy heat of the city.

IT IS TOLD of one of the directors of the General Electric Co., that passing Schenectady the other day on the train, he inquired whose those fine factory buildings were on the side of the road! Some of the delegates to Detroit seemed quite surprised to find that a fine massive building near that of the Detroit independent company was operated by the Michigan Bell for telephone purposes, and one or two of them were observed trying to count the wires running into it, their comment being that it couldn't be an exchange with only that few!

A DELEGATE whose persuasive forensic eloquence was frequently heard in the convention was taking an active part in the final voting when the chilly statement was made that $10 dues must be paid before a vote could be cast. His work of canvassing votes ceased suddenly, he disappeared for several minutes, but could be seen behind some of the scenery on the stage groping assiduously about his person for a ten dollar bill. With a charming air of utter unconcern he slid back at last, paid up, and resumed his patriotic duties with as much fervor as though he had been, not one of the last, but the very first to sign the new constitution.

INTERVIEWS with prominent men in the convention, like Messrs. Thomas, Savidge, Blow, Taylor, McLeod, Keelyn, Dodge, and others, revealed the fact that in spite of differing points of view in policies, there was a common feeling of satisfaction in the fact that the independent interests had got together in such strong force. It was predicted that the movement would now be more rapid and pronounced than ever.

ATTENTION was called to the fact that the Eastern and Northeastern States showed up so sparsely at the convention, so far as operating independent companies were concerned. In reality, New England was a total blank, New York had a very slim deputation, and New Jersey "was not in it." The strength of the movement would seem to lie at present in the bunch of big States lying close together around Ohio, and in another big bunch including Indiana, Michigan, Wisconsin and Iowa. There is much interest to see how this ratio will continue to manifest itself. The State Association delegates present evidently felt that they were cuttig out some great work in their respective regions and that they had but barely begun.

EXHIBIT NOTES.

MR. W. S. ECKERT was present in the interests of the bi-metallic wire, and found ready listeners among the telephone men representing companies about to undertake new lines and seeking to give better competing service with circuits of a higher conductivity while securing the greater tensile strength.

BROWNLEE & CO., Detroit, Mich., the well-known manufacturers of poles and cross-arms for telegraph, telephone and other purposes, were well represented by their principals.

AMERICAN ELECTRICAL WORKS, of Providence, R. I., were represented by their Chicago agent, Mr. Edgar H. Hammond.

MR. E. RUEBEL, the president and treasurer of the St. Louis Electrical Supply Company, was present in the interests of that concern.

MR. P. P. NUNGESSER, the manufacturer of the admirable dry, chloride of silver and other Nungesser batteries, was present in behalf of the Nungesser Electric Battery Company. He is not only an inventor, but a practical chemist and electrician and has brought a long experience to bear on the subject of batteries. The products bearing his name are well known to telephone companies as well as to electrical people throughout the world.

STROMBERG-CARLSON TELEPHONE MFG. CO., of Chicago, were represented by Mr. A. B. Cotton, secretary; Mr. Delos Thompson and Mr. Hy. Shafer, and had a superb exhibit of well designed, beautifully built apparatus representative of their exchange, private line and other systems. Their transmitters and receivers are excellent pieces of mechanism and so constructed as to free from liability to danger of accident, the working parts being all carefully and thoroughly enclosed. The receiver is of the bi-polar magnet type, with solid brass head, and will hold up a dead weight of half a dozen pounds by sheer pull. These were all shown in working connection with desk sets, wall sets, long distance lines and as used in conjunction with the company's boards, all of which were equally interesting, providing for very rapid work by the operator, satisfaction to the subscriber, and facility for ready inspection and repair. Additional to all these were sets for police and fire alarm use, street railway complete sets to plug in on pole contacts along the road, and a very ingenious stenographer's set for direct dictation without leaving one's desk. There were also shown a variety of hand and power generators, extension bells, motors, triplet telephone sets to replace rejected apparatus of other makes right on the same backboard with the saving of all except the old receiver, transmitter and induction coil. It is hard to speak too highly of the cleverness and workmanlike style shown in the Stromberg-Carlson apparatus.

AMERICAN ELECTRIC TELEPHONE CO., of Chicago, were represented by Messrs. H. C. Dodge, general manager; P. C. Burns and a large staff of assistants. Their fine exhibit in Parlor G at the Cadillac Hotel consisted of their latest improved apparatus, such as their fine new "Express" switchboard, which was a great favorite with all who examined it, and which is being widely adopted. Mr. Dodge reported having closed under warm competition orders for a 700 express board, replacing another make, at Sandusky; one of 700 at York, Pa.; 800 at Shreveport, Pa.; 300, Monroe, Ill.; 400, Coshocton, O.; 300, Belleville, O., making all told a total of 5,000 drops ordered within 60 days. At St. Joseph and Benton Harbor, a 400 number exchange is now being built under their supervision. Among the other new apparatus shown may be mentioned the special telephone with adjustable transmitter arm, allowing fine adjustment both as to height and as to lateral position and maintaining the transmitter movement exactly plumb at all times. Their new solid back amplifying transmitter was also shown, which is now being used on several lines up to 500 miles in length, and which the American Company holds to be absolutely free from the slightest taint of possible infringement. The company, which has moved lately to Chicago, reports employing 137 hands, and putting out daily on the average 125 telephones and drops to the number of 150. Mr. Dodge spoke of the outlook for independent telephony as extremely bright.

WESTERN SIGNAL CO., at the Russell House, represented by the veteran electrician, Mr. B. F. Stewart, showed some very ingenious and taking apparatus, which embodies the idea of using the telephone in conjunction with certain automatic devices doing away with the great complication of the purely and more familiar automatic system. For instance, a man in case of a fire goes to the box and having begun he sends in the automatic signal, without further initiative on his part, by releasing the hook, which will tell the department headquarters the location of the fire. If the man has any senses left, or is an official, he can communicate by the telephone and state exactly the nature of the fire, its location in the block, and further particulars. The telephone is put in circuit by taking it off its hook. The signal goes in anyhow, and over a grounded circuit, while the talk goes over what becomes a metallic circuit. Another line that this apparatus is being introduced for is street railway work. The conductor carries the small telephone box on his car, it being 4 x 3½ x 5 inches, including a granular carbon transmitter, watch case receiver and the necessary connecting apparatus. In an instant by pushing the plug into the calling boxes put on the poles along the road, the conductor can reach his dispatcher or headquarters. He hangs his box up, plugs in and the central of the system is called up. The whole thing has been very neatly and deftly worked out.

WESTERN TELEPHONE CONSTRUCTION CO. were represented by Messrs. J. E. Keelyn, K. B. Miller, C. P. Platt, J. G. Nolen, W. D. Barnard and J. A. Russell, and had parlors for their wonderfully comprehensive exhibit put together in 48 hours under Mr. Russell's care. It was a central exchange in miniature and of the most complete character, besides being graced with a variety of detail apparatus and very handsome cabinet work. It consisted of a very fine exhibit of display board upon which the apparatus was mounted, comprising a telephone booth in the center with two wings on each side, in light wood. The various apparatus mounted showed a 100 drop switchboard complete throughout with all the latest details and improvements. A unique feature of the board was its compactness, its mechanical self-restoring drops and its new automatic circuit changers. The key table apparatus of a board has always been a cause of much trouble and annoyance. In this board, the operator by simply rocking a little lever to and fro, can get and put the calling and the called subscriber in quickest touch yet maintain control of the situation and thus expedite service all around. There were also shown some fifteen different styles of telephone instruments, including wall sets, desk sets, and different styles of mounts. A new long distance transmitter just put on the market was also put through its paces. It resembles the solid back of familiar design, but does not pack, can be refilled without dismounting the transmitter and is neat and handy. Various kinds of power generators, hand magnetos, etc., completed that part of the exhibit. Parts were also shown of regular 100 and 200 drop boards, mounted on a very handsome oak table. Every pains was taken to describe all the exhibit and illustrate its operation.

SMITH & PATTERSON, of 10 Warren street, New York, had on the hotel desk a very neat exhibit of their Ericsson telephone set as made in Stockholm, Sweden. Its novel style and beautiful workmanship, as well as its handiness of manipulation and good talking won it many encomiums.

THE KEYSTONE TELEPHONE CO., of Pittsburg, Pa., had a Cadillac Hotel parlor well filled with their substantial and businesslike apparatus. They were represented by Messrs.

Burt Hubbell, secretary and treasurer—the builder, by the way, of the first independent telephone exchange; and by Mr. J. G. Ihmsen, their courteous and efficient manager. They showed switchboard sections, their revolving granular type of transmitter, and their well-made bar magnet receivers and watch case receivers. They also exhibited their desk sets, intercommunicating system and other essential varieties of apparatus, and called special attention to a new and highly ingenious lightning arrester and protector, which allows any one line affected to be looped out at will without the slightest hindrance to operation of the others, and provides with marvelous cheapness and simplicity for the quick renewal of perfect connection. As an adjunct to telephone exchange operation it looks like a piece of apparatus sure to come into very general demand and use.

NATIONAL CARBON CO. had in one of the Cadillac parlors a very fine display of their many carbon specialties for telephone work, ranging from their latest types of batteries to their carbon for use in telephone apparatus. The exhibit was highly comprehensive and received much attention.

THE GARL ELECTRIC CO., of Akron, O., makers of telephone apparatus, were represented by Mr. M. Garl.

THE STANDARD UNDERGROUND CABLE CO. was well represented by Superintendent of Construction, F. S. Viele, who was about to point with pride to the large amount of excellent underground and cable work done for the independent Detroit Telephone Company.

ALLAN HUSSEY CO., of Chicago, makers of interior telephones, etc., were represented by Mr. A. R. Hussey.

MOON ELEC. MFG. CO., of Chicago, makers of telephone apparatus, were represented by Mr. A. H. Procunier.

NORTH ELECTRIC WORKS, of Cleveland, were represented by Mr. C. H. North.

RAWSON ELECTRIC CO., of Elyria, were represented by Mr. S. B. Rawson.

STANDARD TELEPHONE AND ELEC. MFG. CO., of Madison, Wis., were very efficiently represented by president H. A. Taylor, and secretary J. J. Nate, the latter of whom is a well known old-timer in electrical circles. Mr. Taylor is not only a telephone manufacturer, but is largely interested in exchanges, owns the Wisconsin "State Journal," and is actively in touch with many important enterprises and public policies in his own State.

VIADUCT MFG. CO., of Relay, Md., the old and famous makers of telephones and other electrical material were represented by Mr. J. Harry Lee.

COL. S. S. STOUT, a well known patent lawyer of Chicago, was one of the most interested and interesting men present. His sagacity and foresight were remarkably shown in a letter, familiar to many, addressed to the Telephone Protective Association in June, 1895, when he predicted with accuracy the results in the Berliner case and outlined the actual subsequent course of events.

PHOENIX INTERIOR TELEPHONE CO., of New York City, were represented by Mr. John H. Scofield, who was naturally a greatly interested participant in all that went forward.

WHITMAN & COUCH, the well known "Swedish instruments" telephone firm of Boston, were represented by Mr. Couch, who came in company with Mr. Leatherbee to voice the sentiments of independent telephony in New England.

W. R. COLE ELECTRICAL WORKS were represented by Mr. W. R. Cole himself.

ANDREWS-RYAN CO., of Boston, Mass., were represented by Mr. G. W. Andrews.

BISSELL, DODGE, ERNER CO., of Toledo, were represented by Mr. V. Bissell, from headquarters.

DETROIT SWITCHBOARD AND CONS. CO. were represented by Mr. F. M. Ashe.

TELEPHONE MFG. CO., of Sumter, S. C., were represented by Mr. F. C. Manning.

FARR TELEPHONE AND CONS. CO., of Chicago, already so well and favorably known in the telephone field, were represented by Mr. R. J. Cram from their home city.

WILLIAMS & ABBOTT ELEC. CO., of Cleveland, celebrated as makers of electric bells, etc., for telephone and other purposes, had a good exhibit of their product, doing justice to their various excellent specialties. Messrs. Williams and Latta not only upheld the reputation of the firm in this way, but scored heavily by their hearty and cordial hospitality, of which many delegates will have carried away a delightful impression. The concern is doing a large business and blazing the way for bigger.

CONNECTICUT TELEPHONE AND ELEC. CO., of Meriden, Conn., were well represented by their Mr. E. C. Wilcox.

THE ELECTRICAL PRESS was well represented, there being present Messrs. L. E. Powers, K. B. Miller, H. B. McNeal, Carl Kammeyer, T. C. Martin, W. J. McConnell, W. J. Johnston, C. T. Child, J. V. S. Church.

MR. J. H. CUMMINGS, of Cummings conduit fame, attended the meeting, being in Detroit, and met many friends. His company has not catered at all for telephone work, but this has not prevented the telephone men from knowing the claims for the Cummings system.

ORGANIZATION FORMED AT DETROIT OF INDEPENDENT TELEPHONE MANUFACTURERS.

The manufacturers of independent telephones met on June 23 at Detroit and held an enthusiastic and harmonious meeting, and organized an association to protect and promote the interests of the manufacturers and users of independent telephones. The following officers were elected unanimously:

President, H. A. Taylor, Standard Telephone and Electric Company, Madison, Wis.; Vice-President, S. B. Rawson, Rawson Electric Company, Elyria, Ohio; Secretary and Treasurer, J. Harry Lee, Viaduct Manufacturing Company, Baltimore,

An Executive Committee was formed, consisting of one member from each concern represented in the association.

Ample means were pledged to carry out the objects of the association and carry on any litigation brought against and repel all attacks upon the independent telephone business of the country.

The meeting was held behind closed doors, and no detailed report of the proceedings of the association was made public.

THE STOCK MARKET

A FIRM MARKET.

THE improved condition of trade is well reflected in the firm condition of the market for all classes of securities. An encouraging feature of the situation is the fact that exportation of gold, recently resumed, has had no effect on the prices of stocks, thus showing restored confidence on the part of investors.

General Electric is quoted at 33¼. Western Union rose to 83½ on good demand. American Bell remains firm at 231 bid.

Copper is quoted at 11⅛c. to 11¼c. for Lake ingot, and 10¾c. to 11c. for electrolytic; with 10½c. to 10¾c. for casting stock.

Steel rails are quoted at $19 to $20 at tide water.

LEGAL NOTES

WESTERN ELECTRIC CO. SUES THE HOME TELEPHONE CO. OF MOBILE, ALA.

The Western Electric Company has begun suit in the United States Circuit Court against the Home Telephone Company of Mobile, Ala., with connections throughout Alabama and Mississippi, for an alleged infringement of the patents of Charles E. Scribner's switch-board improvements. The Home Co. employs the system claimed by Paul Minnis, of New York. Messrs. Barton & Brown, of Chicago, will appear for plaintiffs, and Judge Charles B. Tilden and James E. Morris, the patent experts of Washington, are engaged for the defendants.

WESTINGHOUSE SUES BEACON LAMP CO.

Suit has been brought by the Westinghouse Company against the Beacon Lamp Company, for infringement of patent. The answer of the defendants to be filed in the U. S. Circuit Court at Trenton, N. J., will, we understand, raise the question of the existence of a combination to control the lamp business in restraint of trade.

MORE OF THE MANHATTAN-JANDUS — BUCKEYE IMBROGLIO.

A special dispatch from Cleveland, O., of June 16th says:— Novel proceedings in quo warranto were commenced in the Circuit Court to-day to declare forfeited the rights and franchises of the Buckeye Electric Co. to do business in Ohio. The proceedings grow out of an alleged abrogated contract between the Jandus Electric Company, of Cleveland, and the Manhattan General Construction Company, of New York. The Buckeye Company, it is claimed, was responsible for its broken contract by committing acts exceeding its corporate scope in Ohio.

The Buckeye Company is alleged to have purchased stock of the Jandus Company and carried it on the books as part of its assets. The Buckeye, by virtue of this ownership, is alleged to have assumed control of the Jandus Company's business and abrogated the contract with the Manhattan by the terms of which the latter was to sell goods made for and owned by the Jandus Company.

PERSONAL

MR. GEORGE A. McKINLOCK.

OUR readers will be glad to learn that Mr. George A. McKinlock, president of the Central Electric Company of Chicago, is now quite restored to health, and is again actively engaged in directing the large and increasing business of his company. Mr. McKinlock has not been in good health for over a year, but, refreshed by enforced vacation from the cares of daily business, he is now daily at his office and giving to his business that amount of concentrated energy which did so much to build up the success of the Central Electric Company, years ago. It is encouraging to note from a personal interview with Mr. McKinlock that business in the West is steadily improving, and the affairs of the Central Electric Company were never in better condition than at present. Orders are coming in from all over the Western territory, and the future looks extremely bright.

DR. HENRY MORTON, president of Stevens Institute, had the honorary degree of L.L.D. conferred upon him by Princeton University last week, in company with ex-President Grover Cleveland.

MR. J. C. O. MORSE, ex-superintendent of the State Reformatory at Hutchinson, Kan., has been appointed manager of the Water, Light and Power Company of that city. The plants include water works and electric light, gas and street railway enterprises.

MR. F. D. VARNAM has been elected assistant wire inspector of the St. Paul, Minn., wire department with a salary of $1,000 a year. The position has recently been created by city ordinance.

MR. PAUL M. LINCOLN.—The announcement is made from Niagara Falls that Mr. Paul M. Lincoln, the popular and efficient electrical superintendent of the Niagara Falls Power Company, is to wed Miss Elizabeth R. Hague, of Columbus, Ohio, on June 30.

MR. I. R. EDMANDS, of the General Electric Company, has gone West to take charge of the installation of the electrical machinery of the power development at Minneapolis and St. Paul, Minn.

CITY ELECTRICIAN GREENE, of Toledo, has resigned in order to take a more remunerative position with the Central Union Telegraph and Telephone Company.

LETTERS TO THE EDITOR

ELECTRICAL MANUFACTURERS AND DUTY ON MICA.

READING over the discussion about the tariff on mica in a late number of the "Congressional Record," amazement at the want of knowledge upon the subject as a whole on the part of our legislators is the feeling that dominates one who has happened to have a close connection with both the production and consumption of this remarkable article.

The general refrain is that mica is too cheap. If we could only increase the cost of mica three or even fivefold the country will be richer. If we could stop the importations profitable mines would be opened up in almost every State in the Union. Is this the truth? From my own experience it is not. The true cause of the low price of mica is owing to the fact that the supply greatly exceeds the demand. And even at the present low rate of prices the material is looked upon as a necessary evil, on account of its cost, by every consumer, and the tendency is to use pieces as small as possible. The smaller the piece used the greater the labor entailed; so in all cases an equilibrium has to be struck, which balances the price of the mica with the subsequent labor. If the price is increased smaller sizes will be used and vice versa. If the price is reduced large sizes can be used, and, what is of greater importance, owing to the over-supply, larger quantites also.

Every one knows that mica varies greatly in its properties, especially in hardness and transparency. North Carolina and Dakota mica and mica from other States stands at the head in combining these two properties—excessive hardness and perfect transparency—and this mica has nothing to fear from competition with that of other countries. It will always command a fair price, and, if the consumption is not interfered with, the mining industry in the States concerned will be in a healthy condition. The consumers of this quality of mica are the stove manufacturers, the makers of lamp chimneys, shades, etc., and, to a limited extent, the electrical manufacturers. Although the electrical manufacturers use this kind of mica where its qualities are required, the bulk of this kind happens to come both from Canada and India. Both countries possess mica of exceeding softness, the quality which is absolutely necessary for them, and Canada with its high-priced labor successfully competes with India; and so would this country if it only had the proper quality. This soft mica has not been discovered in this country and the electrical manufacturers must have it at any price, and no electrical engineer in his senses would think of using a hard mica where a soft one was essential. He would rather use a substitute, such as paper or fiber, which may be said to rank as the next best practical insulator. Paper at 3 cents, mica at 19 cents—a pretty bedfellow, to be sure. Any increase in the price of mica is certain to result in a decreased consumption, and it is to the interest of every one in the mica business, whether he be a miner or importer, that the price of mica be as low as possible. The increased sales at a low price will more than offset the small sales with a large profit.

Whatever tax is put upon the mica imported from other countries will not increase the price of mica mined in this country. There is already an overproduction. It would increase the price of the soft mica imported from Canada and India, and there would be a stronger tendency than there is now for the electrical manufacturers to use different substitutes. It is the electrical manufacturer who has scoured the world over to find a suitable cheap mica for his purpose, and the present duty of 20 per cent. is a severe tax upon his business, and the question of using mica is always before him. If from any cause the price is greatly increased a great blow will be struck at the mica business, and the miner, whether he be in Dakota or India will equally suffer. It will not only be the miner, however, but the electrical manufacturer also. There is no business in the country which has brighter prospects of sending its product abroad than that of the electrical manufacturer.

Only the other day one of them secured contracts in England and Australia entailing an outlay of over one million dollars. In fact, they are now looking forward to their export business as their chief outlet, and any tax upon them, when competing with England or Germany (and the one on mica is about the only one) might result in a loss of foreign business to the amount of millions of dollars. Mica, by the by, has played no unimportant part in securing these contracts. Owing to its large use American insulation stands very high abroad. This debate about mica in Congress shows a general pressure put upon the various representatives for a higher duty on mica. This pressure has come from those who own a bit of land with mica upon it. They are not in a position to know if a duty would help them or not. I most emphatically say that it would not. The remedy is a greater demand, not a higher price.

I may be like one crying aloud in the Wilderness, but for the benefit of the miners, the thousands of men and women who are employed in working the mica after it has been mined and for the mica business generally, I trust these few words will have a hearing.

MICA INSULATOR COMPANY,
Charles W. Jefferson, Manager.

New York City, June 18, 1897.

NEWS AND NOTES.

ELECTRICITY AT THE ROYAL SOCIETY.

A cablegram from London states that there were several notable electrical novelties at the Royal Society's soirée last week. Lord Kelvin showed conduction through air under the influence of uranium, the work being done in quasi-perpetual-motion manner by contact between uranium and zinc, aluminum, or air.

Mr. W. H. Preece, chief engineer and electrician of the British post-office, had an illustration in action of a system of signalling messages without wires by the use of a remarkably sensitive little instrument, the invention of Marconi[1].

Dr. Muirhead also exhibited a method of signalling by means of Hertz waves, as practised by Dr. Oliver Lodge in 1894, with a Branly tube of filings as a receiver and now adapted to the Kelvin recorder. An automatic telegraph transmitter, breaking the circuit of the coil and causing short sparks was placed in a distant room. The receiver was in a room near a responding recorder. The only source of communication between the two instruments was the waves of impulse sent through the intervening ether of space.

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[1] See page 713.

Some new applications of Röntgen rays also excited much curiosity.

SOCIETY & CLUB NOTES

SIXTEENTH ANNUAL CONVENTION OF THE ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The sixteenth annual convention of the Association of Railway Telegraph Superintendents was held at the Cataract House, Niagara Falls, on Wednesday and Thursday, June 16 and 17. The attendance was about fifty. In the absence of George M. Dugan, president of the association, Vice-President Lattig presided. The papers scheduled to be read were: "Relays and Their Resistance," by Thomas D. Lockwood, of Boston, Mass.; "The Apprenticeship System," by George C. Kinsman, of Decatur, Ill.; "The Delivery of Commercial Telegrams at Railroad Stations," by L. H. Korty, of Omaha, Neb.; "Railroad Telegrams," by C. Selden, of Baltimore, Md.; "The Telegraph," by A. R. Swift, of Chicago. The new officers of the association are as follows:

President—J. W. Lattig, superintendent of telegraph of the Lehigh Valley, at South Bethlehem, Pa.

Vice-President—W. W. Ryder, superintendent of telegraph of the Chicago, Burlington & Quincy, at Chicago.

Secretary and treasurer—P. W. Drew, superintendent of telegraph of the Wisconsin Central, at Milwaukee, Wis.

The association will hold its next convention in Hot Springs, Ark., June 15, 1898.

ELECTRIC TRANSPORTATION

EIGHTY MILES OF TROLLEY FROM BOSTON.

It illustrates the extent to which trolley extension has been carried in eastern Massachusetts, says the Meriden "Journal," to know that a party of gentlemen started out from Boston the other morning and rode eighty miles over a continuous series of trolley tracks, going as far as Lowell.

CONSOLIDATION OF BALTIMORE TROLLEY ROADS.

The Baltimore Consolidated Railway Company has been organized, the stockholders of the Baltimore Traction Company and the City and Suburban Company voting almost unanimously to consolidate the roads. The capital stock is $10,000,000, consisting of 400,000 shares at a par value of $25 a share. The new company will issue $12,000,000 4½ per cent. gold bonds, $10,500,000 of which will be used to retire the divisional mortgages as they mature, the remainder going into the treasury of the company. The combined trackage of the consolidated company is 185 miles.

One hundred and ninety-six thousand shares of the new stock goes to the Traction Company—of this 193,200 will be given in exchange for present traction stock at the rate of $21 per share, par value $25. The City and Suburban gets 163,600 shares of the new issue, of which 160,000 will be exchanged for the old stock of the City and Suburban, at the rate of $50 per share, which is par value.

The following are the officers of the Consolidated Company: President, Nelson Perin; vice-president and general manager, William A. House; treasurer, F. S. Hambleton. The directors are: Charles Adler, Edward L. Bartlett, Jesse Hills, W. T. Dixon, T. E. Hambleton, J. S. Hagerty, William P. Harbey, Nelson Perin, William A. House, Geo. C. Jenkins, George A. von Lingen.

The Mercantile Trust Company, of Baltimore, is trustee for the new bonds and also transfer agent. The consolidation takes place at once, but accounts will be adjusted up to July 1.

POWER TRANSMISSION

NEW USES OF NIAGARA POWER.

NIAGARA power has made another conquest. A contract has just been made between the Cataract Power and Conduit Company and President Hill of the Great Northern Railway Company and the Great Northern Steamship Company, whereby the Great Northern elevator now in course of construction in Buffalo is to be operated by Niagara power. The contract calls for 1,250 horse-power, and this the Cataract Power and Conduit Company will supply over their transmission line from Niagara Falls, they being the distributing agents for Niagara power in Buffalo. The new elevator will be one of the largest in the world.

Under Section 10 of the franchise granted to the Cataract Power and Conduit Company, said company was to be prepared to furnish 10,000 horse-power to consumers within the city of Buffalo on or before June 1897, but recently the aldermen of Buffalo granted the company six months' extension of time in which to do this.

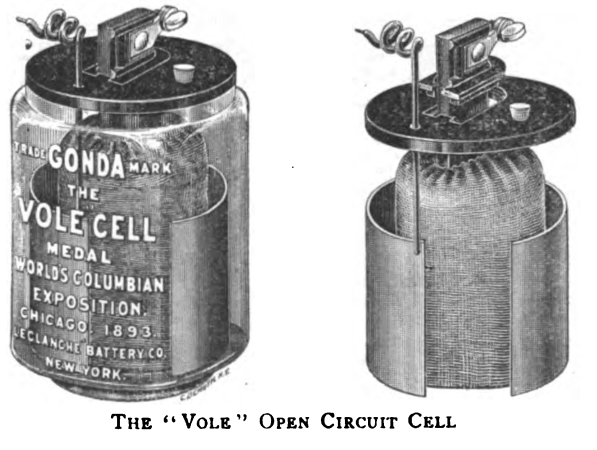
In Niagara Falls, Ont., the aldermen are discussing the prospects of developing power along the whirlpool rapids between the cantilever bridge and the whirlpool. Surveys have been made by an engineer named Mitchell, and he finds there is a fall of about 46 feet in the level of the river between the points mentioned. The commissioners of Queen Victoria Park have made surveys with similar results. The feeling is that many water powers with less fall have been made available. The land is controlled by the park commissioners, and the town of Niagara Falls, Ont., would probably have to contribute materially to the park revenues to gain the right to develop the power.

The Buffalo and Niagara Falls trolley line has recently made a change in its route to and from Buffalo whereby a saving of seven and one-half minutes is made each way, or fifteen minutes on the round trip. President Ely further says another change is in contemplation whereby another saving of fifteen minutes will be made, thus making the trip wonderfully short so far as time is concerned. "Through by lightning" seems to be the motto of the management of this road.

TRADE NOTES & NOVELTIES

THE "VOLE" OPEN CIRCUIT BATTERY.

THE "Vole" cell, made by the Leclanché Battery Co., of New York, has recently undergone a considerable improvement, so much so that it is claimed to be the best low-resistance open-circuit cell on the market, being specially adapted for electric gas lighting and kindred purposes, where large amperage is requisite.



THE "VOLE" OPEN CIRCUIT CELL

The negative electrode of the "Vole" cell, as shown in the accompanying engravings, consists of a carbon, having projecting vertical wings, over which is stretched a bag so as to form pockets between the wings for the reception of the depolarizing material. The electrode is suspended (in a jar) from the cover by a patented forked center-piece, which slips on the carbon under its head and rests in an opening in the cover through which the carbon passes. The zinc is a cylindrical sheet, the lower end of which rests in the channel around the well at the bottom of the jar. To the zinc is soldered a gutta-percha covered zinc wire, intended to pass up through the smaller hole in the shoulder of the jar, for connecting to the carbon of the next cell or to the line wire.

The neat little catalogue of the Leclanché Battery Co. gives full descriptions of the "Vole," "Gonda," and "Axo" batteries manufactured by the company, together with a digest of useful electrical and other data.

MAYRHOFER'S STAGE LIGHTING APPARATUS.

Mr. J. Carl Mayrhofer, of 28-32 Centre street, New York, will shortly issue a new and complete edition of his catalogue for the season of '97 and '98. The forthcoming catalogue will be complete in every detail, embracing many new features, and describing numerous electrical, optical and mechanical effects, some of them never before introduced in any stage productions.

A considerable space in this new issue will be devoted to the detailed description of new Mayrhofer arc light apparatus and effects.

The new '97 constructions embody every conceivable requirement and improvement that long experience and practical use have shown to be of value, and represent the most advanced type of modern stage lighting apparatus at a moderate cost.

The catalogue will be sent on application.

NEW YORK NOTES.

BUFFALO, N. Y.—The Acme Malleable Iron Works are erecting an absolutely fire-proof building for the storage of their patterns. This building is 30 feet wide and 60 feet long. The building will be constructed of non-combustible material, and the frame work will be of steel, the covering of corrugated iron, and the racks supporting the patterns will also be made of metal. The Berlin Iron Bridge Company are furnishing and erecting the steel frame work and covering.

THE ELECTROZONE COMPANY has removed its offices from the Morris Building, Broad street, to 415 Lexington avenue, corner Forty-third street, where it will attend to its growing business with better facilities. Electrozone has become very popular as a purifier and disinfectant.

FRED. M. LOCKE, of Victor, N. Y., has recently issued a very neat and interesting pamphlet on the subject of his high insulation line insulators, steel pins, brackets, break arms, etc. The material is well illustrated and thoroughly described. Mr. Locke's work has lately been associated with some of the longest power transmissions in the country.

C. A. ECK, Newark, N. J., reports receiving orders which will keep his factory busy throughout the summer season. Mr. Eck manufactures fan motors, dynamos, etc.

WESTERN NOTES

THE ELECTRIC APPLIANCE COMPANY have been so very successful in the introduction of the American electric soldering iron, that they are preparing a circular of a few of the many testimonial letters received from customers in regard to the operations of these irons. The Electric Appliance Company look for a very large sale of these goods, as a satisfactory electric soldering iron has long been wanted.

ST. LOUIS LIGHTING.—The Western Electric Company, through Mr. F. W. Crandall, has now sold out its lighting interests in St. Louis to the local Edison Illuminating Company, which thus consolidates all the central stations in the city.

WATER WHEELS.

IN the article on "The Principles and Construction of Water Wheels," appearing in our issue of May 19, there appeared an illustration, on page 529, showing the comparative size of overshot water wheel and turbine. The credit for this graphic illustration belongs to the James Leffel & Co., in whose trade publications it appeared originally.

REPORTS OF COMPANIES

IMPORTANT SIEMENS-HALSKE DEAL.

The Siemens-Halske Electric Company is, it is announced, to be at once consolidated with the Pennsylvania Iron Works of Philadelphia, with a combined capital of $3,250,000.

THE W. J. JOHNSTON CO., LTD., publishers of "The Electrical World," have applied to the New York Supreme Court for a voluntary dissolution of the company and September 23 is set as the date for a hearing on the order to show cause. The liabilities are $3,420, and assets $8,930.

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The Electrical Engineer.

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ELECTRIC TRANSPORTATION

WILLARD STORAGE BATTERY LAUNCHES.

AMONG the recent work done by the Willard Electric & Battery Company, of Cleveland, is the installation of a complete storage battery outfit in two launches used by the W. F. & John Barnes Company, of Rockford, Ill. Our illustration, Fig. 1, shows the launches which present a very trim appearance.

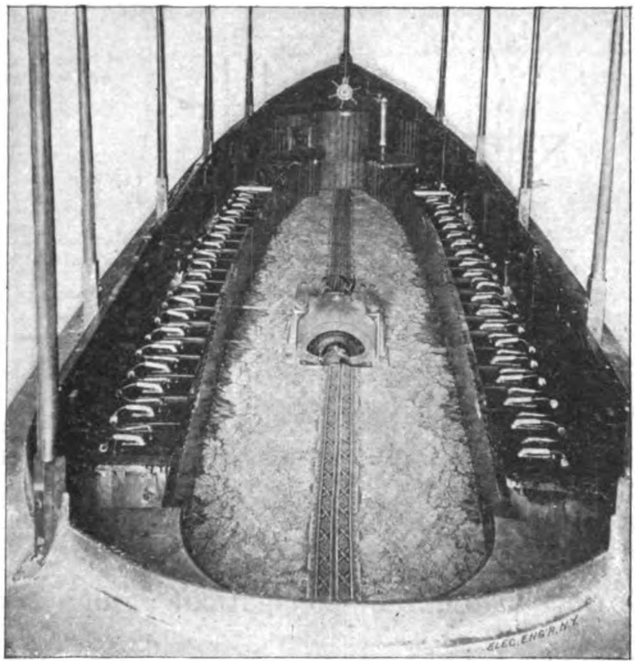


FIG. 2.—WILLARD STORAGE BATTERY LAUNCH.

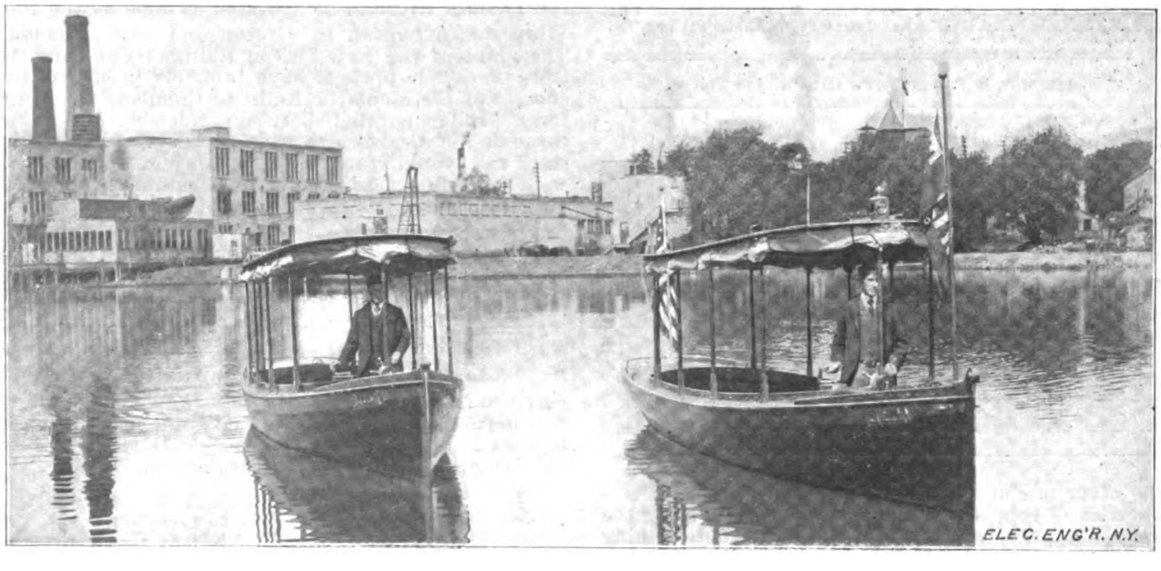


FIG. 1.—WILLARD STORAGE BATTERY LAUNCHES.

The launches are 30 feet long, 6 feet beam, and draw 22 inches of water, with 40 Willard type "G9" Cells. These launches are capable of attaining a speed of 14 miles an hour. The motor, as will be seen from the illustration, Fig. 2, is connected directly to the propeller shaft, is easily accessible, and takes up very little space. The launches have been in operation the past three months and are giving excellent satisfaction. The Willard Company have fitted out quite a large number of electric launches, and those illustrated are representatives of the most popular type and size.

The Willard storage cells possess unusual qualities for this class of work, owing to their peculiar construction. The elements are so encased that the rolling motion of the boat does not interfere in any way with their operation.

TROLLEY LINE CONSTRUCTION DATA.

A PUBLICATION containing an unusual amount of valuable information is the catalogue on "Trolley Poles," just issued by the National Tube Works Company. Besides giving full information as to sizes of their standard and extra strong poles the little booklet gives a brief but excellent description of the best methods of erecting steel trolley poles.

Beginning with the foundations, it describes the methods illustrated in The Electrical Engineer Data Sheets, Nos. 5751-4, 5 and 6, and gives tables of various lengths of trolley poles.

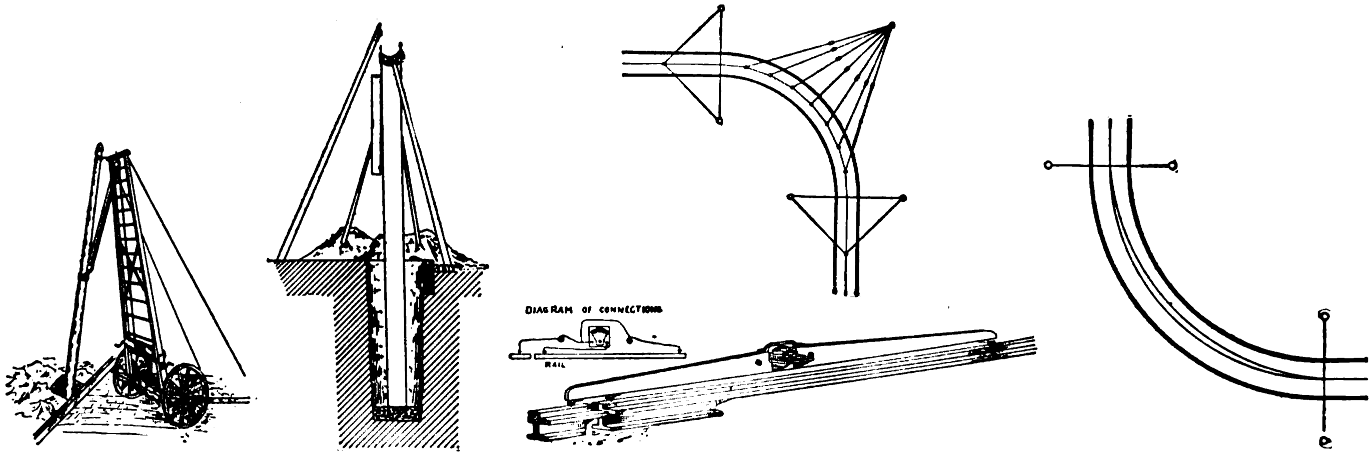
The method of erection is described as follows:

The method of raising the poles and lowering them into the holes is generally done by a portable derrick mounted on a heavy dray, together with a crab winch, see Fig. 1. This is driven as close to the pole hole as possible—the pole previously being rolled parallel to the road, as close to the hole as convenient, or it can be raised directly from the dray. A chain is rigged around the pole a little above its center of gravity, and the pole raised up into a vertical position, and the derrick moved over until the pole is directly over the hole. The bottom end of the pole should be plugged up flush with wooden plug at least 6 inches long, and it should have had at least two coats of good anti-rust paint. The pole is guided down the hole against a skid plank until it rests on the 8 inches of cement and guyed into position, see Fig. 2. The rake of the pole should be from 8 inches to 12 inches, depending on the flexure of the pole and the character of the foundations. A level is very useful for varying and determining rakes, and by sliding a 1¼-inch projection on one edge of the level any rake can be determined from 7½ inches to 15 inches for a 24-foot pole, and the pole can be set by means of this level.

It is well if a large stone can be placed at the heel of the pole, then more cement is put in and tamped around the pole, tamping thoroughly every few shovels full, until it is within 4 inches of the top. The top should be finished off, as shown in sketches for pole foundations, so as to drain the water away from the pole, as the point at the surface of the earth is the point where the pole deteriorates most rapidly, and is subject to the greatest strain. No caps or rings should be used, as any rusting here affects the strength of the pole, and if a steel pole is thoroughly protected at this point it is a permanent structure. Poles should be allowed to stand from eight to ten days for the concrete to set before the line is erected.

Curves.—Where an electric railway changes its direction the trolley line must conform in some degree to the path in which the car diverges, in order that the trolley does not leave the trolley wire. In all forms of overhead curve construction the trolley wire is pulled into a polygon approximating the curvature of the track.

All tensions should be taken off the trolley wire at the end of both tangents to the curve; this can be done by running strain wires to take up this tension, as shown in Fig. 3. The location of the trolley should not be over the center of the track at the middle of the curve, as the car body forms a side of a polygon as it sways around the curve. In the center of the car is located the base of the trolley pole, and consequently the trolley wire should be guyed in at shorter curvature than the radius of the track, see Fig. 4. For a curve with a radius of 50 feet, the trolley wire should be 8 inches inside of the center of track at the center of a curve for two tangents at 90 degrees. A table gives what this departure should be to keep the trolley on curves from 35 feet to 350 feet radius, also the distance in feet that pull-offs should be spaced, so that the deflection of the trolley wire at any one point will not be sufficient to throw the trolley in passing around the curves. Many different ways of guying have been devised, and several of the most commonly used methods are shown.



FIGS. 1, 2, 3, 4 AND 5.

The strains brought on poles acting as master poles for curves warrant ordering larger and longer poles, so that they can be set from 7 feet to 7½ feet deep, and the hole should be dug at least 26 inches in diameter that is to be filled with concrete. The pole may be given more rake than allowed in straight line work.

THEORETICAL WATTS PER TON OF 2,000 LBS. AND PER MILE PER HOUR, WITH VARIOUS GRADES AND TRACTION COEFFICIENTS.

Per Cent. Grade.	Coefficient, in Pounds Draw Bar Pull per Ton.										
	12	13.5	15	18	20	25	30	35	40	50	60
0	23.9	26.9	29.8	35.8	39.8	49.7	59.7	69.6	79.6	99.5	119.4
1	63.7	66.6	69.6	75.6	79.6	89.4	99.5	109.4	119.4	139.2	159.1
2	103.4	106.4	109.4	115.4	119.4	129.3	139.2	149.2	159.1	179.0	198.9
3	143.2	146.2	149.2	155.2	159.1	169.1	179.0	189.0	198.9	218.8	238.7
4	183.0	186.0	189.0	194.9	198.9	208.9	218.8	228.8	238.7	258.6	278.5
5	222.8	225.8	228.8	234.7	238.7	248.7	258.6	268.5	278.5	298.4	318.3
6	262.6	265.6	268.5	274.5	278.5	288.4	298.4	308.3	318.3	338.1	358.1
7	302.4	305.4	308.3	314.3	318.3	328.2	338.1	348.1	358.1	378.0	397.9
8	342.4	345.1	348.1	354.1	358.1	368.0	378.0	387.9	397.9	417.8	437.6
9	381.9	384.9	387.9	393.9	397.9	407.8	417.8	427.7	437.6	457.5	477.4
10	421.7	424.7	427.7	433.7	437.6	447.6	457.5	467.5	477.4	497.3	517.2
11	461.5	464.5	467.5	473.5	477.4	487.4	497.3	507.2	517.2	537.1	557.0
12	501.3	504.3	507.2	513.2	517.2	527.2	537.1	547.1	557.0	576.9	596.8
13	541.1	544.1	547.1	553.0	557.0	567.0	576.9	586.8	596.8	616.7	636.6
14	580.9	583.9	586.8	592.8	596.8	606.7	616.7	626.6	636.6	656.5	676.4
15	620.7	623.6	626.6	632.6	636.6	646.5	656.5	666.4	676.4	696.3	716.2

Among the other useful information are several tables giving the properties of copper wire, a chart for determining the size of feeders, together with a rapid method of determining the resistance of the rail joint in terms of the rail resistance. The latter is as follows: By using a milli-voltmeter having the zero in the middle of the scale, this relation of joint to rail resistance can best be found by the arrangement shown in Fig. 5.

Mount the milli-voltmeter on a straight edge about 6 feet long, three drop points being secured to the bottom of the straight edge and flexibly mounted to a spring, as it is necessary for all these points to make contact on the rail where the straight edge is pressed down. This device is carried along the track and the connections are best made on the tram of the rail, the joint being included between those two drop points, one foot apart, leaving a length of rail 5 feet between the other two points. Resistance spools of about 10 ohms each are placed in circuit with the milli-voltmeter. The deflection of the voltmeter one way will be due to the current flowing in the rail; the other way the drop will be due to bond resistance, and the two deflections bear the ratio of the bond to rail resistance, or certain deflections can be fixed above which the bond should be replaced, and these imperfect joints can be marked for repairs. About two miles can be done in one day of double track by this method.

We also notice the accompanying table of the power in watts required to move a given load at various speeds, grades and traction coefficients.

ANOTHER PROJECTED CONNECTICUT THIRD-RAIL LINE.

On July 15 the present repair shops of the Norwich and Worcester Railroad Company, at Norwich, Conn., will be discontinued, and the work divided between the shops at East Hartford, Conn., and at Norwood, Mass., of the New England Railroad Company, which leases the Norwich and Worcester. The vacated shops at Norwich will be fitted up as a power station to operate a projected third-rail on the east side of the Thames River to be operated as soon as the Norwich and Worcester extension to Groton and New London is made. The plans of the New Haven Railroad Company, which controls the whole project, have probably been expedited by the success of the Montville Railroad Company in getting its plan for a trolley parallel between Norwich and New London through the Legislature in a disguised form. The proposed third rail would reach for a distance of about fourteen miles, with opportunity to extend to Stonington, and make Watch Hill and other summer resorts much more accessible than now.

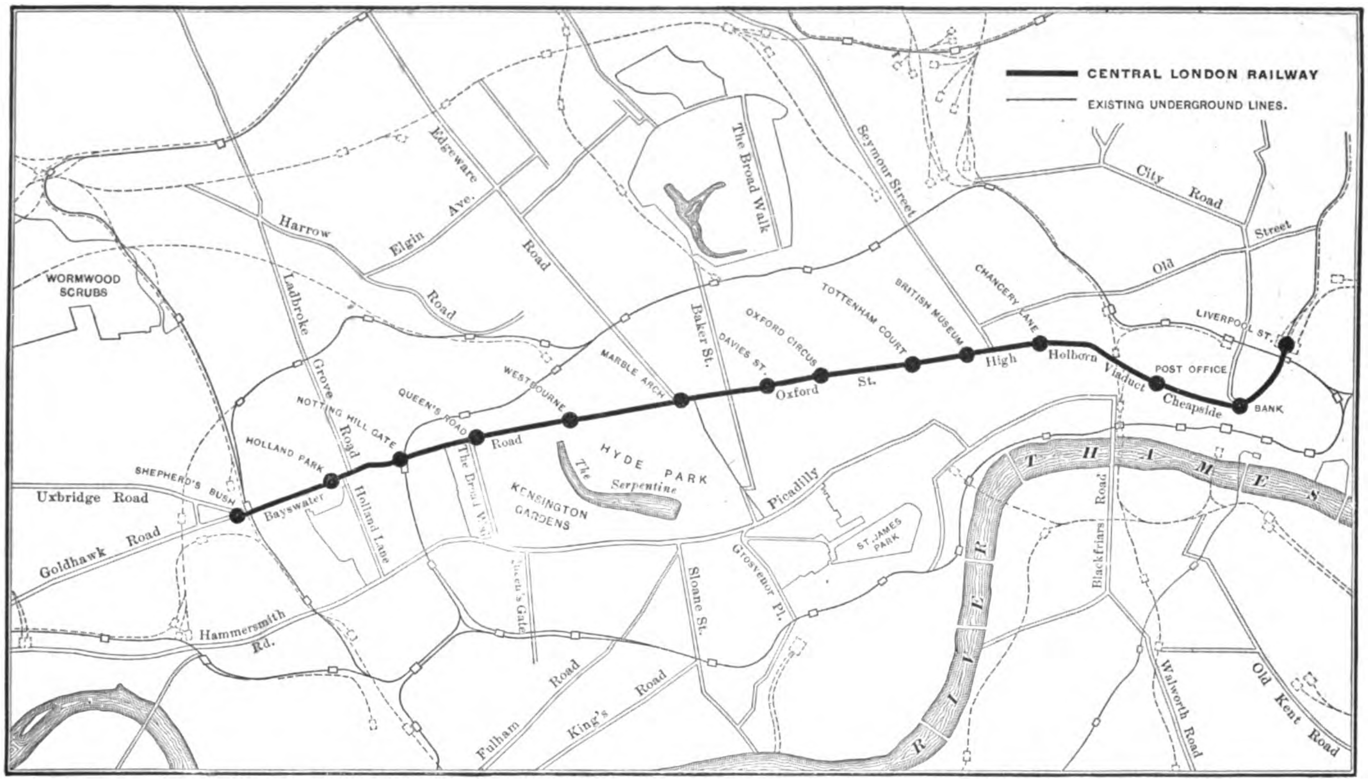
ELECTRIC RAILWAYS FOR GHENT, BELGIUM.

The last Consular Report contains a letter under date of April 16, from Consul Morris, at Ghent, Belgium, calling attention to the proposed electric railway in that city. It is proposed to use accumulators within the city and the trolley system beyond the city limits. The franchise will be sold to the highest bidder. Plans and specifications have been sent to the Department of State, Washington, D. C.

PRESIDENT H. H. VREELAND, of the Metropolitan Traction Company, New York, expresses the belief that the substitution of electric for horse traction on Madison avenue, just sanctioned, will result in a 50 per cent. increase of traffic, using larger cars, but not more of them, at a higher rate of speed.

ELECTRICITY ON THE LONDON CENTRAL UNDERGROUND.

THE most recent addition to the system of underground railways with which London is provided and the most important of all the present undertakings of a similar character in the world—the Central London Railway (Underground) has an especial interest for Americans. This is due to the fact that the entire system of electrical equipment will be American. With the exception of the elevators, of the famous Sprague make, the entire electrical contract has been assumed by the British Thomson-Houston Company, Limited, representing in Great Britain the General Electric Company, of Schenectady, while the elevator contract has been secured by Mr. Frank J. Sprague, of New York. The road, laid in two deep subway tunnels, driven by the Greathead Shield, stretches from Liverpool street beneath the station of the Great Eastern Railway Company, near Broad street, the city terminus of the North London Railway and the Bishopgate Street Station of the Metropolitan Underground Railway, through the very center of the great commercial district of the city and runs due west under Holborn, High Holborn, Oxford street, and past Hyde Park, as far as the Generating Station located at the terminus at Shepard's Bush. It follows the line of greatest traffic in London. The road will receive passengers from the great underground central depot, now in course of construction by the Central Railway Company, between the Bank of England and Royal Exchange, passengers brought in by the main lines of the London and Northwestern, Midland and London and Southwestern railroads. It is especially at this point in the city that crossing is a perilous task, and the railroad company is now engaged in constructing a series of subways immediately below the surface for the convenience of pedestrians and as approaches to its own station below. From this central depot will radiate not less than five underground tunnels, some 85 feet below the surface, each feeding a separate and equally populous district of the great agglomeration known as London.



MAP OF THE LONDON CENTRAL UNDERGROUND ELECTRIC RAILROAD.

The construction of the road itself has been carried out by the Electric Traction Company, which has also financed it. It is this company that has made the contracts with the British Thomson-Houston Company, which will turn over the road fully equipped and in working order to the Central London Underground Railway Company ready for operation.

It was not until three years after the necessary parliamentary act was passed in 1893 that the actual work of building this road could be undertaken. Vertical shafts were driven at six different points to a depth of 60 feet and 70 feet, and the tunneling was begun in four tunnels at once, two running in each direction from the shaft. At each of the stations were driven two shafts 23 feet in diameter and 87 feet deep, and one 18 feet in diameter and 76 feet deep—the two former containing two ingress and two exit elevators and the smaller two spiral stairways, one for ascending the other for descending passengers. The shafts are built up of cast iron plates 1⅛ inches thick and 4½ inches in the flanges. All crevices in the back of the plates are filled with hydraulic lime grout injected under pressure. The glazed white brick passages leading from the bottom of the shafts to the stations are 8 feet 3 inches wide on the entrance side. On the exit side, where crowds might collect in front of the elevators, they are 13 feet wide.

At the stations the widened tunnel is 21 feet in diameter and 375 feet long. The main tunnels are each 11 feet 6 inches in diameter, and are practically steel tubes driven forward through the clay. The plates used to line these tunnels are ⅞ inch thick, with flanges 4 inches deep. The shield for driving the small tunnels was 12 feet 8 inches in diameter and was pushed forward by six hydraulic rams giving a pressure of 230 tons. For driving the station tunnels the shield was 23 feet 8 inches in diameter, and was pushed forward by 22 rams giving a pressure of 840 tons.

Each tunnel will contain one track, one tunnel carrying the eastbound trains, the other the westbound trains.

In laying the roadbed, the best modern steam railway practice has been followed. The steel rails weigh 100 pounds to the yard, and are laid upon heavy-crossties. The system of contact will be the third rail, with the contact rail placed between the service rails of the track and insulated by insulators. The conductors will be supplied at intervals from a copper feeder cable. This feeding will be controlled from the signal boxes, and the operator will be able to cut out any section of the line when necessary. This method of contact is similar to that employed so successfully by the General Electric Company in the installations on the East Weymouth, Nantasket Beach and Berlin-Hartford branches of the New York, New Haven and Hartford Railroad. The method of traction, however, will differ radically from that used on the branches above mentioned. Instead of passenger-carrying motor cars, with the motors mounted on the forward axle, locomotives similar in appearance to those used on the Belt Line tunnel service of the Baltimore & Ohio will be used to haul the trains. The reason for this lies in the fact that the tunnel is only 11½ feet in diameter, and that the bottom of the tunnel must accommodate the roadbed. This materially reduces the clearance. The motors require to be suspended between 30-inch wheels, at least, to give the necessary clearance between them and the ground, and this fact has brought about the locomotive in place of the passenger motor car.

The total length of the road is 6½ miles, from the station at Shepard's Bush to the Mansion House, or 13 miles of single track. There will be fourteen stations, including the termini. In designing the line a decided departure has been made in the arrangements of the station approaches. As the railway company is not embarrassed by any considerations of grade, as in the case of surface railroads, the plan was adopted of making the road act as an auxiliary to the operation of the trains as well as merely to carry them. On each side of each station is a 3 per cent. gradient, rising on the approaching side and falling again to the level of the road on the departing side. This unique method gives a retarding effect to all trains approaching the stations, equivalent to the application of considerable braking power, while materially aiding in the acceleration of all trains as they leave the platforms. Furthermore, the saving in power necessary to secure requisite rapid acceleration is by the adoption of this plan calculated to amount to about 33 per cent. The schedule speed of the trains will be 14½ miles an hour, with stops at each station of 20 seconds. The trains will be run at first under a headway of two and a half minutes, which will be reduced as soon as the traffic demands to a headway of two minutes.

The generating station will be located in the open air at the extreme western end of the line near Shepherd's Bush Station. In building this the most modern American methods will be followed. The steam will be supplied from Babcock & Wilcox boilers, and the engines, of which there will be six, will be horizontal Allis machines, each of 1,300 h. p.

The electrical system adopted is the three-phase alternating high voltage primary with reducing transformers and rotary converters, similar in general principle to that installed successfully by the General Electric Company for the roads between Lowell, Mass., and Nashua, N. H., and at Portland, Oregon, between Niagara Falls and Buffalo, and on the line between Dublin and Dalkey, in Ireland. The dynamos, of which there will be six, will each be directly driven by its own engine. These dynamos are of the newly developed rotating field and stationary armature type, already illustrated in The Electrical Engineer. Each will have a capacity of 850 kilowatts. The speed of revolution will be 94, the frequency 25 cycles, and the initial voltage 5,000 volts. The total capacity of the power station will be 5,100 k. w., or 6,800 h. p.

From the switchboard the current is carried to the converter sub-stations, of which there are four. Two of these will contain seven step-down static transformers, six for service and one in reserve, each of 300 k. w. capacity, and two rotary converters, each of 900 kilowatts capacity. The other two stations will contain four 300 kilowatt static transformers and one 900 k. w. rotary converter. In the transformers the voltage of the current will be reduced from 5,000 volts to 330 volts alternating, at which pressure it will enter the alternating side of the rotary converters, issuing from the commutator side direct railway current at 500 volts. The spare transformers mentioned above will be put into service when the headway of the trains is reduced. The static transformers are of the air blast type, the windings being cooled by air forced through them by a blower. The rotary converters will be similar in construction to those used at Niagara, Buffalo and Nashua.

The use of the sub-station method of electrical distribution insures a uniform pressure throughout the entire length of the line. Fluctuation, therefore, which would materially interfere with the lighting of the station and trains, is reduced to a minimum. The limit of variation fixed by the Board of Trade, to the rules of which department all electrical installations in Great Britain must accord, is ten volts. With the method adopted in this installation, the variation in pressure will not exceed three volts.

The locomotives will number 35. Each will consist of a sheet iron cab containing the controller, indicating instruments, air brake, pump and controller, sand boxes, etc., mounted upon a locomotive truck. The motors have been especially designed for this work. They are of the gearless type and according to the new system of motor nomenclature adopted by the General Electric Company, are known as the G. E. 56. Four of these motors will be mounted on each locomotive, one to each axle, the total drawbar pull being 14,000 pounds. The controllers will be of the series parallel type arranged for four motors. Each controller will embody the magnetic blow-out principle.

The weight of each locomotive complete will be 35 tons of 2,240 pounds. The trains will be made up of seven cars, weighing, when loaded, 105 tons additional, giving a total train weight of 140 long tons. The seating capacity is calculated at 336 persons.

Access to and exit from the stations will be effected by means of powerful high speed elevators. These will also be of American manufacture, and will be built by the Sprague Electric Elevator Company, of New York. The elevators will be forty-nine in number, each will have a capacity of 15,000 pounds, or about 100 passengers per trip. The speed of elevation will be about 150 feet per minute. These elevators will be of the double drum type similar to those built for the War Department, at Washington, but of much higher carrying capacity.

It is estimated that the number of passengers which this road will carry per annum is 48,000,000, which, at an average fare of 4 cents, will give an ample return to insure dividends upon the capital stock.

A SPECULATION REGARDING THE CAUSE OF ROENTGEN RAYS.

BY PROF. ELIHU THOMSON.

SINCE so eminent a physicist as Prof. J. J. Thomson has in a recent paper put forward the hypothesis of the breaking down of what we have been accustomed to call the "elements," and has shown a reasonable basis for such a hypothesis, the writer deems it not improper to state that a similar view had quite independently risen in his own mind, the origin and progress of which may, it is thought, be interesting to others working and thinking in the same field. No apologies are offered for indulgence in the speculations herein presented. They are not presented as scientific theories, demonstrable by appeal to facts, but may possibly aid in investigation, and they are, therefore, given for what they are worth.

For some years past the writer has felt that some light might be shed upon the nature and relations of the so-called elements could we attain exceedingly high temperatures by any means. The elements may have been evolved in the order of their complexity in a manner similar in some respects to the species of plants and animals.

About four or five years ago an experiment was planned as one possibly capable of permitting temperatures far exceeding that of an electric arc, our present limit, to be obtained. A temperature of less than 4,500 degs. C. above absolute zero is not high when it is remembered that there can be no upper limit assigned to possible temperatures. Our chemistry is now all confined, so to speak, within lower limits than 4,000 degs. C. to 5,000 degs. C., and even within these limits most known compounds are decomposed or dissociated. Can we not raise our plane of temperature and give birth to a new chemistry in which the present elements, though apparently stable hitherto, shall become dissociated into simpler forms; for, that they are complex is to be inferred from the complex spectra which all, not excepting hydrogen itself, possess.

It was seen that the temperatures attainable by electric means were limited by the volatility and consequent expansion into vapor of the substances subjected to electric current, but that if the expansion could be prevented there might result the possibility of securing indefinitely high temperatures. To do this it was planned that a very strong and thick but short cylinder, of tempered steel, should have a small central opening through it so as to make it into a thick tube. This was to be lined with an insulating lining of some simple compound, as magnesia, for example, in a perfectly pure state. A core or wire of, say, metallic magnesium, was to pass through this, after which carefully insulated heads or caps were to be very solidly clamped to cover the ends of the cylinder and form the terminals for the passage of an electric discharge. This would pass from head to head through the central core (wire of magnesium).

This discharge was to be that of an enormous condenser charged by alternating currents furnished by a step-up transformer and the amount of energy to be delivered in a fraction of a second was to be made very large. The operation would be nearly instantaneous and should result in enormously high temperature of the material within the steel shell. There could be no expansion to lower the temperature. A spectroscopic examination was to be made of all the materials present before the experiment and a similar examination after the experiment, should declare the presence of any element not there before.

Reasoning on the idea that many complex compounds arise from sudden heating and cooling of comparatively simple compounds, it was thought possible that if dissociation of elemental forms took place at the enormously high temperatures the cooling would probably give rise to small amounts of the denser elements, discoverable, perhaps, by the spectroscope. These denser elements were to be the "elemental tars" or "polymers" of simple ones subjected to experiment. The experiment was to be varied in many ways.

This general proposition was described to several associates at the time it was thought out. Among these are several well known workers, such as Mr. C. P. Steinmetz, Mr. E. W. Rice, Jr., Mr. Robert Shand and others. The plan was recognized as a basis for a possibly fruitful research. There was no opportunity to prepare for the work and the idea was allowed to rest, in the hope that the future would yield the coveted freedom to undertake it.

After two or three years the discovery by Röntgen of the peculiar radiation from the Crookes tube, led to the writer's giving considerable time to investigation of the actions occurring and probably as a consequence of the prior thought in relation to elemental dissociation, the idea came that in the Crookes bombardment stream the conditions, upon collision with the platinum anode, must represent those of an exceedingly high temperature of the gas. With certain exciting apparatus of great power it was found that the bombardment was so energetic as to heat in a few seconds an anode plate one-sixteenth inch thick and an inch square to intense glowing heat. Considering the small mass of the molecules of gas projected from the cathode, the velocity of their movement was seen to be extremely great if they were to convey the energy delivered in so short a time to the platinum anode. The layer of gas immediately in front of the platinum must, it appeared, reach an extremely high temperature and represent in a measure the conditions sought for in the proposed experiment with the steel tube above described.

The question arose, Could it be that the increase of vacuum was after all due to the formation out of the gas, of small amounts of denser materials, or even that the elementary gases were decomposed at the high temperatures only to re-form on cooling, but with a small "tarry" residue, so to speak, polymers, perhaps, or denser, non-volatile elements? If this were so, then the gas should eventually all disappear in the same way. It does disappear, but how? We have guessed, but may be mistaken. We need to know more of it.

Considering these matters it occurred to the writer that a cause for the production of Röntgen rays might be found if the elements were dissociated into simple or more primordial matter. Taking the view, which has much to support it, that in the spectrum of ordinary heat and light we find all those rates of electric oscillation which characterize vibrating molecules or the atoms of elements composing them; that they set waves up in the ether because the ether is essentially electromagnetic; that the great rigidity of the ether so opposed to its apparent extreme mechanical mobility is after all only a chemical or electromagnetic rigidity, bearing no proportion to its mechanical properties, any more than the ordinary fluidity of a chemical compound bears to the chemical stability of the compound, we arrive at an interesting supposition respecting the Röntgen ray emanation. If the residual elementary gases are broken up into simpler and finer matter within the area of the bombarded spot, the normal electromagnetic rates of vibration of that finer matter should be far higher in pitch or of shorter wave lengths than in the case of the ordinary spectrum.

According to this view there would be no oscillation so slow as ordinary light originating in the finer matter dissociated from the elements at the exceedingly high temperatures represented by the colliding molecules or atoms immediately at the front of the platinum anode. All the wave lengths emitted as normal to the new forms of matter, only existent at the highest temperatures, would be of the Röntgen ray order, and a spectrum of such rays might characterize the matter present, as the ordinary spectrum does the low temperature combinations. But absence of diffraction and refraction effects thus far are formidable obstacles to such analysis of these higher pitch rays.

The absence of the lower or Hertzian waves from sunlight probably depends on there existing no molecules or atomic aggregations in ordinary matter which can possibly vibrate electrically at such low rates. So in the hot primordial matter no ordinary light waves need be generated, but only the higher order known at Röntgen rays. The latter are the normal vibrations occurring in such matter. The spectroscope cannot help us in the analysis of these higher waves and the forms of matter giving rise to them.

Further, if in the universe some of the hotter nebulæ contain this ultra-elemental matter the eye will not discover it, and the air around the earth is too absorptive for these higher rays to penetrate it and reach us. A "fire mist" of primordial matter must remain invisible until some part cools sufficiently to form aggregations which we call elements, which are, perhaps, only extremely stable forms resembling in stability most of our known compounds at near absolute zero.

Admit the possibility of the view here expressed as a speculation merely, and it follows that there may be stars so hot interiorly as to possess only an outside layer of elements in the ordinary sense, while further down within them are the black depths which shine only with the higher rays. Our sun has a low density, and if its interior, not subject to radiation loss, be of very much higher temperature than its exterior cloud of ordinary elements, a rift in the cloud might let out Röntgen rays which would produce electrical disturbances in the earth's outer atmosphere.

Again, the mystery of the sun's supply of heat would be in part resolved. The heat given out in the formation of ordinary chemical compounds may be relatively very small compared with that yielded during the condensation of the ultra-elemental matter assumed, into ordinary forms called elements under very powerful chemical or electrical forces. One can then conceive of a real photosphere surrounding the sun and begin to understand the meaning of those tremendous outbursts of activity connected with prominences and spots. Ordinary elementary forms arising by combination and cooling in the outer solar layers would precipitate themselves into the hotter dark interior to be violently decomposed, and this would occur over and over again until the interior temperature was too low for it. Should the action become rythmic we may begin to understand sun spot periods or stellar variability.

These ideas are not scientific in the limited sense; they are the result of imagination allowed free scope in dealing with imperfect data. The whole fabric must stand or give way according to fitness in the light of advancing knowledge of real facts. The history of science and invention shows that progress often depends upon a fortunate leap in the dark, and that no harm can come from consideration of many suggested hypotheses in a field where so little is known. To forewarn is to forearm, even if the final result is to expose a fallacy.

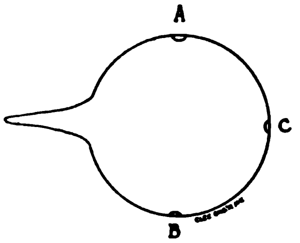
If the writer succeeds in drawing attention more than ever to such a fruitful field of research as the Crookes phenomena furnish, he will be satisfied. The conviction cannot be escaped that we have in them the opening of a new era in physical science, an extension of limits, a new chemistry, perhaps.

THE EFFECTS OF ROENTGEN RAYS UPON A BEAM OF LIGHT.

BY FRANCKE L. WOODWARD.

SOME experiments were recently made by myself in relation to the effect of Röntgen rays upon a beam of light projected through a vacuum and as the results appear to be of much interest, I send herewith an account of the same.

The accompanying illustration shows the form of tube used in carrying out the experiments. The tube is entirely coated with black paper except at the points A, B and C, which are small circular openings one-half inch in diameter, the tube being exhausted to the highest state of vacuum. A calcium lamp was used so covered with heavy black paper that only a circular beam of non-actinic light one-quarter of an inch in diameter was projected from it. With the addition of a good Crookes tube, this apparatus is all that is required to proceed with the experiments, which must be conducted in a perfectly dark room. The Crookes tube must also be covered with black paper to prevent any visible fluorescence.



Now, upon projceting a beam of light from the calcium lamp upon the vacuum tube at the opening, B, so that it shall emerge from the opening, A, and fall upon a screen conveniently arranged, it will be found that the beam of light coming from A will not have more than one-twentieth the intensity of the same beam entering at the opening, B. On viewing the interior of the tube through the opening, C, the beam in crossing the interior vacuum is almost imperceptible. It would seem from this that if the vacuum were perfect and no diffusion or reflection were possible, no light would emerge at the opening, A.

Now, performing the identical experiment again, but having a powerfully excited Crookes tube focused upon the vacuum bulb, it will be found that the beam of light emerging at A, will have almost the same intensity that it has on entering at B. Repeating the experiment with tubes of different exhaustion, it will be found that the intensity of the emerging beam of light will be inversely as the degree of exhaustion, except when the Röntgen rays are focused upon the vacuum tube. This would seem to strongly support the theory of Tesla, who has claimed that the Röntgen rays are moving particles projected, for when the vacuum tube is traversed by the X-rays or rapidly projected particles, the beam of light is better able to traverse the intervening space and certainly shows a remarkably interesting relation between the Röntgen rays and ordinary light.

It has been suggested to me that no artificial means can produce a more perfect vacuum than that existing in interstellar space, that this affords a practically non-resisting medium for the transmission of light, and that it is inconceivable how any vacuum, unless it were a vacuum space in the ether, could afford the slightest absorption to a beam of light.

The above suggestion has seemed true to me until my recent researches have led me to believe otherwise, and my results are confirmed by Prof. M. B. Snyder, of the Franklin Institute, who recently, in an address before that body, is quoted as saying: "There is nothing in the Röntgen ray differing from what we call an electromagnetic ray. In time it will be possible to refract and reflect it and do anything with it that we can with light. Possibly what we term light in our atmosphere is nothing more than a transformation of energy out of the cathode rays shot off by the sun itself. Possibly light does not come from the sun at all." He believes that the vibrations known as light are generated in the atmosphere. Were we to go up beyond the atmosphere, we would not see the sun at all.

ELECTRIC LIGHTING

A 250 C. P. INCANDESCENT LAMP.

BY JAMES E. CRIGGAL.

NOW that electricians are interested in high voltage incandescent lamps it will not be out of place to call attention to a form of incandescent lamp that would be very desirable at present.

To any one who has had experience with incandescent lamps of different candle-power and has noticed the lasting qualities of each, they have no doubt noticed that a 50 c. p. 50-volt lamp will last very much longer than the ordinary 16 c. p. lamp. If we take the same thickness of material that a 50 c. p. 50-volt filament is made of and increase the length five times, we have a filament that will take five times the voltage to bring it to incandescence and it will give five times the candle-power, or 250 c. p. at 250 volts. The cost of platinum will be the same as the 50 c. p. 50-volt lamp; the only difference will be a longer filament and a larger bulb. The arrangement of such a filament in a suitable bulb is not a serious problem.

Now that there are methods known to take all of the residual air out of the bulbs and also a process of taking all of the gases out of the filaments, there will be less danger of sparking across the terminals, and there is no reason why such lamps should not be on the market. There is no doubt that such a lamp would give an ideal method of interior lighting of stores, store windows, churches, and with properly designed waterproof sockets, street lighting.

Although the cost of such lamps to maintain would be perhaps a little more than arc lamps, they will give much better distribution of light.

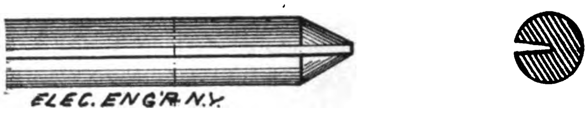
They are free from sparks flying round, and they will do away with that bugbear, trimming of arc lamps, which is sometimes a nuisance.

THE FOOTE SLOTTED ARC CARBONS.

TO prevent the traveling of the arc around the circumference of the carbon, the device of coreing it with a softer carbon mixture has been successfully introduced in practice, and cored carbons are now considered indispensable where the highest perfection of arc lighting is sought for.

With a view to obtaining the same result of maintaining the arc constantly at the center of the carbon, Mr. Theodore M. Foote, of Chicago, has hit upon the idea of slotting the carbon over its entire length, the groove penetrating to the center, as shown in the accompanying illustrations.

It is ascertained in the practical use of these carbons that the arc interval shifts within a very materially circumscribed path of travel, owing to the ever-present cut-out or notched portion maintained by the groove, in the circular edge of the crater, and instead of moving continuously about the circular path of the edge of the crater the arc interval simply shifts alternately back and forth between the two sides of the groove about the edge of the crater. With this limitation of the shifting movement of the arc interval it is demonstrated in practice that the shadows do not form, since the one side does not, under these conditions, become of such a relative height as to cut off the rays.

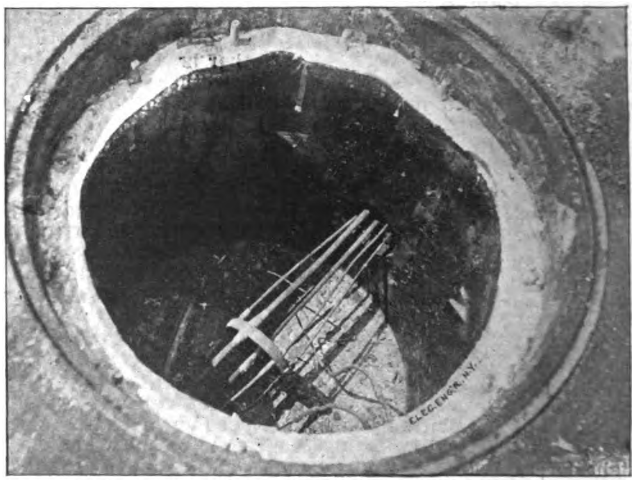


THE FOOTE SLOTTED ARC CARBON.

THE CUMMINGS CONDUIT AT NIAGARA FALLS.

BY ORRIN E. DUNLAP.

THE Niagara Falls Hydraulic Power and Manufacturing Company, of Niagara Falls, have found the Cummings Conduit Company's system of carrying bare wires underground very serviceable. At Niagara Falls the conduit is laid under the asphalt pavement on Falls street, the length of the conduit in use being about three-quarters of a mile. The conduit as there laid consists of an iron pipe, in 20-foot lengths, containing five ducts. The best standard lap-welded pipe is used, dipped in an insulating varnish. The ducts are made from the best kiln-dried wood, also in 20-foot lengths and boiled in oil to thoroughly saturate the wood and kill the fiber. After a group of ducts has been placed in the pipe an insulating compound is forced in, completely filling the space between the ducts and the inside surface of the pipe.



CUMMINGS CONDUIT AT NIAGARA FALLS.

At Niagara Falls six ducts are used, and through them are run two circuits of 2,000 volts each, alternating current, and one circuit of 500 volts, direct current. The current so transmitted is used for light and power purposes. The conduit starts in an alley between the Riverway and Prospect street and extends up Falls street to Third street, crossing Falls street five times to provide outlets. The outlets consist of pipes containing four ducts. Manholes are placed at convenient distances, the number in the length mentioned being six, each about 3 feet in diameter.

The accompanying engraving shows the interior of one of these manholes and the bare wires passing through it, also the wires leading to one of the outlets. The manhole junction boxes are of iron and have two covers, the outer cover being flush with the street pavement, while the inner cover is bolted against a rubber gasket, preventing water or moisture from entering the box. The service over the lines in this conduit has been continuous night and day for two years, and it has been found efficient in every way. Supt. Frank G. Lott, of the Niagara Falls Hydraulic Power and Manufacturing Company, speaks well of it.

SOME THINGS ABOUT WIRING AND WIREMEN.—I.

BY S. H. SHARPSTEEN.

To do electric wiring successfully is one of the severest tests of the skill of a workman. When the designer sets to work to plan a dynamo, he has much data to work from, everything is carefully considered and once the patterns are out, the first lot of machines running successfully, the careful mental supervision is over and thousands of machines may be made with but the ordinary shop supervision. But such is not the case with wiring; every job has some new condition about it, the obstacles that are ever coming up are legion and yet there is so little written about it. The fact is that the wiring business does not get the consideration that it should, the execution of the work is often left to the man not skilled in the art of wiring, but full of ingenuity which he uses to fool the fire underwriters, architects and owners of buildings. The way in which some wiremen will get misfits to go is surprising, and the result is that very much of the wiring done is botch work. Go where you may, aboard an ocean-going steamer, in a large office building, a mansion, an electric light station or a factory, the same thing prevails. After passing through the steamer or building there are many things that would meet the eye that are in a tumble-down condition. On asking the engineer in charge he will tell us of something that was not put in properly and had to be "pulled down."

If there is a person who thinks that this state of things does not exist, let him visit some of the large State hospitals and listen to the tale of woe as told by the person in charge of the electrical work. Oftentimes said person will wonder why he is not in a ward with the "loons," as he calls them. This condition of things should not exist and if the wiring business had the consideration that it deserves it would not. Some persons will say that if the price was paid the work would be good; this is not true, since the State has paid out enormous sums of money for work that is not good engineering. The one great fault is that architects, engineers and inspectors have not got the proper knowledge of the work.

The writer might cite an example: He had charge of some work in a number of State hospital buildings. There were two inspectors on the job; one was local and the other was from the Capitol and we called him the State inspector. These men were employed, one by the local hospital board, the other by the State, and not by the fire underwriters. The reports of both inspectors used to get into the hands of the local board of trustees. The State inspector looked over a building and reported some incandescent wiring as very poorly done; wire running through air shafts tied up with strings, etc. The facts of the case were, no work had been done in said building and the wiring passed upon was some that had been done years before and was used in the fire alarm system. All the wire used for lighting was rubber-covered. This fire circuit was a cheap weather-proof. There was hardly a thing about the work to suggest that it was to be used for lighting purposes. A detailed account of what happened during the completion of this contract would read like a novel in the hands of a good writer.

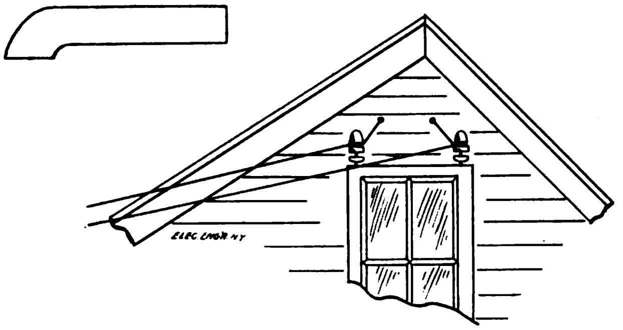
We often hear it remarked that the young man who has learned the carpenter trade is good timber out of which to make a wireman. The reason is this: A wireman has much carpenter work to do. Many old buildings have to be rewired, and there is much cutting and planning that only a carpenter can do successfully. How to use a brace and bit, especially in getting holes through woodwork that is full of nails, and have the holes parallel, is a job that taxes the skill of the best of wiremen, and as a person looks at the entrance wires where the service wiring is above ground, he will see many things that tell of the use of the brace and bit in the hands of an amateur.

Many wiring firms have carpenters employed with their gangs to do the carpenter work, but the man that wires a building quickly and gets the money out of the job is he who has the knowledge of the carpenter and wireman combined. A carpenter will see things one way and the wireman another, and in trying to get their veiws reconciled much valuable time is often wasted.

The young wireman should become thoroughly conversant with the use of the mitre box as a good job of moulding work is another evidence of the skill of the carpenter combined with that of the wireman. After long practice many wiremen will guess at how to cut a mitre and make a good looking job from the outside, but the use of the box and good solid joints with as little fitting with the knife as possible is preferable.

Possibly the writer is safe in saying that the wiring jobs done in the average dwellings are not safe, although the best grades of rubber wire and porcelain are used and the workmen do the work in accordance with the latest rules of the underwriters. We will graphically wire a dwelling and give reasons why we do certain things and see where we differ from old customs.

The first question that comes up is where to enter with our service wires. In this case we will come in at the back of the house in the attic. Two neat iron brackets on which are mounted a good grade of glass insulators, iron, well painted to keep from rusting, will be placed up near the roof in the gable, each wire equally distant from the center of gable and about 2 feet apart, if the service wires are not too long and can be drawn up tightly. If the service wires are long, 3, or even 4, feet would be better; in this case the wires would be so far apart that they could not get crossed or "kiss" each other when the wind blows. Over the insulator brackets, and about 8 or 10 inches each side of the center, put holes for the porcelain entrance tubes; some contractors use a tube like Fig. 1, but it seems that they are uncalled for. The writer would recommend a straight tube, but makes sure to have the hole slant out. The service wire is brought from the porcelain, tied on the glass and put through the porcelain tubes.



FIGS. 1 AND 2.

Now if one end of the tube is turned down, like Fig. 1, and the service wire is large, there is a difficult time in store to get the wire through the tube, but if the tube is straight the wire goes through into the building easily. Another bad thing about a tube like Fig. 1 is that in case the service wire is heavy and should come off the glass the tube is more apt to break from the pull on the crook by the service wire where it enters the tube. Each entrance tube should have a ¼-inch wall, should be well fastened in its respective hole and project at least 3 inches from the building on the outside; the head should be inside.

Inside the building on a smooth board painted with insulating compound we place a main block amply large to carry the current for the whole building. In this case we will consider that we are going to wire the building for 200 16-candle-power lamps; hence, the main block should be of at least 100-ampere capacity. The wires sticking into the building are tied upon appropriate sized knobs to hold them in position and then the ends are placed securely into the main block.

Now the outside of the building should look like Fig. 2. From the glass to the tubes the wire should be drawn up tightly, so that it cannot be bent against the building by a painter's ladder or any similar cause. Some contractors possibly would put the transformer on the building, if alternating current was to be used, for they reason that it would save running a heavy service wire from the pole line, but we think that the best practice now puts the transformer on the pole and the fire underwriters demand it.

We get in the gable, if we can, to save the wires from ice and snow falling on them from the roof in winter. We put good strong brackets on the house (and not the wires directly into the tubes), to hold the wires securely and to save the tubes from too hard strain in sleet storms, and we put the porcelain tubes above the glass so that all water will run away from the holes in the building.

RECENT PROGRESS IN ARC LIGHTING.—III.

BY PROF. ELIHU THOMSON.

(Concluded.)

THE distribution of light from an alternating-current arc with vertical carbons, owing to the fact that the chief light source—the positive crater—is on the upper and lower carbon alternately, is both downward and upward.

A moment's consideration will show that under no circumstances can an alternating arc give out as much light for a given expenditure of energy as does a continuous-current arc for the same expenditure. The light comes mainly from the positive crater, whose temperature and consequent luminosity is limited by the vaporizing point of carbon. The positive crater from which the current passes to the arc is much larger and much hotter than the negative spot on the opposite carbon receiving current. If, now, there is a rapid interchange or reversal of current and dead points or zeros between the reversals at each alternation, the positive crater has to form anew upon a surface, which, while negative, was, on the average, far below crater temperature, having cooled during the time it was negative, and during the zero or period of extinguishment. It results from this that the average temperature of the light-emitting surface of carbon in an alternating arc is below that of the vaporization temperature of carbon, and the emission of light consequently lessened. It is known that the light emitted from a hot surface as temperature rises, increases far more rapidly than the temperature or total radiation.

The shape of the wave of current has a great influence on the conditions of temperature just pointed out, and the rectangular wave must necessarily approach in its efficiency more nearly that of continuous currents than a peaked wave with longer zeros.

The use of single arcs across alternating constant-potential mains requires only that the lamp mechanism be operated by variations of the current passing the arc. Hence, an electromagnet in series is used to lift and feed the carbons, or sometimes the expansion of a high-resistance wire, traversed by the lamp current, has been applied for the same purpose, as in the "Kester" lamp. The electro-magnet is open to the objection that its action is so instantaneous as to be liable to provoke chattering at starting. In the use of a hot wire the objection of chattering at the start is overcome without difficulty, and the wire is noiseless in its action; but it demands that considerable energy be wasted in it, and hitherto the temperature at which the wire must be run to secure sensitiveness of feed or rapid heating and cooling, following variations of current, has been such as to endanger its permanence or cause it to oxidize. The writer obtained, a considerable time ago, a much better result by using the hot-wire principle. but variably shunting it by a set of contacts controlled by a small electro-magnet in series relation, which addition imparted greatly increased sensitiveness, while the slow start given by the hot wire was still secured.

It is well known that in practice an alternating-current arc often starts readily with new carbons, the trouble of chattering appearing when a new arc is to be started with carbons which had before been heated or used. This difference is owing to the fact that in the latter case the high temperature of the arc had driven out the gases and volatile materials, which, as present in the ends of the new carbons, facilitate the formation of flame or lower the resistance of the arc at starting. By dipping the ends of the used carbons in a solution of some salt for a moment, the required volatile matter may be furnished to them so that they will start as readily as the new carbons.

With the open-air arc a comprehensive set of tests made under the writer's supervision disclosed the fact that various makes of carbon gave widely different results. It was found that the length of arc or separation of the carbons for a given potential was, under equivalent conditions, quite variable, and the curious fact was noted that with some makes of carbon the variation of arc length with variations in the potential of the circuit supplying the lamp were much less than with certain other makes. Some gave excessive variation of arc length with moderate variations of potential at the arc, while others gave only moderate variations of arc length for considerable variation of potential at the arc. Of course, the latter are far the most desirable carbons for practical use. It is too early to predict what part the "inclosed" alternating arc may play in the future art of arc lighting, but it probably will find a considerable application.

It may be well to add to the present paper, which has grown to unexpected length, a statement concerning the results arrived at by innumerable tests of the different types of arcs and arc lamps under conditions resembling those of practice, with a view of ascertaining their lighting values. These tests have been embodied in comprehensive reports by Mr. Jesse Coates, of the testing department of the General Electric Company, at Lynn, and the tabulated results might easily furnish material for a lengthy discussion. They embody complete series of measurements of candle-power in various directions, and curves of the same for each kind of arc or condition of surrounding globe, together with mean spherical and estimated useful illuminating intensities. The methods of measurement cannot be detailed here, but are such as, in the writer's judgment, can be relied upon to give comparative figures. Moreover, the mean of many observations is, in each case, taken for comparison and plotting of curves.

The purpose here shall be to state, in a general way, some of the results obtained.

It is well known that the larger the arc, or the larger the current in it with a normal voltage, the more efficient is the light production. The energy is more effectively converted into luminous waves, so that the watts per candle would naturally be less with a twenty-ampere arc at 48 volts than with ten amperes flowing. Measurement shows that where, with continuous current, the same brand of hard carbons is used of diameters varying approximately with the current strength, naked arcs, with ten amperes and 48 volts, may take for each mean spherical candle-power 1.2 watts, while arcs of seven amperes and 48 volts require 1.4 watts.

The use of a cored upper carbon appears to raise the efficiency to a moderate extent, probably because the arc may be maintained at a voltage somewhat less, as at 42 or 44 volts. The use of a clear globe surrounding the arc loses 10 to 12 per cent. of the light, while alabaster and opal globes lose from 45 to 65, according to their thickness and the specific absorptive power of the glass. Naturally, since an inclosed arc, consuming approximately the same energy in watts at the arc as a ten-ampere open arc, will have a current of only about seven and one-half amperes, the efficiency would be expected to be less. Measurements show, after a run of 102 hours, and per each mean spherical candle-power of a four and three-quarter ampere, inclosed, continuous-current arc with clear inner and no outer globe (½-in. carbons), an expenditure of 1.94 watts at the arc. If the energy expended in the lamp branch be taken as the true expenditure, that lost in resistance is added to that of the arc, and the watts per candle increased accordingly. A similar loss is, of course, experienced with naked or open arcs on constant potentials, owing to resistance being used in series. The result given above, or 1.94 watts per candle, is at the end of a long run of 102 hours, but with a clear inner globe. Inclosed arc lamps with clear inner and clear outer globes are not satisfactory, and, in fact, for good results of uniformity and diffusion, a slightly opal inner globe is needed. Those now known as alabaster" are well suited to the purpose. When these are used, the watts at the arc per mean spherical candle-power will, at the first part of a run, range about two watts, increasing seriously only toward the very end of the run. While it may seem that the watts per candle are higher than might be expected, yet it must be borne in mind that, in all inclosed arcs, the current is relatively small and the potential high for a given expenditure of energy, and this acts in a double way to lower the efficiency, as not only the crater emitting light is smaller, but a large part of the energy goes to sustain the arc flame, which is long, while, also, the absorption of light by the surrounding glass is not to be neglected. No construction of lamp, regulation or adjustment thereof can get rid of the inherent properties here pointed out. Nevertheless, it is true that the character of the light, both of the open or exposed arc, and of the inclosed arc, is such as to make it very desirable as a substitute for daylight and for many cases of use. The fact that the light is shed mainly downward by continuous-current arcs results virtually in an addition to the efficiency and economy of the light; thus, if the light emitted downward be considered as alone useful, the expenditure per mean useful candle would, with naked arcs, fall to about one-half a watt, and with inclosed arcs, to from one to one and one-half watts at the arc.

With alternating arcs the conditions are different, since the light is sent up and down equally. By a reflector placed above the arc, a considerable fraction of the light which would often be lost upward is sent downward to increaese the effectiveness; thus, a sixteen-ampere, 25-volt, naked alternating-current arc used, per mean spherical candle, 1.49 watts, or for mean useful below the horizontal, 1.12 watts, which was reduced to .8 to .9 watt, when a porcelain reflector above the arc was used. For the same causes that necessarily reduce the efficiency of an inclosed continuous-current arc as compared with the uninclosed, the efficiency of an inclosed alternating arc falls below that of the open arc with similar currents. The watts at arc per candle will be found, per mean spherical candle, to be, under the best conditions, about two watts, increasing toward the end of the run, owing to obscuration of the inner globe and other causes. No reflector or deflector can be used with much effect with the inclosed arc, so that the mean useful is but little different from the mean spherical candle-power.

The apparent advantage in economy of the continuous-current inclosed arc over that with alternating currents is in large measure neutralized by the fact of the former requiring a dead resistance in circuit to give stability to the current, while the latter can be run without it, or, at most, with a reactive coil which wastes but little energy.

Still it must be confessed at the end that the luminous yield is but little better than that obtained in incanadescent lighting. After all, it may be that the whiteness of the light and the daylight effect obtained may be a sufficient reason for the large introduction of inclosed arcs, now that the frequent trimming and attention to the lamp is not needed. Indeed, it may also appear that all the varieties of arc lighting which have grown into importance within the past few years have their own fields of usefulness, and that, therefore, the work spent in developing them has not been labor in vain.

It should be said, in conclusion, that the figures given above and expressing the watts per mean spherical candle, while strictly comparative so far as a study of arc lights alone is concerned, might vary somewhat if the object had been to compare arc and incandescent lights, owing to the difference in color of light, though the variation would not in any case be great.

POWER TRANSMISSION

ELECTRIC MOTORS IN THE NORTHERN PACIFIC R. R. SHOPS.

ELECTRICITY is used to drive all the machinery in the shops of the Northern Pacific Railroad at Edison, in the Far West. Recently the completion of the long distance transmission line between Folsom and Sacramento, Cal., has placed it within the power of the Southern Pacific Railroad to use motors in their shops at Sacramento with most satisfactory results. In their operation the motors have already shown considerable economy over that by the original steam plant which they superceded. The motors are placed in the shops where steam engines had previously been used and the difference between the results obtained apart from the mere question of economy, is marked.

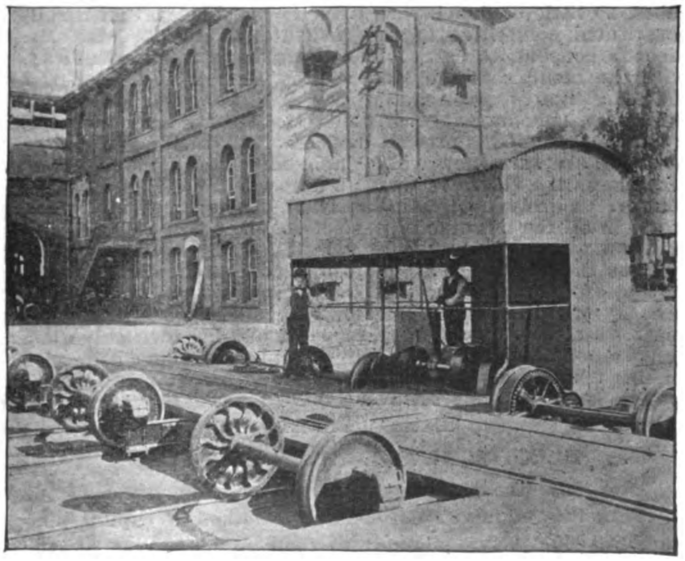


FIG. 1.—TRANSFER TABLE IN SACRAMENTO SHOPS, SOUTHERN PACIFIC RAILWAY.

Three motors are used; the first, a direct current motor placed upon a transfer table used for shifting the locomotives. The motor is a G. E. 800, similar in every respect to those used on the ordinary trolley car, and it is driven by 500-volt railway current from the station. It is so geared that it operates not only the table, but also drives a drum carrying a wire cable, used to haul the locomotives upon the table. This it does with perfect ease, hauling all sizes of locomotives. Instead of taking the current from the overhead wire by means of a trolley, the conductors are laid in an underground conduit and the contact is made by means of a plow running in this conduit. Some fears were at first expressed as to the result in rainy weather, but, although considerable rain has fallen since the installation of this motor, no difficulty has been experienced. The transfer table and motor are shown in Fig. 1.

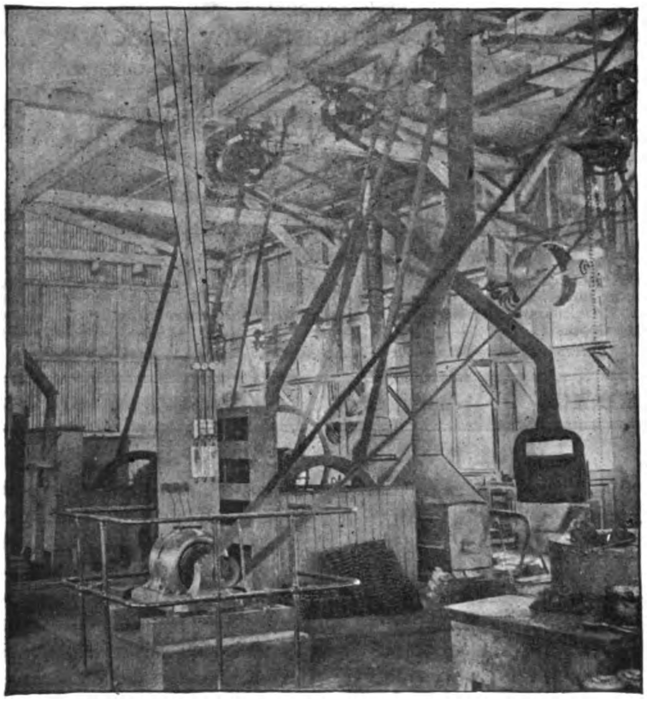


FIG. 2.—INTERIOR SPRING SHOPS, SOUTHERN PACIFIC RAILWAY.

The motor used to operate the machinery in the boiler shop, as well as in the tender shop, is a 50 horse-power motor driven by 440-volt current from the step-down transformers. The machinery in these shops is peculiar in that each machine is provided with a heavy flywheel for carrying it over the sudden shocks which occur in punching and shearing and similar work. For three or four seconds the motor has an excessive amount of work thrown upon it in starting the machine from idleness, and until the maximum speed is acquired. The load then drops to 30 horse-power. Such sudden drops as this are calculated to demoralize motors of ordinary construction; with the induction motor the drop in the load is hardly noticed.

Fig. 2 shows the interior of the spring shop, driven by a 10 horse-power motor; this motor also has to cope with sudden heavy loads. In this shop all the springs—spiral, elliptical and leaf—used in the construction of locomotives, etc., are made and the most difficult piece of work done is the making of the spiral springs, some of which come to the machine as a bar of red hot steel 1¼ inches in diameter. This is placed in the machine, is instantly wrapped around a mandril and it is such work as this that throws for a few seconds an enormous load on the motor. Although it has been in use for some time it shows no sign of strain.

The two motors last named are of the General Electric Company's three-phase induction type, without commutator, collecting rings or brushes. They are driven by 440-volt three-phase alternating current from the transformers, which step-down the 11,000-volt current transmitted twenty-four miles from the generating station at Folsom. This installation is only one of many made since the completion of the transmission from Folsom to Sacramento, which latter city is rapidly becoming dependent on electricity as its exclusive motive power.

THE
ELECTRICAL ENGINEER
[INCORPORATED.]

PUBLISHED EVERY WEDNESDAY
NEW ADDRESS:
120 LIBERTY STREET, NEW YORK.
Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

T. COMMERFORD MARTIN AND JOSEPH WETZLER, Editors.

A. C. SHAW, Secy. and Business Manager.

WESTERN OFFICE - - - 1564 Monadnock Block, Chicago, Ill
PHILADELPHIA OFFICE - - - - - - 916 Betz Building.

Terms of Subscription

United States, Canada and Mexico - - - - - -	per year.	$3.00
Four or more Copies in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York Post Office, April 9, 1888.*]

VOL. XXIII. NEW YORK, JUNE 30, 1897. No. 478.

"THE ENGINEER'S" ENTERPRISE.

IN spite of the fact that the meeting of the independent telephone companies closed at Detroit around midnight June 23, when the long new constitution was given out for publication, The Engineer appeared with its report on June 25, devoting several pages to the subject, with editorial discussion, notes of exhibits, and other features of interest. This was several days earlier than any of the other electrical papers, some of whom were not even in attendance at this momentous convention. We are glad to know that the enterprise of The Engineer has been highly appreciated at this juncture, when so much importance is attached to the subject of independent telephony.

A TELEPHONE FIGHT PREPARING.

ALL who have read our report last week of the important meeting of the independent telephone interests must, we think, agree with us that a formidable front has suddenly been presented against the Bell Company, and that the opposition has assumed in a very short time an aspect of activity, strength and belligerency that few expected. Indeed, the action of the United States Supreme Court in declaring that the American Bell Company ought to have its belated Berliner patent has inflamed and intensified a great deal of latent hostility; and so far from being intimidated the opposition gives every sign of being anxious for the fray.

Probably opposition to a great monopoly never before rallied so big a force as this of 1,200 new companies with many more organizing. By the time the meeting ended last week, 50 of them had signed the new constitution—"the declaration of independence,"—and all of them realize that the larger the number of accessions to the ranks, the less the burden on each of necessary litigation will be.

As to the outcome of the fight, it can only be regarded from the standpoint of speculative prophecy. If the American Bell Company were to buy up the whole existing outfit, makers and users, there would be others at once. And as to infringement damages, a curious parallel may be inspiring some of the courage of the opposition. Perhaps, on the whole, a patent has never been better sustained than that on the Edison lamp. Yet at one time, there were about 1,200 or more Thomson-Houston and other companies using incandescent lamps in direct violation of the Edison lamp patents. If any of those opposition companies has ever paid a cent or is ever likely to do so, we have still to be informed of the fact. It is true that recently some of the manufacturers have got together and have agreed to work under certain other patents, but the field is still an open one and never more so than to the new lighting companies as they spring into being. The treasure poured out to sustain the Edison lamp patents was spent in a far more righteous cause than that of the bifurcated Berliner patent, but there is absolutely nothing to show for it, and the thousand infringing companies, if they infringed, are none the worse for their long immunity from any kind of payment. We are not now expressing any kind of approval or disapproval of those bygone events, but simply stating the notorious fact. The interesting question now is whether the Bell Company, magnificent as all its resources of generalship, legal talent and finances are, can make any better showing.

THE GLAD HAND AND THE MARBLE HEART.

WE note that The Electrical Review returns to the apparently pleasant task of throwing cold water on the work and aspirations of Mr. D. McFarlane Moore in vacuum tube lighting. Far be it from us to deny to our contemporary its iconoclastic pleasures; but, whereas it has heretofore confined itself to glittering generalities, its last utterance gives some glimpse of what its opinions are based on, and the public will be glad to be enlightened. Our contemporary explains itself as follows: "Now when we learn that vacuum tubes operated with Mr. Moore's devices take from eight to ten times the energy that ordinary incandescent lamps consume for the same amount of light, and, what is more, that the process by its very nature, is unavoidably connected with such inefficiency, even though the devices attain ideal perfection, we cannot, even to honor the opinion of the emotional editors of our contemporary, though it would give us much pleasure to do so, attach to such efforts the commercial value they would give it." As to the emotional attributes of the editors of this journal, that is aside from the question, though we confess that we prefer to extend the glad hand of encouragement to the struggling inventor, rather than to chill him after the style of our contemporary, with the coldness of the marble heart. But, whence or from whom, we would like to ask, does our contemporary "learn" that Mr. Moore's devices take from 8 to 10 times the energy of the ordinary incandescent lamp? This is most valuable and important information, if true. Certainly, Mr. Moore has never made any such statement of the efficiency of his system, so that it must emanate from "The Review's" own personal experiments. As a matter of fact, Mr. Moore denies absolutely the truth of our contemporary's assertion, and we think that in justice to both Mr. Moore and its readers, "The Review" ought to give the data of its information. Let us have the truth above all and by all means. In this connection, we beg to recall to our contemporary's recollection that when, a year ago, one of the editors of The Engineer, before the American Institute of Electrical Engineers, mentioned the power consumed by Mr. Moore's tubes, so little credence was given to his figures, that a self-constituted committee of the Institute undertook, with Mr. Moore's consent, to carry out its own tests in its own way, with the result that the Moore tubes showed up even better than the figures given before the Institute. Our contemporary very encouragingly foretells the speedy abandonment, by Mr. Moore, of his present devices. And what of it? If he does, we are sure they will be abandoned for something better, just as the vibrators were an antecedent for the improved rotator. Surely no great invention was ever given to the world in all the minutiæ of perfection. It is this blindness to, or, shall we say, ignorance of, the philosophy of history, that disarms the criticisms by our esteemed contemporary. As a matter of fact, nothing that our contemporary or ourselves can say will change by one iota the status of Mr. Moore's deeds. Mr. Moore will have to work out his own salvation, and we hope and believe he will do it; but we don't believe in making the task of the honest worker and inventor any harder than it is by jumping all over him.

ELECTRICAL EXECUTION HORRORS.

IF the philanthropists upon whose recommendations New York State adopted the electrical method of capital punishment, could have pictured to their minds some of the sickening scenes which have been enacted since the law went into effect, we doubt whether they would have so strongly championed electricity as the life extinguishing agent. On several occasions things have gone wrong with the apparatus at the critical moment, and only last week again, it required five separate shocks to kill a miserable convict in Auburn prison. The five shocks were necessary, owing to the imperfect contact. The delicious smell of burning human flesh was quite distinct in the death chamber. This incident reads more like a chapter from the damnable days of the Inquisition than a tale of the end of the nineteenth century; yet under the law as it exists in New York State such horrible scenes are likely to occur at any time. To insist that such a method of execution is the most humane that can be devised is simply ridiculous, and it is high time that some genuine humanitarian society should take up the subject with a view to removing this stigma from New York. One of the very strongest arguments put forward by the sponsors for the electrical execution law was the alleged absolute certainty of the electrical method. Yet this very feature has been again and again proved to be lacking. And as to the alleged painlessness after the first shock, hundreds can bear witness to the fact that a shock can be a prolonged agony of the most excruciating kind. Unfortunately New York's example has recently been followed by Ohio, but it is earnestly to be hoped that no more States will adopt this barbarous, medieval law.

ELECTRICITY IN WARFARE.

RECENT occurrences in Europe have brought out very clearly the growing use of electricity in warfare. Naval experts at Kiel have been testing the practical uses of dragon-shaped airships or balloons, which may be put on board vessels for use during naval engagements, and in reconnoitering. Some of the balloons rose 5,500 feet, remaining fastened to the decks of torpedo boats, which were steaming 18 knots an hour, enabling the balloonists to make valuable observations of the stations of vessels at a great distance. The observations made were communicated by telegraph or telephone from the balloons to persons on the decks of the vessels below, enabling them to change the course of the latter accordingly. At the British jubilee naval review last week, the United States man of war "Brooklyn" received great attention; and Mr. Laird Clowes, the naval expert, declared that, as proved by the new ship, England is in the resort to electricity many years behind the United States. That she will remain so is seriously open to question, but credit for our leadership is welcome and must be ascribed to the patient and brilliant work of such men as Lieut. B. A. Fiske, who may be said to be devoting their lives to this subject, in behalf of our navy .

THE TROLLEY AND COUNTRY RETAIL TRADE.

A WRITER in the "Iron Age" speaks of the trolley as a "dangerous feature for the smaller dealers" in hardware, because it enables the farmer, who was formerly tied down to the general local store, to reach easily the larger centers of trade. "It did not pay the inhabitants of small cities to spend $3 to $4 for the purpose of purchasing about the same amount in a large neighboring city, especially when the number of trains was limited, and when it consumed a whole day and well into the night to make the journey. But now the electric car stops at the farmer's door, suburban cars leave every 30 minutes, they carry express packages, and they take much of the local trade to neighboring cities. The small country dealer is the greatest sufferer. He loses his cash customer, and retains those whom he has to carry and who have no ready money. The larger towns gain from the country what trade they lose to the cities, while the cities have nothing to lose." It strikes us from a different point of view. The very fact that the trolley cars deliver express packages should enable the small general store in a village to carry practically a much larger stock than ever before, and to fill many wants that previously were not felt or went unsatisfied because of the distance from market. Besides, accessibility always promotes trade and intercourse, and this ought to be a good thing for the small country dealer, particularly if the trolley brings into his neighborhood a number of residents, earning good weekly cash salaries, to whom the real country was formerly out of reach. Heretofore, the small dealer has presumed on his inaccessibility, and made it an excuse for not handling a number of useful and desirable things. The trolley gives him a genuine opportunity of new life. But if he supinely lies down to die, he will die before he is dead, and someone else will see the modern chances and find a profitable way out.

MUNICIPAL LOSSES AT YARMOUTH, ENGLAND.

ACCORDING to figures given at the last council meeting, the town of Yarmouth, England, is already paying pretty dearly for its municipal electric light plant. The deficiency for the last year and a quarter is $3,650; the deficiency for the previous year was $3,780. The town council begins to wonder whether it is in for a yearly deficit of about $3,500, and how long the public and the modest local treasury will stand it. This is one of those successful foreign plants people are so fond of telling us about.

EDUCATIONAL

MR. J. B. WHITEHEAD.—When the Johns Hopkins University in Baltimore resumes its course of work next fall it will have a new assistant professor in the person of Mr. John B. Whitehead, who at present is connected with the Cataract Construction Company at Niagara Falls, Mr. Whitehead having received an appointment to the position.

MARRIED

NALLY-REDD.

Edward J. Nally, assistant general superintendent of the Postal Telegraph Company, with headquarters at Chicago, was married to Miss Lee Warren Redd, daughter of Captain Oliver T. Redd, of that city, on June 10 at Lexington, Ky. Among those present were Guy E. Paine, superintendent of the Postal Telegraph Company at Kansas City, who for several years was manager of the Postal Company in Chicago; C. M. Baker, superintendent of construction, Chicago; F. J. Loesch, H. L. Childress, superintendent at Birmingham, Ala.; W. J. Capen, superintendent at Cincinnati; Grenville Howard, superintendent long distance telephone, St. Louis. The happy pair received a silver chest of eighty-three pieces from Postal Telegraph employés. Mr. and Mrs. Nally will return from Europe on the steamer Majestic about July 31, and will make their home at the Virginia Hotel, Chicago.

OBITUARY

EUGENE E. BOGART.

It is with extreme regret that we announce the death of Mr. Eugene E. Bogart, who for some time past has been doing a large business in the field of electric gas lighting apparatus, in New York City, having succeeded his father, Abraham L. Bogart. Few names are so well known in this branch of the electrical arts. Mr. Eugene Bogart was a retiring man, but made a great many friends by his sterling qualities of heart and mind. It is the more distressing that his death is the result of injuries received from an accident, Mr. Bogart having been thrown from a cable car in this city last February. He is survived by a brother, Mr. A. Livingston Bogart, well known as an electrical expert and inventor, and as a contributor to the electrical press.

THE STOCK MARKET

STEADY BUT SMALL GAINS.

While a sturdy confidence now prevails that general trade will be active in the fall, events are moving but slowly in that direction. There is improvement, however, and it is becoming more pronounced out West, just as a few months ago, the East was in the lead. This oscillatory process is to be noted all the time, but the gains are kept and serve as foundation for a further rise.

During last week 35,584 shares of Western Union were sold up to 84¼, and 3,672 shares of General Electric up to 33¼. American Bell telephone on small sales rose as high as 234, and the effect of the opposition movement is certainly not yet apparent in any decline of value.

TELEPHONY AND TELEGRAPHY

AUTOMATIC TELEGRAPHY.—II.

BY P. B. DELANY.

HAVING estimated the speed of the various systems in use in this country—simplex, duplex and quadruplex Morse, and the Wheatstone automatic—the interruptions to working by disarrangements to which they are liable should not be overlooked. With simplex Morse there is practically nothing of this kind. The Morse duplex, however, requires balancing and readjustment from time to time, owing to the inevitable changes in the atmospheric conditions. These difficulties may be said to be quadruplexed in the quadruplex.

There is no data upon which to found an estimate of the proportion of time used in balancing the quad. Since the introduction of constant pressure by the substitution of dynamo generators and storage batteries the causes of disarrangement are due principally to changes of weather, which are always taking place somewhere over long sections. The working margin is not great, and slight changes call for some compensation if efficiency of working is to be maintained. These difficulties are aggravated where repeaters are necessary, first on account of greater area of country, second on account of double balancing required by the two sections intersected by the automatic repeaters. The introduction of the dynamo and accumulators in telegraphy have not been altogether of unqualified advântage. The voltage has been increased to an excessive degree in order to overcome defective insulation. As may be well understood this has affected the electro magnets unfavorably and worked other evils guarded against when chemical batteries were used. At best, the quadruplex is a fickle dependence; indeed it is the opinion of many telegraph managers that the polar duplex is preferable, holding that the increase of facilities does not balance the increase of labor necessary for its operation and the amount of high-class attention required in keeping it going.

With regard to the Wheatstone system, it cannot be questioned that it represents the best efforts of able telegraph engineers and mechanicians covering a period of about thirty years. It would be hazardous to say that anything is finished or beyond improvement, but in electro-magnetic telegraphy the Wheatstone system seems to have reached the limit about twelve years ago when the quick acting relay was relieved of its self induction effects by the condenser shunt.

While the great number of adjustments necessary and the liability of the Wheatstone to disarrangement on slight provocation are serious drawbacks the fundamental obstacle in the way of any further advance in speed or stability of operation lies in the fact of its being electro-magnetic in principle. In it is probably represented the limit of electro-magnetic actuation of normally inert recording devices, or in other words the utmost rapidity with which the lightest and most delicately adjusted armature can be moved with sufficient power and play to make and break a local circuit or an ink line on a moving tape is demonstrated in this machine. It is evident, therefore, that greater speed can only come through a system not using electro magnets for receivers.

THE CHEMICAL AUTOMATIC.

Thus far the only practical receivers of this kind have been founded on the original plan of Bain's use of a chemically dampened tape, which, under the action of the current passing through it, would leave a mark corresponding to the dot or dash sent into the line at the transmitting station. It is needless to follow in detail the development of this brilliant idea. Improvements have been made from time to time by different people, nearly all having been in some respect, at least, an advance on what had previously been done, but all leaving much to be desired for the practical introduction of this method of telegraphy.

It cannot be doubted that had chemical telegraphy received the same assiduous attention from able experts that has been bestowed upon the Wheatstone, it would have long ago reached perfection and supplanted the Wheatstone system. Even now, however, the early drawbacks of the chemical plan seem to have lingering attractions for some among the prominent Morse men, who, doubtless, on account of prejudicial preferences attaching, perhaps naturally, to the old Morse stand-by, are loth to acknowledge the removal of the obstacles which have so long beset the ideal principle of fast transmission. Craft prejudices have opposed innovations in every industry. The sewing machine, the reaper, the type-setting machine and typewriting machine, the trolley, the telephone, duplex, quadruplex and multiplex telegraphy, in fact, every improvement has in the beginning encountered this opposition, but experience teaches that economical methods must prevail sooner or later.

In telegraphy the proof of this inevitable change may be seen in the disposition to compromise before capitulation. Automatic transmission from Morse embossing of tapes, retaining all the idiosyncracies and imperfections of key working is being resurrected from the rubbish of antiquity by a few expert Morse operators, and all for a doubtful gain of possibly ten words per minute over hand transmission, but at the same time retaining the main objection which they themselves advance against perfect dots and dashes, mechanically made, i. e., preliminary preparation of the message. An operator will punch absolutely perfect dots and dashes as rapidly as an operator can emboss imperfect ones on a tape. The regular automatic transmitter will transmit from its perfect perforations fifty times as fast as the makeshift will send from its imperfect embossings, and the chemical receiver will record perfect signals at least fifty times faster than the single current Morse relay, by which it is proposed to work an embosser indenting a tape which must be run through a local circuit for reproduction on a sounder, thus reproducing all the faults of the embosser's manipulation, plus the unavoidable failures arising from the original transmission into the main line from an unstable stencil, and two repetitions, one from the receiving relay into the local embosser, the other from the tape into the sounder circuit. Every expert Morse operator knows that the main difficulty now is to so adjust his receiving relay that fast hand sending will operate his sounder without clipping, sticking or dropping of signals, and that even with the slightest aluminum levers and closest adjustments, it is sometimes extremely difficult to get all that is sent. How this same shaky condition can be made to successfully work an embosser requiring three or four times the power and twice as much play, at a higher speed, is not plain. Besides, this possible gain of ten words requires two additional employés as machine tenders.

The highest Morse efficiency is reached with an expert sender sending direct into the line and an expert sound reader using a typewriting machine at the receiving end. In this arrangement is also comprised the best column printing system. It would be safe to put this combination against any printing system in use or proposed. Indeed, for a particular class of business it is hard to imagine anything better, but for the great bulk of telegraphic correspondence, it is utterly inadequate without a multiplicity of wires.

The latest system of automatic telegraphy employs a three-keyed electro magnetic perforator having but few mechanical parts. It can be worked with one finger and with no more labor than is required for the operation of a Morse key, or it may be worked manually with both hands like the Wheatstone perforator. Owing to the omission of the center row of holes unnecessary either in the perforator or transmitter, the liability to disarrangements is at the lowest. When the punches become dull the frame holding them can be removed and another set substituted in a few seconds. The feed arrangement is so perfect that twenty feet of tape punched with a continuous row of holes may be doubled on itself and each hole will register with the other absolutely. And as but one hole is made for a signal, the labor is light and possibility of failure reduced to a minimum. The cost of this perforator compared with others is nominal. The transmitter has practically no moving parts beyond the roller for drawing the tape.

The impulses are sent into the line by wire brushes connected to the line pressing downward on top of the tape and corresponding brushes connected to the current generators pressing upwards beneath the tape. When the tape intervenes, the circuit is absolutely broken, when a perforation is drawn between the brushes the contact is perfectly made. The edges of the holes keep the ends of the contact brushes bright and clean. There is no chance for gumming or accumulation of dirt. The separation of the contacts is always the same, and the pressure is always uniform. There can be no trouble from arcing, as it is broken and wiped out by the tape.

The speed at which contacts can be made without mutilating the tape is estimated at about 5,000 per second; 2,600 perfect signals per second, or 8,000 words per minute have already been recorded over an artificial circuit of 200 ohms, 3 microfarads, with 110 volts. The tape can be run through the transmitter a hundred times without impairment. Not depending on a feed row of perforations, the tape can be started at any stage without missing or injury.

The receiver, like the transmitter, has no mechanism beyond the tape drawing rollers. The record is made by three steel wires pressing on top of the chemically prepared tape. The ends of these wires are in even line, across the tape. The two outside ones are electrically one, and are connected to the line. The middle one is insulated from the other two, and is connected to earth. The perforated tape has two rows of holes for the signals. All the dots are in the upper row, all the dashes in the lower. The battery contact brush under the lower row is connected to the positive current. The brush under the upper row is connected to the negative pole.

When the letter "A" is sent, a negative impulse is sent and makes a single dot in line of the middle wire of the receiver. When the dash is sent two dots are made on the receiving tape, one in the track of each outside recording wire. All are dots, but all those representing dots being sent from one pole of the battery are marked singly, and all dots representing dashes being sent from the other pole of the battery are marked in duplicate on the received tape. The letter "A," consisting of a dot and dash, appears thus: — =. Letter "B," comprising a dash and three dots, is represented thus: = - - -.

This is the highest economy of impulses and they are all of the same duration in the line and of the same length on the tape. Heretofore in chemical telegraphy dots and actual dashes have been sent all by one current, and recorded as dots and dashes all in one line. Unequal currents in the line displaced the signals, and retardation ran the dots and dashes together at the receiving end, rendering very high speed impossible and translation always uncertain and slow. The tailing or running effect was partially overcome by the clearing effect of self-induction currents in a shunt or derived circuit at the receiving end, but always at the expense of the marking current. With the arrangement described, retardation and its consequent tailing effect may be practically ignored, it being impossible to mistake a dot for a dash, or a dash for a dot.

The continental code is used because it has no space letters. The highest number of consecutive dots in the alphabet is letter H, which has four; the highest number of dashes is O, which has three. Even though the retardation of line was sufficient to run all the dots of H together, it could be easily distinguished by the composite length from S, I or E, which have three, two and one, respectively. If desired a slight clearing current may be used at the receiving station. All the helpful expedients used for other systems may be applied to this if necessary. The principles of operation described render them unimportant, however.

DELIVERY OF TELEGRAMS ON TRAINS.

At the recent meeting of railway telegraph superintendents at Niagara Falls, a paper from Mr. L. H. Korty, superintendent of the telegraph department of the Union Pacific R. R., said:

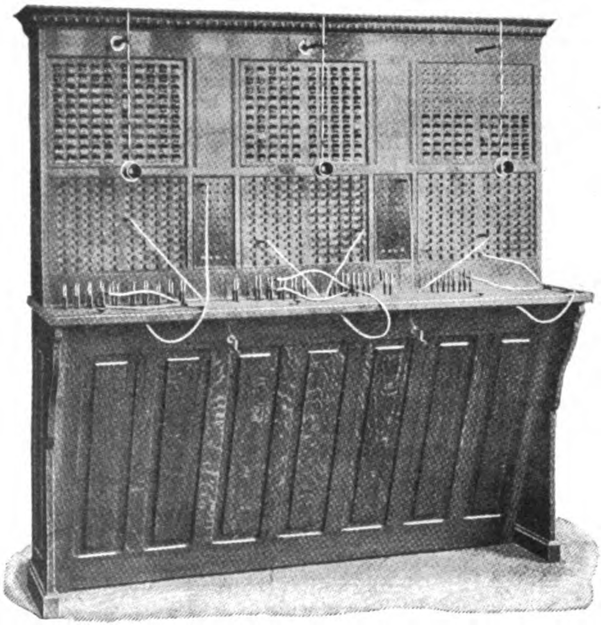
"Many telegrams are received at stations addressed to passengers on trains. These must necessarily be given to the train conductor to find the person. The conductor may be unable to give it personal attention and turns it over to the brakeman to find the owner, but 'Brakesy,' in his anxiety to resume his seat with the woman passenger whom he is entertaining, does not make a thorough search through the train, puts the message in his pocket and the matter is forgotten until the usual claim for damages on account of non-delivery is received. Investigation proves but one thing, namely, that the message was received at the station, but nothing further is on record. The operator claims he turned it over to the conductor of the train, but has nothing to show for it as he failed to take his receipt. The conductor disclaims all knowledge of it. Asked why he does not take receipts for commercial messages delivered, the agent in this case may reply that he does take receipts from everybody except conductors, who usually decline to receipt, and be responsible, for telegrams for parties on trains. Under these conditions there is no certainty that a message will ever reach the owner, or, in case of failure to find him, that the sending office will be notified of non-delivery.

"Most of the irregularities in delivery service exist at the small offices where there is no messenger and not sufficient business to justify the employment of one, the agent performing all the various duties of the station, including delivery of telegrams, and as station employés too often look upon commercial telegraph business as an outside matter, imposing upon them duties for which they receive no compensation, this branch of service is most likely to suffer and be subject entirely to their personal convenience; yet the telegrams received at these thousands of small railroad offices constitute a considerable portion of the whole telegraph business of the country, and, therefore, justly demand our careful attention and individual efforts to improve. Although a railroad company may not share directly in the telegraph earnings, it is compensated in one way or another through its arrangements with the telegraph company, and, aside from the contract obligations properly to handle the telegraph business at stations, there is a moral obligation on the part of the railroad company toward communities and patrons who are dependent upon its employés for this important service. An agent charged up with the tolls on a message delayed or lost through his negligence, generally profits by the experience, and is thereafter usually more watchful of this business; but we should not wait for our employés to be educated in their duties by this means. The paltry amount of tolls refunded to the claimant does not entirely appease his feelings and he will always entertain a lack of confidence in our telegraph service, as well as the service in general at railroad stations."

THE STROMBERG-CARLSON TELEPHONE SWITCHBOARD.

Among the most wideawake and progressive independent manufacturers of telephonic apparatus are the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, This company, as noted by us last week, have carefully worked out and build everything required for local and long distance exchange work, from the receiver to the switchboard.

The accompanying engraving illustrates the standard Stromberg-Carlson exchange board. This switchboard is of the divided type. The company's common return switchboards, wired metallic to terminal pole box, are claimed to be as free from cross-talk as a full metallic board.



The Stromberg-Carlson Telephone Switchboard.

The company asserts that its apparatus is entirely free from infringement of the Bell patents and in an illustrated brochure, just issued, takes up point by point the proof of its claims. We note also some excellent "cautions" intended for prospective telephone investors.

THE PENDER MEMORIAL.

The Marquis of Tweeddale, as chairman of the committee having in charge the International Submarine Telegraph Memorial to the late Sir John Pender, announces that the committee has decided to proceed during the present year with its work. The memorial is intended to commemorate the leading part taken by Sir John Pender in the establishment and development of submarine telegraphy and its extension throughout the world. The committee's work is independent of the General International Submarine Telegraph Memorial to be inaugurated in 1901, and is to take a threefold form. The first of these will be a bust of Sir John Pender, to be placed in some suitable institution and not to exceed in cost £500. Secondly, it is proposed to raise a fund, of not less than £5,000, with which to endow the electrical laboratory of the London University College conditionally on the council's giving to the chair the name of the Pender Chair of Electrical

Engineering and to the laboratory that of the Pender Laboratory. Lastly, the committee proposes to found a Pender scholarship and gold medal in connection with electrical subjects at the Glasgow University. In making its appeal to the public the committee points out that, with the exception of the comparatively small sum to be expended for a bust of the late eminent electrician, the whole of the fund will be devoted to the advancement of technical education. The committee also announces that it has already received subscriptions toward the various objects mentioned amounting to more than £6,000. In this list one-half of the sum is contributed by three telegraph companies—the Eastern, Eastern Extension and East and South African—each of which companies gives £1,000 or more. Among the other subscribers are the Direct United States Cable Company and its staff, £254; the Anglo-American Telegraph Company, £105; J. W. Mackay, New York, £105; the Marquis of Tweeddale, £100; Abram S. Hewitt, New York, £52; the Messrs. Rothschild, £52; Baron Erlanger, £50.

SIGNALLING THROUGH SPACE WITHOUT WIRES.—THE MARCONI SYSTEM.

In our last issue our London correspondent gave some account of the Marconi system of signaling without wires, described by Mr. W. H. Preece before the Royal Institution. We are enabled this week to give some further details of the Marconi apparatus.

Mr. Marconi utilizes electric or Hertzian waves of very high frequency. He has invented a new relay which, for sensitiveness and delicacy, according to Mr. Preece, exceeds all known electrical apparatus. The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

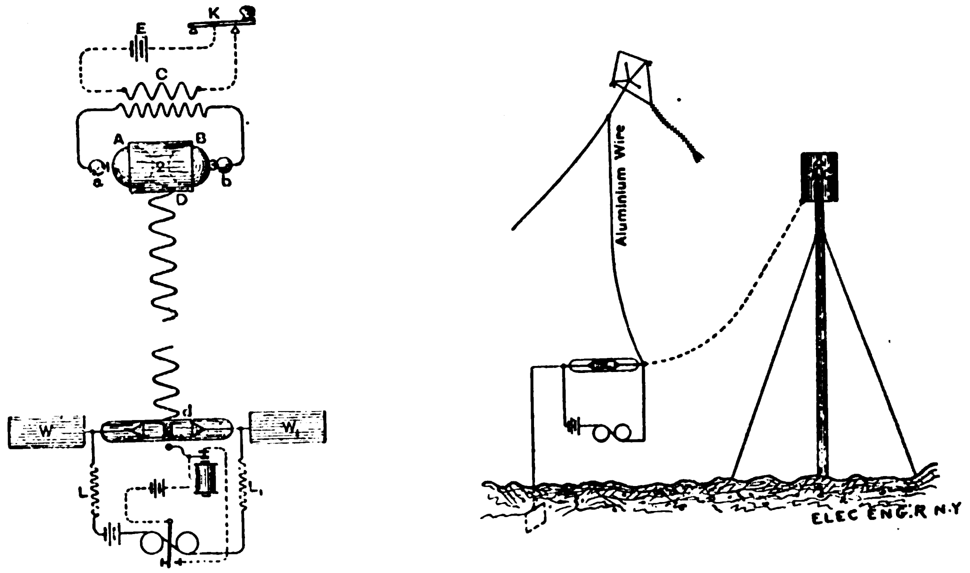
The Transmitter.—His transmitter is Prof. Righi's form of Hertz's radiator, Fig. 1.

Two spheres of solid brass, 4 inches in diameter (A and B) are fixed in an oil-tight case, D, of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. Mr. Marconi uses generally waves of about 120 centimetres long. Two small spheres, a and b, are fixed close to the large spheres and connected each to one end of the secondary circuit of the "induction coil," C, the primary circuit of which is excited by a battery, E, thrown in and out of circuit by the Morse key, K. Now, whenever the key, K, is depressed sparks pass between 1, 2 and 3, and since the system, A B, contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of propagation is Dd, and the frequency of oscillation is probably about 250 millions per second.

The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A 6 inch spark coil has sufficed through 1, 2, 3, up to four miles, but for greater distances they have used a more powerful coil—one emitting sparks 20 inches long. It may also be pointed out that this distance increases with the diameter of the spheres, A and B, and it is nearly doubled by making the spheres solid instead of hollow.

The Receiver.—Marconi's relay (Fig. 1) consists of a small glass tube four centimetres long, into which two silver pole-pieces are tightly fitted, separated from each other by about half a millimetre—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of 4 mm., and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The electric resistance of Marconi's relay—that is, the resistance of the thin disc of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense. It, therefore, becomes a conductor. It may be, as suggested by Prof. Lodge, that we have in the measurement of the variable resistance of this instrument a means of determining the intensity of the energy falling upon it. This variation is being investigated both as regards the magnitude of the energy and the frequency of the incident waves. Mons. E. Branly (1890) showed this effect with copper, aluminum and iron filings. Prof. Oliver Lodge, who has done more than any one else in England to illustrate and popularize the work of Hertz and his followers, has given the name "coherer" to this form of apparatus. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer beat against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the transmitter by varying the capacity of the apparatus. Choking coils prevent the energy escaping. The analogy to Prof. Silvanus Thompson's wave apparatus is evident. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

In open clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question height is needed—tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles. (The system was here shown in operation.)



FIGS. 1 AND 2.—MARCONI TELEGRAPHY WITHOUT WIRES.

Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture.

The wings shown in Fig. 1 may be removed. One pole can be connected with earth, and the other extended up to the top of the mast, or fastened to a balloon by means of a wire. The wire and balloon or kite covered with tin foil becomes the wing. In this case one pole of the transmitter must also be connected with earth. This is shown by Fig. 2.

There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumor that he can blow up an ironclad ship. This might be true if he would plant his properly tuned receiver in the magazine of an enemy's ship.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit.

It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or "note." Mr. Preece said he could show this, but was bothered by reflection from the walls. This does not happen in open space. Tuning is very easy. It is simply necessary to vary the capacity of the receiver, and this is done by increasing the length of the wings, W, in Fig. 1. The proper length is found experimentally close to the transmitter. It is practically impossible to do so far away.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—XIV.

BY JOSEPH APPLETON.

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STORAGE BATTERIES IN EDISON STATIONS.—Continued.

THE Brooklyn Edison Electric Illuminating Company has one storage battery plant in operation and is installing a second of much greater capacity. The former plant is located at their second district station, being used both as an auxiliary to the generating machinery there, which is only run during the hours of maximum load and as a battery sub-station in connection with the main generating stations in the first and third districts, to which it is connected by means of tie-lines. This plant consists of 160 cells, and has a capacity of 800 amperes for ten hours; 2,000 amperes for three hours, or 4,000 amperes for one hour.

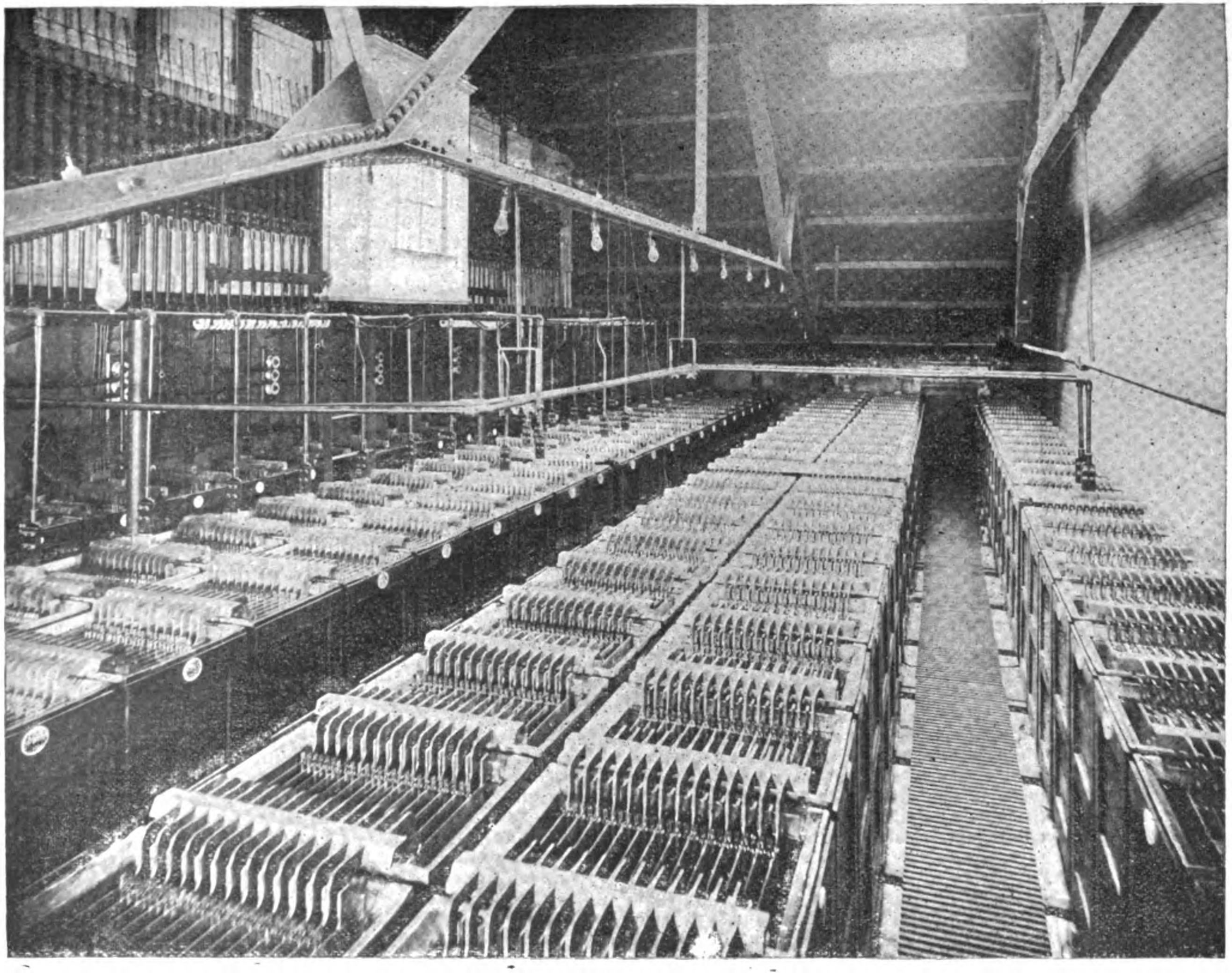


FIG. 59.—STORAGE BATTERY ROOM, SECOND DISTRICT, BROOKLYN EDISON STATION.

Figs. 59 and 60 illustrate, respectively, the battery room, and the cell-regulating switches. The battery is installed in a gallery erected at one end of the station and supported on iron columns. The battery room is partitioned off to prevent the acid fumes circulating through the building.

The cell-regulating switches are located in a small gallery constructed on the end wall of the building, which forms one side of the battery room (see Fig. 59) so as to be in as close proximity as possible to the end cells of the battery, thus reducing the amount of the round copper rod with which they are connected thereto. The thirty end cells on each side of the three-wire system are connected to these switches, so that any number of the cells from 51 to 80 may be used.

The main distributing switchboard is located on the first floor of the building, underneath the storage battery gallery, and all the regulation and control of the battery is effected from this point. The cell-regulating switches are operated by a one-half horse-power Lundell motor connected by worm gearing to the screws; these motors are controlled by special switches placed on the main switchboard, which enable the motors to be run in either direction as desired to cut in or out cells according to the conditions which exist. Fig. 60 illustrates the two cell-regulating switches and motor driving gear for one side of the three-wire system. A novel arrangement is provided for, showing the switchboard operator when the traveling contact brushes of the cell-regulating switches are exactly over the contacts; this consists of two 16 c. p. incandescent lamps placed over each of the motor control switches, and connected so that while the brush is traveling from one contact to another they are in series across the 110-volt circuit, and, therefore, burn dimly. When the brush reaches the position exactly over a contact one of the lamps is extinguished and the other burns at normal candle-power, thereby showing the operator that the brush is in the normal position on the contact and that the motor must be stopped.

In addition to this arrangement there is an indicator with a scale and needle which indicates the number of cells in circuit. The principle on which this works is that of the Wheatstone bridge. A resistance wire is stretched the entire length of the cell-regulating switch and a contact is made on the same by the traveling brush, its position being shown on the indicator according to the relative proportion of the resistance wire on each side of the brush. The scale of the indicator is calibrated in divisions which correspond to the contacts on the cell-regulating switch, and are numbered accordingly.

This method of operating the cell switches from a distance is very satisfactory, enabling them to be placed near the battery, thereby shortening the length of copper conductors, at the same time allowing the control to be effected at the main switchboard where the operator is in touch with the entire system.

As previously stated, this battery is used both as an auxiliary to the second district generating plant during the hours of maximum load, also to carry the entire load in conjunction with a tie-line from the First or Third stations. The charging is done in various ways, depending on the conditions, viz.: From a pair of machines in the Second District station, either with or without a booster; or over the tie-lines from one of the other stations, with or without a booster. This arrangement gives great flexibility to the system and enables the varying load in the district to be carried with a constant load on the lines, and also enables the generating machinery at the Second District station to be run most economically.

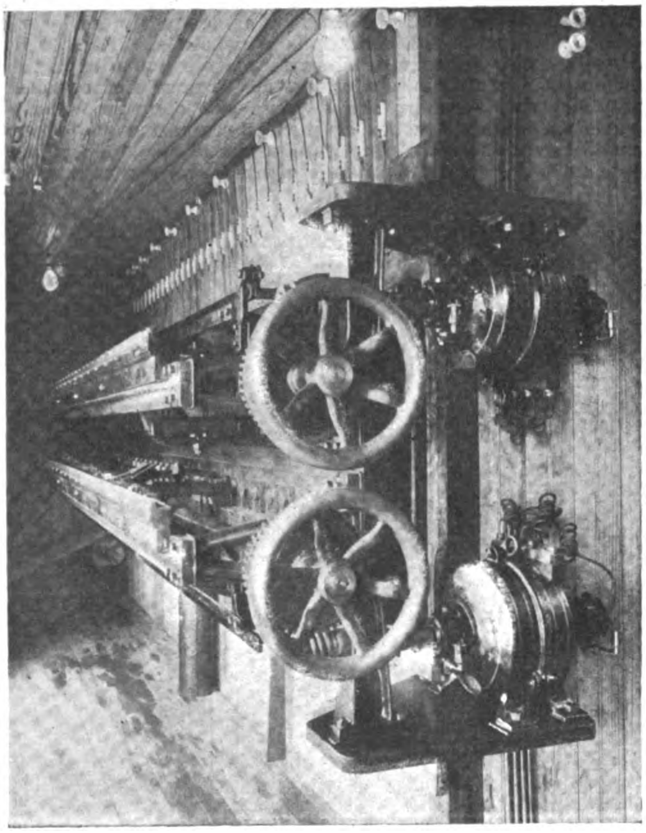


Fig. 60.—Cell Regulating Switches and Motor Driving Gear, Second District, Brooklyn Edison Station.

The second battery which this company is now having installed consists of 156 cells, having a total capacity of 1,200 amperes for ten hours, 3,000 amperes for three hours, or 6,000 amperes for one hour. This battery is located in the station known as the Citizens' Station, situated nearer their main generating station.

The Brooklyn Edison Company are now adopting the high tension system for generating and transmitting, the distribution being low tension direct current over their Edison three-wire system by means of rotary transformers and storage batteries. This will mean that the bulk of the current is generated at a large station on the water front, from which it is transmitted at high pressure to sub-stations scattered all over their district, where it is distributed as direct current through the rotary transformers and batteries. The above mentioned battery plants are the first two sub-stations of this description and will be supplemented by others as the system is developed.

WEISBACH AND RANKINE AS AUTHORITIES ON HYDRAULICS.

BY W. E. WINES.

In your issue of May 26 there appeared a letter from Mr. F. M. F. Cazin, criticising a statement made by me in regard to Weisbach and Rankine. In reply I beg to call attention to the fact that I did not state that these authorities always took the position mentioned. Both Weisbach and Rankine demonstrate that when a jet of water strikes a vein or surface it imparts all its energy to that surface when the velocity of the vane is one-half that of the jet and the motion of the jet is completely reversed.

But in discussing the theory of turbines they insist upon a different principle, viz., that the tangential component of the velocity of the entering water should equal that of the buckets. For example, Rankine (Manual of the Steam Engine, p. 178) says: "In order that the water may work to the best advantage, it should enter the wheel without shock and leave it without whirling motion; for which purpose, the velocity of whirl on first entering the wheel should be equal to that of the first circumference of the wheel, and the velocity of whirl relatively to the wheel, on leaving the wheel, should be equal and contrary to that of the second circumference of the wheel."

James B. Francis (Lowell Hydraulic Experiments, p. 94) says: "The proper velocity to be given to the wheel is an important consideration. Experiment 30, on the Tremont turbine, gives the maximum coefficient of effect for that wheel; in that experiment the velocity of the internal circumference of the wheel is .62645 of the velocity due to the fall acting on the wheel. . . . By this table it would appear that, as turbines are generally used, a velocity of 56 per cent. of that due to the fall acting upon the wheel would be suitable." Fifty-six per cent. is not very far from .5, which is the theoretical velocity of maximum efficiency, provided friction is neglected.

On page 52 of the Lowell Hydraulic Experiments, Francis says: "The turbine has been an object of deep interest to many learned mathematicians, but, up to this time, the results of their investigations, so far as they have been published, have afforded but little aid to hydraulic engineers." Prof. H. P. Trowbridge (Turbine Wheels, p. 6) says: "In other words, while the turbine wheel has been improved and its efficiency greatly increased, we look in vain for suggestions which might lead to such improvements, in the treatises on turbines, by Rankine, Weisbach, Bresse and others, which have been and are still most frequently studied for information on the subject."

HIGHEST BUILDING IN THE WORLD.

Architect George Sage is preparing plans for a fifty-nine-story office and studio building to be erected in the central part of New York City. The estimated cost of the building will be from $12,000,000 to $15,000,000, which will be furnished by a syndicate of Englishmen, who want to own the highest building in the world. The building will be 300 feet square. There will be five electric elevators, which will run upward through the center of the building at the speed of express trains. Water for the upper floors will be forced up by means of electric pumps in the basement. The building will have its own electric fire department.

HEATING WITH EXHAUST STEAM FROM CENTRAL STATIONS.

The Edison Electric Illuminating Company, of Topeka, Kan., has contracted with the American District Steam Company, of Lockport, N. Y., for nearly a mile of underground street mains for the purpose of utilizing their exhaust steam for the heating of buildings. The work will be commenced at once. The Illuminating Company will have an income the first year from heating of about $6,500, derived mostly from the sale of exhaust steam.

The Taylorville, Ill., Electric Company is also putting in an exhaust heating plant to heat the principal buildings of that town.

MR. H. A. WYCKOFF, of the Walton Electric Light Company, writes us from Delhi, N. Y.: "I am a regular subscriber for The Electrical Engineer and am much interested in the articles published and subjects treated upon. The last few copies have particularly interested me."

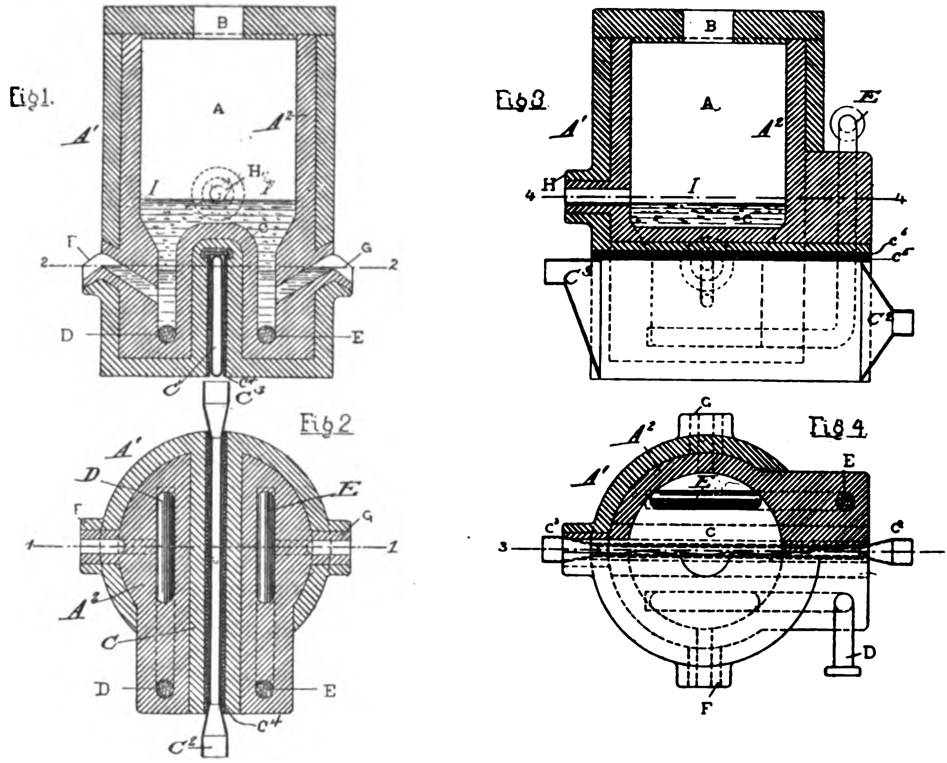
DE LAVAL'S METHOD OF ELECTRIC IRON SMELTING.

FOR some time past it has been understood that Mr. De Laval, the inventor of the steam turbine bearing his name, had invented a method of reducing iron to a state of great purity by means of the electric current, and that a number of large water-powers in Sweden were to be developed to carry out the process.

In a patent just issued in the United States to Mr. De Laval we find a description of a method for smelting iron which will prove of interest to our readers.

The accompanying engravings show in Fig. 1 a vertical sectional view on line 1 1. In Fig. 2 is shown a horizontal sectional view on line 2 2, Fig. 1. Fig. 3 is a vertical sectional view on line 3 3, Fig. 4; and Fig. 4 is a horizontal sectional view on line 4 4, Fig. 3, one-half, however, being in plan.

A indicates the furnace, into which, when iron is to be melted, spongy iron is introduced through the charging hole, B. A' is a casing of iron provided with a lining, A, of refractory material. In the lower part of the furnace there is located a bridge, C, of refractory material, extending transversely across the furnace, on each side of which bridge cavities are provided adapted to receive the pole-pieces, D and E, which are connected with the current generator. These pole-pieces consist of iron bars, which are inserted at the bottom of the furnace into the cavities between the bridge, C, and the wall of the furnace, as shown in the engravings.



FIGS. 1, 2, 3 AND 4.—DELAVAL ELECTRIC IRON SMELTING PROCESS.

F and G are two outlets for the metal, which are disposed as overflows, so that the metal flows out when it has risen to a certain height. The bridge, C, is represented hollow and a flattened pipe, C', passes through this hollow bridge in order to effect the requisite refrigeration of the bridge by conducting water or the like through the mouthpiece, C^2. C^3 is the outlet for the water or the refrigerating liquid.

When the furnace is to be put in action, the metal to be smelted is added through the hole, B, and the pole-pieces, D E, are connected with the generator of electricity. The metal thereby melts and runs away through the outlets, F G. If desired, an electrolyte may be introduced in the furnace for obtaining the necessary heat. In this case molten electrolyte, I, is poured in through the holes, B, and the pole-pieces, D E, are connected with the generator of electricity. The current then passes through the electrolyte and over the bridge, C, thus heating the electrolyte still more. The metal being now added sinks down through the electrolyte while being heated by the latter to the temperature of melting, and gathers, when fused, on the bottom of the furnace. The pole-pieces, D and E, melt also a little, so that the poles will consist of molten metal. As the metal is constantly supplied, sinks down through the layer, I, and gathers on the bottom of the furnace, this molten layer ascends at last, so that metal flows out through the outlets, F and G. Their height above the bottom of the furnace determines thus the distance between the two poles, or the so-called "pole-level," and consequently the way which the current must pass through the electrolyte from one pole to the other. In the same way the height of the electrolyte layer, I, is automatically regulated by the hole, H. The above method and furnace can also be employed to overheat a metal. The metal is in this case introduced in a fused state, and it obtains the overheat when passing through the electrolyte layer, which communicates its heat to the molten metal.

The electrolyte, above mentioned, does not act as a reducing material in the process, but only as a liquid-heating material, acting as a conductor merely. It follows, therefore, that alternating currents can be used as well as continuous. As an electrolyte, magnetic iron ore may be used for smelting iron.

ILLUMINATING THE NIAGARA CATARACT BY ACETYLENE.

There is a possibility that the first large public demonstration of the illuminating powers of acetylene gas will be made at Niagara Falls, where it is proposed to erect a dozen or more searchlights on Goat and Luna islands for the purposes of illuminating the grand cataract at night. The Acetylene Light, Heat and Power Company have offered to make this display of the powers of their gas through their manager, Mr. Joseph Devine. Some years ago electric searchlights were turned on the Falls with good effect, and since then it has frequently been proposed to re-establish them, they having proved a drawing card for summer evenings at this popular resort, where there is little amusement during the evening. The demonstration is expected to attract the attention of the delegates to the American Street Railway Association's convention next October, as acetylene is winning favor in some sections as a street car illuminant.

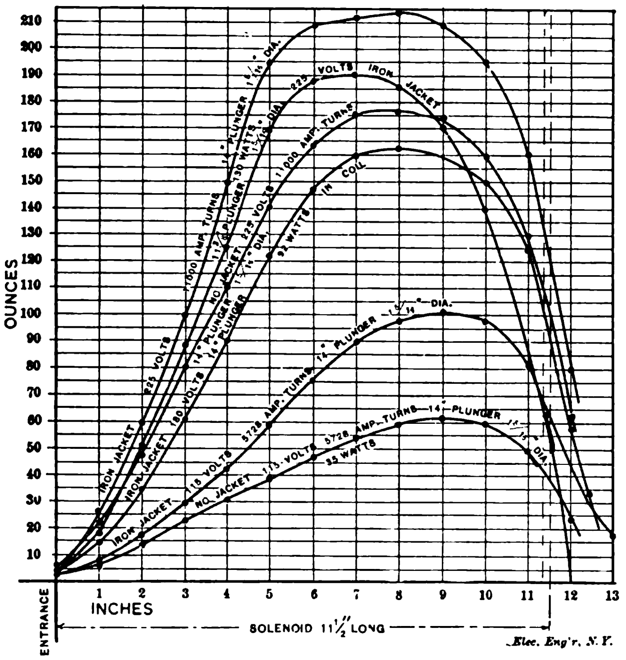
HOW PINTSCH GAS IS MADE.

The material used for the manufacture of Pintsch gas is crude or refined petroleum. In the plant constructed for the supply of Baltimore & Ohio cars in Pittsburg (which is a model plant), the furnace room contains four furnaces, each having an upper and a lower retort, in which the oil is thoroughly converted into a rich, permanent gas of the highest illuminating power known in the art. From the retorts the gas passes through ingeniously arranged apparatus in the purifying room, where it is thoroughly freed from all impurities; but for the purpose of car illumination it must be compressed in order to carry a sufficient supply in the small space available on passenger cars. The gas is then conducted from the purifying to the compressing room, in which are located two powerful compressors of special design, which compress the gas into storage cylinders used for this purpose. From these holders the gas is piped to the Baltimore & Ohio depot where it is supplied to the cars as required.

ACTION OF SOLENOIDS ON CORES.

BY W. H. CHAPMAN.

THE proper proportioning of the solenoids used in the Chapman voltage regulators manufactured by the Belknap Motor Company has necessitated a set of careful experiments, the results of which have been plotted in curves for convenient reference. Some of these curves are of considerable general interest as they show at a glance the effects of a magnetic return circuit, or, in other words, of an iron jacket and also the laws of increase of the force with the increase of the ampere turns.



CURVES SHOWING ACTION OF SOLENOID ON VARIOUS CORES.

The accompanying curves were taken from a simple solenoid 11½ inches long. The ordinates represent the ounces of force exerted on the plunger, and the abscissæ represent the distance that the end of the plunger has entered the coil at each observation. The various conditions under which the different curves were taken are designated on the curves themselves. Two different plungers were used as indicated; one of them was 14 inches long by 1 5-16 inches diameter, and the other one was 11⅜ inches long by 1 5-16 inches diameter.

LITERATURE

THE INDUCTION COIL IN PRACTICAL WORK. By Lewis Wright. New York and London. The Macmillan Co. 1897. Cloth 12mo. Illus. 172 pp. Price, $1.25.

This is a simple and admirable book of the new class called into being by the development of Röntgen ray work. The opening part is devoted to an exposition of principles and practice in connection with induction coils. The next part deals with experiments in vacua; there is a good chapter on spectrum work; and then comes an excellent section in regard to the Röntgen ray and various types of vacuum tubes designed specially for that line of investigation. Why such a serious and well intentioned volume should issue without an index is more than we can venture to explain.

LETTERS TO THE EDITOR

THE ENCLOSED ARC LAMP.

IN the paper on "Recent Progress in Arc Lighting," read by Prof. Elihu Thomson at the Niagara Falls Convention of the National Electric Light Association, and which is now being published seriatim in The Electrical Engineer, much space is naturally devoted to the discussion of the enclosed arc lamp. Prof. Thomson remarks that "the enclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons." He also claims to have made some experiments in this field in 1879 and states that, "for many years after that date (1879) there were not to be found such pure carbons as would give so little deposition as is required to work an enclosed arc practically."

I am much surprised that one so well posted in the state of the art as Prof. Thomson, should ascribe the success of the enclosed arc to the "ability to secure very nearly pure carbons." As pointed out in my recent paper, read before the International Society of Electricians, at Paris, in January of this year, the history of the development of the enclosed arc is the record of a succession of failures up to 1894, when, as a result of my work the first successful enclosed arc lamps were put on the market. The commercial enclosed arc lamp is only three years old. Of the thirty odd thousand enclosed arcs now in successful daily operation in this country, nine-tenths have been installed within the past two years. Was this phenomenal growth due to the discovery of a pure carbon? Inasmuch as practically the same grade of enclosed arc carbon as is now extensively used was to be found in the open market at least five years before the advent of the successful enclosed arc lamp, the sudden rise must have been due to another cause.

As Prof. Thomson has remarked, and as pointed out by me in my Paris paper, "the idea of burning an arc in a practically closed and relatively small glass chamber is quite old." But the idea of operating a high potential arc within an enclosure and maintaining the arc with a small expenditure of current is, however, new. Although years before, I had used very nearly pure carbons in my investigations with enclosed arcs, still the experiments resulted in failure after failure until the idea of the high potential arc was evolved by me. This method of operation, an account of which was first given to the National Electric Light Association at the Washington, D. C., Convention in February, 1894, involves an essential principle of all practical enclosed arcs, and marked the beginning of the commercial enclosed arc lamp industry.

As a contribution to the history of the art, Prof. Thomson's reference to his unsuccessful experiments in this line is interesting, as is all that comes from his pen; but it is quite clear that the successful introduction of the enclosed arc system was not due to his efforts. L. B. MARKS.

New York, June 14, 1897.

MR. NICHOLLS' ACKNOWLEDGMENTS TO THE ELECTRICAL PRESS.

My term of office as president of the National Electric Light Association expiring on the 1st proximo, I desire, as one of the last acts of my administration, to thank yourself and the editors of other electrical journals, officially and personally, for the interest you have shown in the work of the association during the past year and for your kindness in promptly publishing any information that has been forwarded to you for that purpose by the association.

As I took occasion to point out in my annual address, the electrical industry at large owes a debt of gratitude to the electrical press, and, for my part, I am glad to have had an opportunity of acknowledging this obligation.

FREDERIC NICHOLLS.

MR. E. E. GAGE, superintendent of the St. Johnsbury, Vt., Electric Company, writes: "We like The Electrical Engineer very much. It is well worth the price."

MR. C. J. STEBBINS, of Kasota, Minn., says, under date of June 23: "I have been a continuous subscriber to The Electrical Engineer for six years and still consider it the most reliable electrical paper published."

LEGAL NOTES

LITIGATION ON PAPER TELEPHONE CABLES.

The National Conduit Cable Company, of New York City, has begun an action against the New York and New Jersey Telephone Company, which will be tried in the United States Circuit Court in Brooklyn in August. The plaintiff alleges that the defendant has infringed on its patents. The National Company a year ago purchased the Norwich Insulated Wire Company and secured title to certain letters patent in the United States and the rights to certain improvements in electric conductors, consisting of covering wires with spirally wound strips of paper composed of purely vegetable fiber. This type of cable has come very largely into use for telephone cable work.

THE NEWARK TELEPHONE COMPANY DENIES INSOLVENCY AND MAKES CHARGES.

The Newark Telephone Company has filed in the New Jersey Court of Chancery its answer to the application of Frank H. Hall, a dissatisfied stockholder, for the appointment of a receiver. The answer denies the charge of insolvency and says that while the company has debts to the extent of $36,000, only a trifling amount of this is due. The answer also says that the company is doing a prosperous business.

It is admitted that Hall was denied the privilege of examining the books, but it is charged that the officers only refused the permission when they became satisfied that he was in the employ of the New York and New Jersey Telephone Company, a rival organization using the Bell system.

The answer admits having issued 20,000 shares of stock to the Best Telephone Company in return for patent rights, but claims that this was not more than the value of the right thus obtained.

THE STERNE TELEPHONE SUBSCRIBER FIGHT IN NEW YORK.

The Appellate Division of the New York Supreme Court has handed down the following decision: In the action of Simon Sterne against the Metropolitan Telephone and Telegraph Company, of New York City, to enjoin the latter from increasing the amount of the annual rental for the use of the telephone in his office from $150 to $240, the Appellate Division restored an order, which had been vacated by the court below, to examine the defendants for the purpose of showing that the telephone business under the new tariff would yield exorbitant profits. The court holds that on issues as passed by the pleadings, the facts as to profits and cost of operation have an important bearing, and that the plaintiff was not obliged to wait until the trial to examine the defendant officers, for they are non-residents and possibly could not be subpoenaed for the trial.

SOCIETY & CLUB NOTES

NORTHWESTERN ELECTRICAL ASSOCIATION.

The fifth semi-annual convention of the Northwestern Electrical Association will be held at La Crosse, Wis., commencing on Wednesday morning, July 21 next. All interested in electrical matters, whether members of the association or not, are cordially invited to attend this meeting. Cameron Hotel, $2.50 per day, will be official headquarters, and Hotel Law, $2.00, and Hotel Bronson, $1.00, will also accommodate delegates. 110 volt direct, and 7,200 volt alternating current, with abundant space, will be at the service of exhibitors. Address F. A. Copeland, La Crosse, Wis., for hotel and exhibit accommodations. The Western Passenger Association has granted a 1⅓ rate, conditional, however, upon 100 certificates of attendance. Special sleepers via C. & N.-W. Ry. will leave Chicago at 10:15, and Milwaukee at 8 o'clock, on Tuesday evening, July 20, running together from Madison via Elroy. Delegates from or through Chicago should apply for reservations to George Cutter, 1104 Rookery Building, Chicago. Those from or through Milwaukee, to Mr. Mercein. Papers on "Meter Tests," "220 Volt Lamps," "Use of Oil in Transformers," "Utilization of Exhaust Steam," "Evolution of the Incandescent Arc Lamp," "Rotary Transformers" and "Fuels for Central Stations" will be presented by Prof. D. C. Jackson of Wisconsin University, Prof. G. D. Shepardson, of Minnesota University, Prof. R. B. Owens, of Nebraska University, George L. Thayer, of Iowa, O. M. Rau, of Wisconsin, C. F. Scott, of Pittsburg, and John C. McMynn, of Illinois. The Entertainment Committee has arranged an enjoyable programme, including a river excursion and picnic lunch, trolley parties, etc. Mr. T. R. Mercein, of Milwaukee is secretary.

TRAIN DISPATCHERS IN CONVENTION AT DETROIT.

An important meeting of the Train Dispatchers' Association of America was held at the Hotel Cadillac, Detroit, during last week. The attendance was excellent and much interest was shown in the work of the convention. Montreal was chosen as the next place of meeting.

Unless all signs fail, the convention will mark an era in the life of the organization looking toward greatly increased prosperity in the future. Six years ago at the convention in New Orleans nearly one-half of the members withdrew from the association because of a difference of opinion that existed concerning the advisability of incorporating in the constitution certain clauses giving the organization the standing of a labor union in the adjustment of difficulties that it was thought might arise between the several roads and the dispatchers. The plan was defeated, but the feeling was so strong for and against it that harmony seemed for the time impossible.

At that time the association was freighted with a contract with the publishers of a railway publication to contribute a certain considerable sum each year toward the support of that publication. While the membership of the association was large, there was no difficulty in complying with the terms of the contract, but when so many withdrew, financial troubles grew apace. As a result of these conditions, the association has been laboring under a debt amounting to about $2,000 at the present time. It is expected, however, that during the coming year, the whole amount will be wiped out and that the next convention will find the association free from debt of any sort. Action looking to this end was taken at Detroit, when members were urged to subscribe something toward raising the amount. There is a considerable amount due the association from members who are in arrears for dues, and an effort will be made to collect it. In addition it is expected that the membership will be largely increased during the year, and individual members will contribute in various ways toward the effort.

PERSONAL

DYER & DRISCOLL.

MESSRS. DYER & DRISCOLL, we learn, have removed to the new Bank of Commerce Building, 31 Nassau street, New York City, from their long-established offices on Wall street, some time before the 1st of May last. The announcement of removal was delayed until the firm had become quite settled and ready to handle the business of new clients that might be brought to them.

High class patent soliciting is still a specialty of the firm, and particularly in connection with electrical subjects. The success of this firm in litigations arising out of patents relating to electrical inventions is too well known to require comment. The litigation on the Edison patent on the incandescent lamp is one among many which the firm actively brought to a successful termination, and that it has continued for so many years to act as Mr. Edison's patent solicitors speaks volumes as to the high class of work done by it.

MR. H. B. COX has been visiting, before his return to England, the city of Cincinnati, where he did so much of his earlier electrical work. He was born at Zanesville, Ohio, the home also of his cousin the late distinguished statesman, Hon. S. S. Cox, of whom the letter carriers of this country lately put up a statue. Mr. Cox began active life in Cincinnati in the Western Union service.

MR. PERRY S. HEATH, first assistant postmaster general, has been appointed by the United States Court of Claims sole referee in the dispute between the Government and the Western Union Company as to tolls for government messages under Mr. Wanamaker's administration of the post office.

REPORTS OF COMPANIES

ANNUAL MEETING OF THE WESTINGHOUSE ELEC. & MFG. CO.

THE Westinghouse Electric and Manufacturing Company on Tuesday, June 22, 1897, declared a quarterly dividend on its preferred stock of 1¾ per cent.

On Wednesday, the annual meeting of the stockholders took place at the factory of the company in East Pittsburg, Pa. The annual report of the company was read, showing the condition of the company to be a prosperous one. The same Board of Directors of last year were re-elected, they composed of August Belmont, Lemuel Bannister, Geo. Hebard, Henry B. Hyde, Marcellus Hartley, A. M. Byers, N. W. Bumstead, Chas. Francis Adams, Brayton Ives and Geo. Westinghouse, Jr.

The report for the year ending March 31 last showed assets, $17,965,295, of which $1,647,754 was bills and accounts receivable, $1,636,612 material on hand, and $4,689,081 charters, franchises and patents. The bills and accounts payable amounted to $691,685. The report says that a reduction in the surplus account of $1,577,735.93 is due to writing off bad debts, disbandment of old factories, obsolete machinery, etc. On June 4, an increase in the capital stock from $10,000,000 to $15,000,000 was authorized and $3,000,000 of the new stock was sold to the Security Investment Company, of Pittsburg, for $2,489,000, of which $1,260,000 was in cash and the remainder in property and secured notes; $347,419 was expended during the year for the purchase of new patents and plants.

At the stockholders meeting it was announced that the St. Lawrence Construction Company, of New York, had awarded to the company a contract for fifteen 5,000 horse-power generators, which are to be erected at their plant at Massena, northern New York. This is the largest single order ever given for electrical apparatus, and the amount directly involved is about three-quarters of a million dollars.

This contract together with that recently given by the Cataract Construction Company, of New York, for five 5,000 horse-power generators for installation at Niagara Falls, New York, makes the total of twenty 5,000 horse-power generators, having a total capacity of 100,000 horse-power, which have been ordered from the Westinghouse Electric and Manufacturing Company this year.

The five generators for Niagara Falls are well under construction, and the other fifteen required by the St. Lawrence Company will be immediately proceeded with and their construction will give employment to a large number of men.

These orders cover only the apparatus for generating electricity, and there will necessarily be required other apparatus of equal capacity for the utilization of the electrical energy produced by these great generators, and the Westinghouse officials expect that a large proportion of the additional apparatus will be ordered from their company by reason of their having already secured the contract for the principal apparatus.

NORTH AMERICAN CO.

ON June 16 the annual meeting of the North American Company was held in Newark, N. J. The directors whose terms of office expired were re-elected. They are Messrs. H. C. Payne, John I. Beggs and Edward Edes. The annual report shows that the boycott of the Milwaukee Railway continued until about July 1, with a loss in gross earnings for May and June of about $125,000. The force was entirely changed and the lingering effects of the boycott increased expenses and diminished receipts for some months. The efforts of the city council to reduce fares is detailed; the matter is being fought in the courts, and should reach a decision during the coming winter. The company is confident of winning its case.

In February last the Pabst Light, Heat and Power plant and the Milwaukee & Wawatoso Electric Railway were acquired, so that all the electric street railways in the city and immediate suburbs are owned by the company. Gross earnings of the Milwaukee Company, January 1 to May 1, 1896, were $502,891, the largest in its history, and for the same four months this year they have been $503,487. The five months of this year they have been $632,231, against $563,766 last year, an increase of $68,464. Any improvement in general business will increase the company's earnings.

Cincinnati Edison earnings have increased. New machinery must be bought, and a new central station must be built upon a larger site. The present mortgages on the property will be retired, and a new first mortgage, large enough to provide the new capital, will be issued. Enough of these bonds have been sold to a syndicate this month to retire the bonds and pay for the new station.

The treasurer's report follows:

Assets May 31.	1897.	1896.	Decrease.
Mil. Ry. & Light pf.	$2,390,800	$2,390,800	
Mil. Ry. & Light com.	3,078,000	3,078,000	
Cin. Edison stock	382,733	382,733	
Milwaukee 5s.	100,000	......	*$100,000
Cin. Edison 5s.	105,000	......	*105,000
Miscellaneous securities	25,204	39,741	14,537
Accounts receivable	222,403	253,130	30,727
Demand loans	326,403	207,339	*118,720
Time loans	50,145	145,400	95,255
Cash for taxes in litigation	4,300	......	*4,300
Cash	289,759	434,565	144,806
Liabilities.			
Expenses of administration	......	......	......
Old accounts	$17,660	$17,860	$200
Taxes paid in year	6,364	6,202	*162
Salaries and expenses in year	31,518	34,283	2,765
Interest paid and accrued.	2,533	132,050	109,517
Interest and dividend rec. and account	39,256	129,806	95,550

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* Increase.

INTERNATIONAL BELL TELEPHONE COMPANY TO QUIT.

Preparations are being made by the International Bell Telephone Company to discontinue business. The company once had a capital of $1,750,000, but it was reduced to $1,000,000. It has now been decided to reduce it to $750,000 by the payment to the stockholders of a cash dividend of $250,000. This concern introduced the telephone in several foreign countries, the principal one being Russia, where it has a twenty years' contract with the government. This contract expires in 1901, and it is thought that the Russian government will then avail itself of the contract right to take possession of the company's property. Meantime the company is selling its other business in Sweden, Holland, Switzerland and Belgium. The officers think they will be able to pay the stockholders in full out of the proceeds of these sales and the earnings in the next few years.

BELL TELEPHONE DIVIDEND.

The American Bell Telephone Company has declared the regular quarterly dividend of 3 per cent. and an extra dividend of 1½ per cent., both payable July 15th. It has been the custom of the company since and including 1895 to pay 15 per cent. in dividends per annum, the January and July periods carrying an extra payment of 1½ per cent. each. In 1894, 16½ per cent. was paid, in 1893 18 per cent., in 1892 15 per cent., and in the three years previous 18 per cent. per annum.

MR. R. C. FOSTER, of the Schneider Manufacturing Company, 1140 Hamilton street, Cleveland, O., reports a large demand for their water fan motors in the hundreds of towns where no day electrical circuits exist. As the warm weather advances, orders pour in by telegraph for prompt shipment by express. Electrical supply houses are ordering considerable quantities, and show great interest in the subject. A big demand is also springing up for South American trade.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, O., report business as very good. They have just secured what is probably the largest order ever given for printing press equipment with electric motors, viz., the plant of the San Francisco "Examiner," one of Mr. Hearst's papers.

MR. F. M. HAWKINS, so long connected with the Electric Engineering and Supply Company, Syracuse, N. Y., and for the past three years their New York representative, has taken the agency for Pass & Seymour's well known electrical china specialties and the Crouse-Hinds Electric Company knife switches and switchboards. He has opened offices at No. 39 Cortlandt street, where he will carry and keep in stock a full line of the above firm's goods. He reports business good and improving.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 15, 1897.

Alarms and Signals:—

ELECTRICAL CIRCUIT-CLOSING THERMOMETER. A. Luraschi, London, Eng., 584,382. Filed March 15, 1897.

Means for insuring permanent electrical contact between the movable and fixed parts of the conductor within the bore of the tube; also relates to the mode of forming the movable terminal and insuring the fixity of its position after adjustment.

ELECTRICAL ADVERTISING ANNUNCIATOR FOR CARS. J. P. Orr and G. H. Fugh, Pittsburg, Pa., 584,700. Filed September 29, 1896.

Details of construction.

Batteries, Primary:—

PRIMARY CELL. I. Kitsee, Philadelphia, Pa., 584.474. Filed September 15, 1896.

A positive element consisting of a containing cup of a material designed to remain inert, a conducting rod passing through the cup and a solid body of an alloy of mercury and a metal, as zinc, cast so as to fill the space between cup and rod, the surface of said body only being exposed.

Batteries, Secondary:—

SECONDARY BATTERY PLATE AND METHOD OF PRODUCING SAME. W. P. Patton, Jersey City, N. J., 584,649. Filed February 15, 1897.

A secondary battery plate comprising a sheet metal partition coated with soluble inert material on each side, and having openings along the edges, and cast metal perforated sides which are integrally united through the openings in the partition.

Conductors, Conduits and Insulators:—

MECHANICAL CLIP. H. H. Luscomb, Hartford, Conn., 584,383. Filed November 18, 1896.

A clip specially designed for holding trolley wire of 8-section.

FLEXIBLE CONDUIT. A. L. Tucker, Chicago, Ill., 584,428. Filed October 23, 1896.

The combination with a lining composed of annular sections of a spiral winding of tape inclosing said annular sections.

INSULATOR. S. H. Libby, Schenectady, N. Y., 584,476. Filed February 10, 1897.

Claim 1. In a conductor rail insulator, the combination of a metal base, a body of insulating material mounted upon the base, a rail clamp secured to the conductor rail and prevented from moving independently of the insulator by frictional engagement therewith.

INSULATOR. S. H. Libby, Schenectady, N. Y., 584,477. Filed February 10, 1897.

The combination of a conductor rail, a body of insulating material situated each side of and supporting the rail, and a support for each body of insulating material permitting a limited amount of vertical movement of the conductor rail.

Distribution:—

SYSTEM OF DISTRIBUTION. E. W. Rice, Jr., Schenectady, N. Y., 584,482. Filed February 7, 1896.

The method of maintaining potential upon a two-wire system of distribution connected with a three-wire system, which consists in supplying the two-wire system with energy from both sides of the three-wire system.

Dynamos and Motors:—

APPARATUS FOR CONTROLLING ELECTRIC MOTORS. B. A. Fiske, United States Navy, 584,341. Filed March 6, 1896.

Controls the speed and direction of the motor by varying the e. m. f. of the generator.

ARMATURE FOR DYNAMO ELECTRIC MACHINES. H. H. Wait, Chicago, Ill., 584,431. Filed February 27, 1896.

Openings are provided through the armature core for the passage of air to ventilate the armature.

REGULATING SPEED OF INDUCTION MOTORS. E. Danielson, Stockholm, Sweden, 584,577. Filed May 2, 1896.

A number of induction motors mechanically connected together, the motors having different numbers of poles, and means of operating them singly or in tandem groups.

Lamps and Appurtenances:—

LAMP SOCKET. E. M. Bradford, Boston, Mass., 584,321. Filed November 19, 1896.

A device whereby the current is automatically closed upon the withdrawal of the lamp from the socket or may be closed without such withdrawal.

ELECTRIC ARC LAMP. I. H. Hegner, Paris, France, 584,356. Filed February 4, 1896.

Has for its object to group together two or more arc lamps in series or parallel and to regulate the feed according to the total resistance of the group as well as to the resistance of each individual lamp.

INCREASING ILLUMINATING POWER OF ELECTRIC ARC LAMPS. P. Mersch, Paris, France, 584,694. Filed April 14, 1897.

Composition for increasing the illuminating power of electric arc lights, consisting of the admixture of carbonate of magnesia, asbestos, or some other incombustible textile product, and silicate of potash.

INCANDESCENT ELECTRIC LAMP.—C. E. Scribner, Chicago, Ill., 584,750. Filed April 24, 1893.

Object is to enable a two-part lamp to be so constructed that the two parts may be taken apart when desired and either or both used again.

Miscellaneous:—

PRODUCTION OF ELECTRIC SPARKS FOR SIGNALS OR THEATRICAL EFFECTS. V. Tabulewitsch, St. Petersburg, Russia, 584,427. Filed Jan. 16, 1897.

The essential part of the lamp is the burner or the apparatus for obtaining an uninterrupted series of sparks between the carbon and the steel electrode employed.

Railways and Appliances:—

ELECTRIC RAILWAY. T. W. Kloman, Montclair, N. J., 584,511. Filed April 30, 1896.

Relates to a switch mechanically actuated by the passage of the car.

TROLLEY STAND. S. H. Short, Cleveland, Ohio, 584,607. Filed February 16, 1897.

Object is to prevent lateral movement of the trolley arm when in service, but which will permit the trolley arm to be reversed in position relative to the car when desired.

TROLLEY STAND. S. H. Short, Cleveland, Ohio, 584,606. Filed February 16, 1897.

Similar to above.

ELECTRIC RAILWAY. H. M. Jones, Meriden, Conn., 584,639. Filed August 12, 1896.

A conductor having a longitudinal slot at its top, and a tubular cable for normally closing said slot, the cable consisting of a spiral coil, the spirals being arranged close together, yet adapted to open or stretch at points lifted from the slot.

BOND FOR ELECTRIC RAILWAYS. F. T. Newbery, San Francisco, Cal., 584,644. Filed Aug. 25, 1894.

The contiguous ends of the rails are drilled with corresponding holes into which a dowel pin is pressed.

Switches, Cut-Outs, Etc.

LIGHTNING ARRESTER AND MULTIPLE AUTOMATIC FUSE-BLOCK. G. X. Gast, New Orleans, La., 584,632. Filed April 10, 1897.

Details of construction.

Telegraphs:—

ELECTRIC CIRCUIT PROTECTOR. A. L. Creelman, Memphis, Tenn., 584,462. Filed August 11, 1892.

Consists in combining with the usual instruments in a Morse circuit an apparatus controlled by a magnet and train of gear for making and breaking both the ground-circuit and a shunt-circuit around all the instruments in the station and also operating to give an alarm on a bell, and in controlling the operation of resetting such apparatus.

ELECTRIC SIGNAL. A. L. Creelman, Chicago, Ill., 584,463. Filed August 17, 1895.

An alarm or signal designed to be operated electrically by the closure of a main circuit and to continue its operation after the circuit is opened again.

CIRCUIT PROTECTING SOUNDER. A. L. Creelman, Chicago, Ill., 584,465. Filed May 18, 1896.

Operates to automatically give an alarm and shunt the instruments when the main line current is interrupted for a predetermined time and to open a ground circuit.

TELEGRAPH SOUNDER. A. L. Creelman, Chicago, Ill., 584,464. Filed September 3, 1895.

Relates to that class of sounders commonly known as "receiving-sounders," and used in connection with circuit protecting devices.

TELEGRAPHIC SOUNDER. A. L. Creelman, Chicago, Ill., 584,466. Filed July 3, 1896.

Comprehends a sounder provided with a second and third electromagnet and with devices controlled thereby for making and breaking connections through which various operations are effected.

PERFORATOR FOR ELECTRIC TELEGRAPHS. C. G. Burke, Brooklyn, N. Y., 584,722. Filed September 4, 1896.

Details of construction.

Telephones:—

MAGNETO APPARATUS. H. H. Eldred, Brooklyn, N. Y., 584,338. Filed April 4, 1896.

A magneto instrument which is both a magneto-generator and a magneto bell.

PARTY LINE TELEPHONE SYSTEM. W. H. Harter, Norwalk, Ohio, 584,352. Filed August 10, 1896.

A harmonic selective signal system.

AUTOMATIC ELECTRIC SIGNAL TRANSMITTER. A. B. Macklin, New York, 584,384. Filed August 7, 1896.

Details relating to a signaling instrument for automatic telephone exchanges.

TELEPHONE SYSTEM. F. R. McBerty, Downer's Grove, Ill., 584,393. Filed May 14, 1896.

Applies to systems of current supply for telephone transmitters comprising single wire circuits provided with a common return. Its object is to reduce or eliminate the resistance of the common return wire, and thus to avoid cross-talk, which would result from resistance in the return wire.

TELEPHONE LINE CIRCUIT. C. E. Scribner, Chicago, Ill., 584,415. Filed August 1, 1895.

Concerns the sub-station apparatus of metallic circuit telephone lines, its purpose being to so arrange the telephonic and signaling appliances at the sub-station as to dispose with all switches.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 54,414. Filed April 26, 1893.

Object is to provide a mechanically actuated device controlled by means of electromagnets for exhibiting or withdrawing the indicator of the annunciator.

ELECTROMAGNET. C. E. Scribner, Chicago Ill., 584,416. Filed November 4, 1895.

The object of the invention is to provide a polarized signal bell for telephone lines which shall remain undisturbed by current continuously flowing through it, but shall be sensitive to alternating signaling currents.

TELEPHONE CIRCUITS. C. E. Scribner, Chicago, Ill., 584,417. Filed November 4, 1895.

Designed to permit a different mode of operating the telephones in event of the complete discharge of the local storage battery to avoid interruption of service.

SPRING JACK FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 584,418. Filed July 20, 1896.

Details of construction.

TELEPHONE TRANSMITTER. H. C. Alexander, Bonham, Tex., 584,618. Filed February 27, 1897.

Details of construction. Of the Hunnings type.

TELEPHONE. C. C. Gould, Philadelphia, Pa., 584,787. Filed February 9, 1897.

Uses a plurality of transmitters, batteries and coils.

TRADE NOTES & NOVELTIES

THE NUNGESSER DRY BATTERIES.

THE accompanying engravings illustrate two types of dry batteries made by the Nungesser Electric Battery Company, of Cleveland, O. The square form shown, when properly used in call bell work, it is claimed, will give from 5 to 8 years' service without any attention whatever, and enjoys corresponding long life on other open circuit work.

THE NUNGESSER DRY BATTERY.
FOR OPEN CIRCUIT SERVICE.
NUNGESSER ELECTRIC BATTERY CO.
CLEVELAND
THE 1900 DRY BATTERY
FOR OPEN CIRCUIT SERVICE ONLY
MANUFACTURED BY NUNGESSER ELECTRIC BATTERY CO.
CLEVELAND, OHIO.

FIGS. 1 AND 2.—THE NUNGESSER DRY BATTERIES.

The Nungesser Company also manufacture batteries for closed circuit work. The cells have an e. m. f. of 1.45 volts and very low internal resistance. They are made in three sizes, having, respectively, 300, 600 and 1,200 ampere hours capacity. The former size is specially adapted for telephone and telegraph, gas lighting and signal work; while the latter sizes can be used for driving fans, sewing machines, motors, electric pumps, jewelers' and dental lathes, phonographs and other light work.

When these cells are not at work, no local action takes place and no material is consumed.

For testing purposes and as igniters of portable gas and gasoline engines the company make several sizes of chloride of silver batteries, with hard rubber cells. These have an e. m. f. of 1.10 volts.

THE NEW SIEMENS-HALSKE COMBINATION.

With regard to the statement in The Electrical Engineer last week about the consolidation of the Siemens-Halske Electric Company with the Pennsylvania Iron Works, of Philadelphia, it is stated that a majority of the stock of the Chicago company has already been exchanged for the stock of the Pennsylvania. The minority stockholders have sixty days in which to accept the offer of the Eastern concern. With a combined capital of $3,250,000, the two companies will manufacture street railway machinery for the four big cities.

At the annual meeting of the Chicago concern the directors elected were as follows: Charles T. Yerkes, of Chicago; W. L. Elkins, Jr., of Philadelphia; R. Suydam Grant, of New York; Charles E. Yerkes, of Chicago; B. W. Grist, of Philadelphia; F. W. Whitridge, of New York; W. T. Butler, of New York; E. T. Rice, Jr., of New York, and Martin Maloney, of Philadelphia. The new directors are C. T. Yerkes, W. L. Elkins, Jr., and B. W. Grist. Elkins is the son of W. L. Elkins, Sr., of Philadelphia. The directors then elected officers headed by Charles E. Yerkes, son of Charles T. Yerkes, of Chicago.

Whether the name of the Chicago concern will be dropped or changed has not yet been decided.

The capital stock of the Pennsylvania company consists of $1,750,000 six per cent. non-cumulative preferred and $1,500,000 of common stock. The Siemens-Halske capital is divided into $700,000 of preferred and $1,275,000 of common. The Philadelphia company offered $1,000,000 of its preferred in exchange for the $700,000 of Siemens-Halske preferred on a basis of something over one share of the Pennsylvania's stock for one of the Chicago company's.

FAN DAYS.

Notwithstanding the unusually cold weather experienced all over the country during the month of May, the Electric Appliance Company report that the few days of hot weather in June started the fan business going in good shape, and give promise of a prosperous fan season. The Electric Appliance Company state that they still have some copies of their fan motor catalogue left, which they will be glad to send to the trade upon application. It is a complete book of all styles of fan motors.

ASSIGNMENT OF THE ELEC. ENGINEERING AND SUPPLY CO. OF SYRACUSE, N. Y.

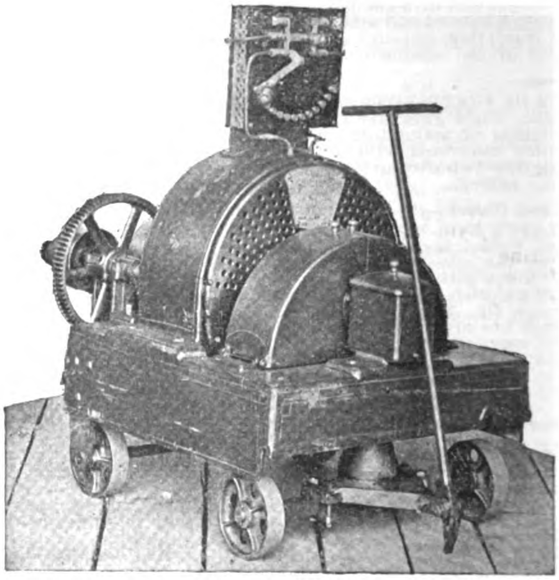
The Electrical Engineering and Supply Company, whose stores and offices are located at Nos. 308 and 310 West Jefferson street, Syracuse, N. Y., has made a general assignment for the benefit of creditors. Benjamin Stolz is named as assignee, and is given an irrevocable power of attorney to close up the affairs of the concern. There are no preferred creditors, all claims to have an equal opportunity in the settlement.

The company was organized in December, 1889, with capital stock of $25,000. Three years later the capital was doubled. According to the last report, the assets of the concern amounted to $92,000, with liabilities not to exceed $36,800. The officers of the company were: H. C. Hodgkins, president; J. L. Hines, vice-president; H. G. Gorke, treasurer and manager; H. A. May, secretary. The cause of the failure is given as hard times and slow collections.

CARD PORTABLE MOTOR.

IN large machine shops, structural iron works and other places where drilling or light boring has to be done on heavy material, much time can be saved by the use of a motor suitably mounted for easy transfer from place to place. The frequent calls for such a tool have caused the Card Electric Company of Mansfield, Ohio, to bring out the mounted motor illustrated in the accompanying cut.

All the working parts of the motor are enclosed as a protection against accidents from dirt or careless handling of material about it. The cone pulley shaft is driven from the armature shaft by gearing and the ratio of the gears is such that the cone pulley is made to run as near 200 r. p. m. as possible. On the armature shaft is a small pulley which can be used for driving high speed machinery direct.



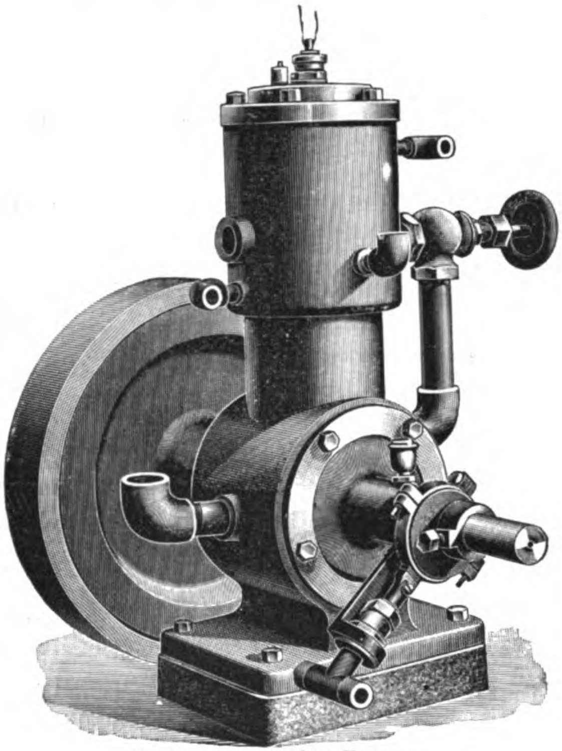
THE CARD PORTABLE MOTOR.

The starting rheostat is non-combustible and has a double pole switch mounted on it, and as all the connections to the motor are made before shipment from the factory, nothing has to be done to put the motor in operation but connect the line wires to it.

These mounted motors are manufactured by the Card Company in sizes from 2 to 12 horse-power inclusive, and purchasers are furnished a list of gears from which they can select a pair to give the cone pulley a speed suitable for their requirements.

THE PALMER ONE H. P. GAS OR GASOLENE ENGINE.

MANY amateurs have use for a small engine, and for such the Mianus Electric Co., of Mianus, Conn., have designed the 1 h. p. vertical gas or gasolene engine illustrated in the accompanying engraving. The company furnish either the complete engine or castings with working drawings, so that amateurs can, if they choose, finish and assemble the parts themselves. The engine is built on the two-cycle compression system, with an impulse at each revolution of the crank. It receives its charge and exhausts through a cylinder port opened and closed by the movement of the piston. A suitable valve regulates the charge received from the closed crank chamber in which the mixture is compressed by the downward stroke of the piston. Vapor and air are drawn into the crank case by the upward stroke of the piston, and thoroughly mixed by the motion of the crank. The engraving shows the circulating pump used for marine purposes, but the pipe leading from the pump to the water jacket is omitted. On the stationary engine a tank is used instead of a pump.



PALMER 1 H. P. GAS ENGINE.

The height of the stationary engine is 23 inches and that of the marine is 17 inches. The height from the base to the center of the shaft is 4½ inches. The weight of the marine engine is 135 pounds; of the stationary, 200 pounds.

The engine illustrated will run a 16 or 18-foot boat or light motor carriage. The company also build a ¾ h. p. engine.

A. K. WARREN & CO. CATALOGUE.

The new catalogue just issued by A. K. Warren & Co., 451 and 453 Greenwich street, New York, is well calculated to elucidate clearly the line of goods which this company carries. We find in it, described and illustrated, every article employed in a lighting or power installation from generator to lamp, or from the source of power to the motor, only the latest and most approved material being enumerated.

In getting up the catalogue the old-time index has been dispensed with; to make reference sure and easy, however, the various apparatus has been grouped in alphabetical order, a plan which by trial we find to work exceedingly well. Besides the apparatus illustrated we note a number of excellent full-page half-tone views of the various departments in the company's factory, which prove it to be excellently equipped for its work.

THE TRIUMPH ELECTRIC CO.'S CATALOGUE.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., have just issued an exceedingly well gotten up catalogue of their apparatus, which affords a most convincing proof of their ability to turn out first-class apparatus. We note among the excellent illustrations views of many actual plants in which the Triumph direct connected apparatus for lighting, street railway and general power purposes is employed, as well as their marine set.

Besides the standard apparatus we find several illustrations of special machines, among them a mining machine and a cloth cutter. The company also build elevator motors and controllers, views of which are given.

A table at the end of the catalogue gives complete data of sizes, capacity, etc., of the company's machines.

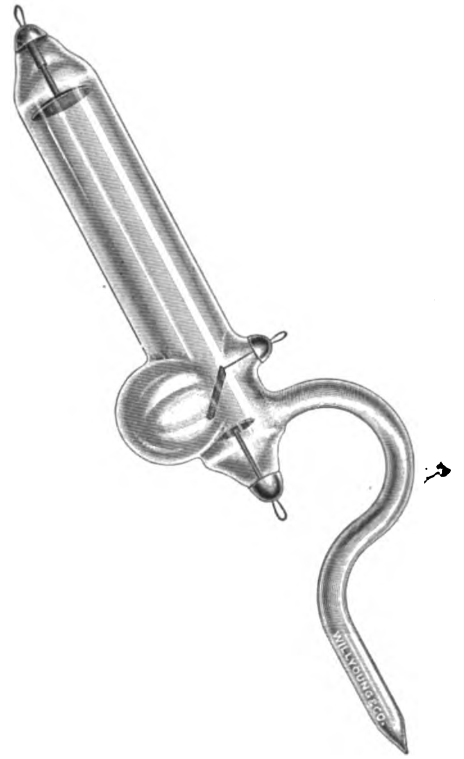
"BOWDOIN" X-RAY TUBES.

MORE than a year ago Profs. Hutchins and Robinson, of Bowdoin College, conducted some important experiments with X-ray tubes, and, as a result, developed a very efficient type which has since been largely used by both physicists and physicians. As the inventors were too much occupied with their professional duties to engage in the business enterprise justified by the merits of these tubes, an agreement was made with Messrs. Willyoung & Co., Philadelphia, to manufacture them in conjunction with and as part of their "W—S" X-ray plants.

The "Bowdoin" X-ray focus tube differs essentially from others in having a fluorescent material fused into the inner surface of the thin glass bulb; which not only tends to constancy of vacuum, but also secures a magnificently clear definition with the fluoroscope or in radiography. Also, the electrodes are so arranged that the reflector plate is not connected to a terminal, but merely acts as an obstacle to the bombarding rays; the anode being a disc at the end of the tube away from the cathode. This plan almost entirely prevents blackening of the glass from deposited platinum, however long the tube may be used.

Apart from remarkable definition the most important feature of the "Bowdoin" tube is the small amount of energy required to fully excite it, the claim being confidently made that a tube of this make energized by a 4-inch spark Willyoung induction coil will produce results that can only be approached by other apparatus of at least 50 per cent. greater capacity.

During the past two months changes have been made in design and dimensions of the Bowdoin tubes, thus making them better than ever; and at the same time because of largely increased output, it has been possible to materially reduce prices —a fact of utmost importance, in view of the fragile nature of all X-ray tubes.


WILLYOUNG & CO.

THE BOWDOIN X-RAY TUBE.

Mr. James G. Biddle, 910 Drexel Building, Philadelphia, is sole agent for Bowdoin tubes, as for all apparatus made by Willyoung & Co., and will gladly supply further particulars to interested parties.

WESTERN NOTES

THE WALKER CO., of Cleveland, have appointed Mr. W. R. Mason, 1202 Fisher Building, Chicago, their agent for the State of Missouri. He will open an office in St. Louis in the near future. The Walker Company are to be congratulated upon securing the services of Mr. Mason as one of their representatives, as his progressive work is well known in the West, where he has a host of friends among the electrical fraternity.

H. M. UNDERWOOD & CO., Marquette Building, Chicago, have appointed the Brewster Engineering Company, Thames Building, New York, sales agents for their duplex lamp guards in the East, with the exception of the New England States and Pennsylvania. The concern have had a number of inquiries for the Cloos junction box and report that the demand for this box is increasing and that the prospect of large sales in the near future is very good.

J. J. NORMAN COMPANY, 52 South Clinton street, Chicago, manufacturers of the Chicago Gas and Gasoline Engine, were closed up by the sheriff on June 18, by order of the Cook County Circuit Court, where three writs, in the names of Sophia Zerwnel, Anna Wolf and Philomena Kinderbusch, had been given against the company. Henry J. D. Wodeich has been appointed receiver for the concern. All the stock in trade and fixtures of the company will be sold on Tuesday, June 29.

THE AMERICAN RHEOSTAT CO., of Milwaukee, have recently sold through Kohler Bros., their Chicago agents, a number of rheostats for export to Japan, and have just sent a 50 h. p. overload starter to Liege, Belgium. They are at work on some new apparatus, which will soon be ready for the market.

SOLDERING FLUX for electrical work has been put on the market in a variety of different shapes. The latest thing in this line is Highland insulating soldering paste, which is being marketed by the Electric Appliance Company. Great claims are made for this paste on account of its convenience and non-corrosive qualities. The Electric Appliance Company are prepared to send small sample boxes of this paste to the trade on application, as they feel confident that its merits will bring business where it has once had a test.

NEW ENGLAND NOTES

L. A. CHASE & COMPANY. In our issue of June 16th on page xxxvi of the advertising pages, an unfortunate error crept in, whereby in the advertisement of L. A. Chase & Co., Boston, instead of printing an illustration of the Elden circuit breaker a cut was shown illustrating a switch of another make. It was probably apparent to all our readers that the cut was an error, but we wish to call particular attention to it.

CLARKE MOTOR CO. has been formed at Portland, Me., for the purpose of manufacturing electric motors. The capital stock is $1,000,000. The officers are J. W. Briggs, president, and G. A. Clarke, treasurer, both of Boston.

THE HOLTZER-CABOT ELECTRIC COMPANY have removed their business offices from their former location, 92 Franklin street, Boston, to the factory building, Station street, Brookline, to which place they request all communications to be sent hereafter.

PHILADELPHIA NOTES

THE LANGHORNE ELECTRIC LIGHT AND POWER COMPANY, Langhorne, Pa., has recently increased its electric light plant by adding a 200 h. p. engine built by the Ball Engine Company, Erie, Pa., being the third engine of this manufacture placed in this plant.

THE WAINWRIGHT BREWING COMPANY, Pittsburg, Pa., have recently installed an 80 h. p. engine, built by the Ball Engine Company, Erie, Pa. The engine is direct connected to General Electric dynamo.

MR. WARDELL JUKES, formerly with the United Electric Improvement Company, of Philadelphia, will represent the Shelby Electric Company, handling for them the Shelby incandescent lamps in that city and vicinity.

NEW YORK NOTES

MR. JOHN FINNEY, of Rochester, N. Y., has been chosen as superintendent of the Canandaigua electric light and street railway plant.

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